Abstract

Understanding the temporal relations which hold between situations described in a narrative is a highly complex process. The main aim of this thesis is to investigate the factors we have to take into account in order to determine the temporal coherence of a narrative discourse. In particular, aspectual information, tense, and world and context knowledge have to be considered and the interplay of all these factors must be specified.

German is aspectually speaking an interesting language, because it does not possess a grammaticalised distinction between a perfective and imperfective aspect. In this thesis I examine the German aspectual system and the interaction of the factors which have an influence on the derived temporal relation for short discourse sequences. The analysis is carried out in two steps:

- First, the aspectual and temporal properties of German are investigated, following the cross-linguistic framework developed by Carlota S. Smith. An account for German is given which emphasises the properties which are peculiar to this language and explains why it has to be treated differently to, for example, English. The main result for the tense used in a narrative text — the *Preterite* — is that information regarding the end point of a described situation is based on our world knowledge and may be overridden provided context knowledge forces us to do this.

- Next, the more complex level of discourse is taken into account in order to derive the temporal relations which hold between the described situations. This investigation provides us with insights into the interaction of different knowledge sources like aspectual information as well as world and context knowledge.

This investigation of German discourse sequences gives rise to the need for a time logic which is capable of expressing fine as well as coarse (or underspecified) temporal relations between situations. An account is presented to describe exhaustively all conceivable temporal relations within a computationally tractable reasoning system, based on the interval calculus by James Allen.

However, in order to establish a coherent discourse for larger sequences, the hierarchical structure of a narrative has to be considered as well. I propose a Tree Description Grammar — a further development of Tree Adjoining Grammars — for parsing the given discourse structure, and stipulate discourse principles which give an explanation for the way a discourse should be processed.
I furthermore discuss how a discourse grammar needs to distinguish between discourse structure and discourse processing. The latter term can be understood as navigating through a discourse tree, and reflects the process of how a discourse is comprehended.

Finally, a small fragment of German is given which shows how the discourse grammar can be applied to short discourse sequences of four to seven sentences.

The conclusion discusses the outcome of the analysis conducted in this thesis and proposes likely areas of future research.

Declaration

I declare that this thesis has been composed by myself and that the research reported herein is my own. This thesis complies with all the regulations for the degree of PhD at the University of Edinburgh, and falls below the requisite word limit specified.

Frank Schilder

Edinburgh, 17th September 1997
Acknowledgements

I would like to express my deepest thanks to my supervisors, Lex Holt, Sheila Glasbey and Marc Moens for taking interest in my work, and providing me with insightful feedback and encouragement.

I would also like to take this opportunity to thank my examiners, Mimo Caenepeel and Ian Pratt for their detailed comments and suggestions on the manuscript, and for a very interesting discussion during the viva.

Special thanks go to my office mates Alice Drewery, Bernie Jones, and Karin Verspoor who were always willing victims of my linguistic experiments and provided me with the required native speaker intuitions.

I am also grateful for the feedback I got from the Tense and Aspect group. In particular, I enjoyed the stimulating discussions with Alistair Knott and Martin Mellor.

This thesis was supported by a PhD studentship awarded by the DAAD (German Academic Exchange Service). An IBM research scholarship allowed me in addition to spend six inspiring weeks at the Institute for Logic and Linguistics in Heidelberg. Thanks to Michael Herweg, who made this possible and interested me in all these time related problems in the first place.

Others who gave me feedback on my work in various ways and at various times: Alex Lascarides, Amy Isard, Birgit Hamp, Brit Dalen Laux, Carl Vogel, Carlota Smith, Carola Eschenbach, David Tugwell, Frank Keller, Heike Tappe, Mari Broman Olsen, Markus Egg, Nicholas Asher, Petra Dunges, Sheila Rock, Sylvie Hancil and Zelal Güngör.  

Special thanks to my family, in particular my parents, Ingrid and Karl-Heinz, who always supported me in achieving whatever I wanted to do.

Finally, thanks to Dani, who had to put up with more than three years not being together, for the time we had together.

Notational Conventions

In this thesis, the following notational conventions are used:

* a linguistic example in the body of the text is in italics which can also be used for emphasis.

(1) However linguistic examples which are numbered appear in Roman type, unless a literal translation into English is required:

(2) Die wörtliche Übersetzung ist in Kursivschrift.

The literal translation is in italic-writing.

The literal translation is in italics.

(3) In numbered examples, the particular item of interest appears in bold.

Material that has been added (to make a real text example easier to understand) appears in brackets; where material has been excised ( . . . ) three dots appear between brackets.

A sentence or phrase which is ungrammatical is denoted by a preceding ’/‘, while a sentence or phrase whose well-formedness is questionable or highly questionable is denoted by a preceding ’/?‘ or ’/??‘, respectively.

A sentence or phrase which is grammatical but unacceptable in the given context or expresses an contradiction is denoted by a preceding ’/#‘.

Feature structures are represented as follows: [FEATURE value]
## Contents

1 Introduction  
1.1 The phenomena under investigation .................. 2  
1.2 Aims of the thesis .................................. 3  
1.2.1 Temporal relations expressed by a German narrative .... 4  
1.2.2 A time logic for underspecified temporal relations .... 4  
1.2.3 A discourse tree structure as a formal representation ... 5  
1.3 Methodology ......................................... 5  
1.4 Overview of the thesis ................................ 5  

2 Former Approaches  
2.1 Introduction .......................................... 8  
2.2 Aspectual class, Aktionsart, aspect and the narrative .... 9  
2.2.1 Vendler (1967) ..................................... 11  
2.2.1.1 Homogeneity vs. heterogeneity ..................... 12  
2.2.1.2 States vs. the other classes ....................... 13  
2.2.1.3 Accomplishments vs. achievements ............... 13  
2.2.2 More aspectual classes ............................ 15  
2.3 Reichenbach’s reference time .......................... 16  
2.4 How to move narrative time? ........................... 17  
2.4.1 Partee (1984) and Hinrichs (1986) ................. 18  
2.4.2 Dowty (1986) ....................................... 18  
2.4.3 Defaults in discourse ............................... 21  
2.4.3.1 Non-monotonic reasoning ......................... 22  
2.4.3.2 Lascarides & Asher (1993) ....................... 23  
2.4.3.3 Problems ........................................ 25  
2.5 Conclusions .......................................... 26  

3 Aspectual Information Encoded in German  
3.1 Introduction ........................................... 28  
3.2 Situation types and viewpoints ........................ 29  
3.2.1 Situation types .................................... 31  
3.2.1.1 Situation types following Smith (1991) .......... 32  

4 Discourse Sequences  
4.1 Introduction .......................................... 64  
4.2 One viewpoint ........................................ 67  
4.2.1 Temporal schemata as intervals .................... 67  
4.2.1.1 The typology of Caenepeel (1989) ............... 68  
4.2.1.2 Intervals and situation types ..................... 70  
4.2.2 Viewpoint-interface ............................... 72  
4.3 Situation types .................................... 73  
4.3.1 state/activity.state/activity ....................... 74  
4.3.2 event.state/activity ............................... 78  
4.3.2.1 Consequence .................................... 79  
4.3.2.2 Background ..................................... 82  
4.3.3 accomplishment.event ............................ 86  
4.3.3.1 Consequence .................................... 86  
4.3.3.2 Elaboration ..................................... 88  
4.3.4 punctual_event.event ............................ 89  
4.3.4.1 Consequence .................................... 90  
4.3.4.2 Iteration ....................................... 91  
4.3.5 state/activity.event ............................... 92  
4.3.5.1 Consequence .................................... 92  
4.3.5.2 Background ..................................... 92  

4.4 Forward movement of narrative time .................. 94  
4.4.1 Contingency structures in German ................. 94

## Contents

3.2.1.2 Situation types in German ....................... 33  
3.2.1.3 Concluding remarks ............................ 36  
3.2.2 Viewpoints ........................................ 36  
3.2.2.1 Smith’s point of view ......................... 37  
3.2.2.2 Bauerle’s perspective on the German Preterite .. 40  
3.2.2.3 German and the open-perfective viewpoint ....... 44  
3.3 Only one viewpoint? ................................ 50  
3.3.1 Discourse structure ................................ 51  
3.3.2 Du hast keine Wahl, aber nutze sie ................ 53  
3.3.2.1 English ........................................... 54  
3.3.2.2 French ........................................... 54  
3.3.2.3 Russian .......................................... 55  
3.3.2.4 The viewpoint and the states .................... 55  
3.3.3 Activities revised ............................... 56  
3.3.4 No progression in German? ....................... 58  
3.3.4.1 gerade dabei sein etwas zu tun .................. 58  
3.3.4.2 The nominal progressive ....................... 60  
3.4 Conclusions .......................................... 62  

4.4.1 Contingency structures in German ................. 94
4.4.2 Semelfactives ........................................ 96
4.4.3 States and activities looking for an end point .......... 97
4.4.4 Forward or backward? ................................ 97
4.5 Conclusions ........................................... 99

5 Time Logic ............................................ 102
5.1 Introduction ........................................ 102
5.2 Points, intervals, situations and their temporal relations .... 104
5.2.1 A model for time ................................ 105
5.2.1.1 Situation structure ......................... 105
5.2.1.2 Point structure ........................... 108
5.2.1.3 Interval structure ....................... 108
5.2.2 Temporal relations ................................ 111
5.2.2.1 Situations ............................... 111
5.2.2.2 Intervals ................................. 112
5.2.2.3 Points ................................. 113
5.2.3 Situation types and interval constraints ................. 114
5.2.3.1 Stative .................................. 115
5.2.3.2 Bounded ............................... 116
5.2.3.3 Punctual ............................... 117
5.2.3.4 Telic .................................. 118
5.2.4 Open-perfective viewpoint and temporal constraints .... 120
5.3 Coarse and strict temporal knowledge ....................... 123
5.3.1 Point algebra ................................ 124
5.3.2 Convex relations ............................... 125
5.3.3 Conceptual neighbourhood .......................... 128
5.4 A hierarchy of convex relations .......................... 130
5.4.1 The hierarchy ................................ 130
5.4.2 Minimal point relation sets ....................... 131
5.5 Applied temporal knowledge ................................ 132
5.5.1 Open intervals ................................ 133
5.5.2 Punctual intervals .............................. 136
5.5.3 Closed and durative intervals ..................... 138
5.5.4 Forward movement ............................. 138
5.5.5 Some critical remarks on convex relations ............. 139
5.6 Conclusions ........................................... 141

6 The Rhetorical Structure of a Narrative ....................... 143
6.1 Introduction ........................................ 143
6.2 Discourse structure ................................... 144
6.2.1 Rhetorical relations ................................ 145
6.2.1.1 Narration ................................ 145
6.2.1.2 Elaboration ............................... 147

A All 82 Convex Relations ................................... 194

B Convex Relations and Intervals ................................ 198
B.1 All possible temporal relations ............................ 198
B.2 Open intervals ........................................ 199
B.2.1 Two open intervals ................................ 199
B.2.2 One open interval encounters a border ............... 200
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Hierarchical structure of aspectual classes according to the mereological tradition</td>
</tr>
<tr>
<td>2.2</td>
<td>Aspectual class hierarchy according to the stative/non-stative distinction</td>
</tr>
<tr>
<td>2.3</td>
<td>The nucleus developed by Moens (1987)</td>
</tr>
<tr>
<td>2.4</td>
<td>Simple Past vs. Past Perfect according to Reichenbach (1947)</td>
</tr>
<tr>
<td>2.5</td>
<td>Dowty’s TDIP</td>
</tr>
<tr>
<td>3.1</td>
<td>The decision tree for the German situation types</td>
</tr>
<tr>
<td>4.1</td>
<td>The temporal relation influenced by four different sources</td>
</tr>
<tr>
<td>4.2</td>
<td>The contingency structure by Caenepeel (1989) allows the second situation to be embedded into the consequent state of the first one</td>
</tr>
<tr>
<td>5.1</td>
<td>The 13 interval relations</td>
</tr>
<tr>
<td>5.2</td>
<td>The four point relations, which hold between the end points of the two intervals</td>
</tr>
<tr>
<td>5.3</td>
<td>The convex relations in a strict ordering</td>
</tr>
<tr>
<td>5.4</td>
<td>Conceptual Neighbours</td>
</tr>
<tr>
<td>5.5</td>
<td>A part of the hierarchy</td>
</tr>
<tr>
<td>5.6</td>
<td>The full hierarchy of the 82 convex relations</td>
</tr>
<tr>
<td>5.7</td>
<td>The relations between instances and intervals</td>
</tr>
<tr>
<td>6.1</td>
<td>Openness by Lascarides and Asher (1993)</td>
</tr>
<tr>
<td>6.2</td>
<td>The hierarchical structure according to Lascarides and Asher (1993)</td>
</tr>
<tr>
<td>6.3</td>
<td>The Nixon Polygon which arises</td>
</tr>
<tr>
<td>6.4</td>
<td>A labelled tree description</td>
</tr>
<tr>
<td>6.5</td>
<td>A tree description for a sentence embedded in a discourse</td>
</tr>
<tr>
<td>6.6</td>
<td>A tree description representing the minimal discourse of one sentence</td>
</tr>
<tr>
<td>6.7</td>
<td>Substitution and adjunction operation on tree descriptions</td>
</tr>
<tr>
<td>6.8</td>
<td>The example discourse repaired</td>
</tr>
</tbody>
</table>
ONE

Introduction

“The island of Anthos is reached by the said steamer, which anchors once a week, if required, off the bay. Of course I kept a diligent look-out during the voyage.”

“Now, I thought, while the storyteller poured himself another glass, ‘any moment now the phrase ‘leaning over the rail’ will come,’ for he was proceeding along well-worn tracks of language. And sure enough it did come.”

“I was leaning over the rail. It was true about the dolphins at least — waves of the sea, one might think, that have turned into creatures. They were accompanying our ship.”

(Penzoldt, Der Delphin, p. 21–23)

The cognitive process of reading and understanding a narrative like the one above has to be seen as an interaction between the text and the knowledge the reader can contribute. Consequently, it seems to be necessary for the story writer to follow certain conventions which she assumes the reader shares.

This view on how narratives have to be interpreted, namely as an interaction between the text and the reader’s knowledge, has been taken by many researchers (e.g. Dillon (1978) or Eco (1979)). However, if we presumed that the understanding of a narrative is based only on commonly shared conventions, there would not be much to investigate or it would be difficult to stipulate certain principles or generalisations that the processing of a text is based on.

A closer look reveals that the meaning of certain verbs and sentences are used in order to convey the intended temporal structure of a story. When a scene is set at the beginning of a story, quite often stative descriptions like in the text above are used.

The story continues with an event which indicates that the narrative time moves forward. Movement verbs describing a change of location are frequently chosen to transfer this infor-
1.1 Introduction

The phenomena under investigation

mation to the reader:

(...) Ein Boot mit zwei großen Augen am Bug, wie man sie auf griechischen Augen-

schalen findet, brachte mich an Land zu dem einzigen Hotel am Platz (...). (Penzoldt,

Der Delphin, p. 22)

(...) A boat with two great eyes on the prow, as they are to be found on Greek eye-bowls, 
brought me ashore to the only hotel in the place (...)
(Penzoldt, The Dolphin, p. 23)

It is commonly supposed that so-called aspectual classes have a major influence on the interpre-
tation of a narrative with respect to the expressed temporal relations. The work by Hinrichs 
(1986) and Partee (1984), for example, takes this into account and shows that a forward move-
ment of narrative time can be expected for events like a boat brought me ashore to the hotel, 
whereas states like I kept a diligent look-out during the voyage do not have this effect.

But this is not the end of the story. The distinction between states and events — in the 
following chapters we will see that an even more fine-grained differentiation is needed — can 
only be seen as a rule of thumb. The generalisation does not hold in every case:

Mitten in jenem Winter kam er mit Fahrrad und Auftrag hierher (...) Muham-

 kam er den Dorfweg hinauf, der an der Schule vorbeiführte (...). Durch die Fenster der 
Schulklasse sahen wir ihn näherrücken (...). (Lenz, Der Verzicht, p. 110)

It was in the middle of that winter when his bicycle and his orders brought (lit: came) 
him here. He toiled up the road into the village which runs past the school (...). We saw 
him approaching through the classroom windows (...). (Lenz, The Renunciation, p. 111)

This example shows again that we need to consult our world knowledge to interpret this 
sequence correctly with respect to the expressed temporal ordering of the situations. The sec-
ond sentence provides us with more details of the first described situation. No movement of 
narrative time is perceived. The bottom line is that there are certain generalisations about how 
we derive the temporal relations, but we should not forget how much the inference we draw 
is influenced by the world knowledge we possess.

1.1 The phenomena under investigation

This thesis is concerned with the question of how the process of deriving the expressed tem-
poral relations in a narrative discourse can be formally explained. Normally, a text presents 
situations in a particular temporal ordering. Whether they precede or overlap each other, or 
whether one situation includes the other one, is inferred while reading a text.

There are three questions to be asked regarding this seemingly easy to perform task:

- What temporal information with respect to the described situation is provided by a sin-
gle sentence in the past tense (e.g. state vs. event distinction)?
- Which knowledge sources are taken into account to derive the temporal relation between 
the described situations (e.g. so-called aspectual classes, world and context knowledge)?
- How do those different factors interact and influence the temporal relation conveyed?

1.2 Introduction

Aims of the thesis

Since I focus mainly on German narratives, the question has to be asked what temporal 
information is expressed in particular by the German past tense — the Preterite. Interestingly 

enough, this does not always seem to be the same as in English. Consider:

(1.1) Hans überquerte die Straße. Ein Lastwagen schoß auf ihn zu und überrollte ihn auf 
Höhe des Mittelstreifens.

Hans was crossing the street. A lorry approached him at speed and ran him over in 
the middle of the road.

Bäuerle (1988) has already observed that the Preterite is more flexible than the English sim-
ple past. That means there are certain context conditions which allow the 
Preterite (i.e. Hans crossed the street) is not 
capable of expressing such a reading. However, the question remains what exactly these con-
ditions are and how the temporal properties can be formally expressed for the Preterite.

Taking the properties of German into account, a more detailed analysis of German dis-
course sequences is undertaken. The interaction of different factors which influence the 
derivation of the temporal relation are investigated.

In addition to this linguistic angle, this thesis also scrutinises how the temporal information 
should be represented within a temporal reasoning system. A formal framework is chosen and 
tested as to whether it can apply to all temporal relations found in the analysis of discourse 
sequences. This account expands on the representation of the presented temporal relations.

Former approaches only assumed rather coarse relations derivable for the described situations.

Finally, the structure of discourse is assumed to be hierarchical rather than strictly linear. A 
substantial body of recent scholarship has presented various proposals for a theoretical frame-
work specifying how to obtain a static representation of the rhetorical structure conveyed by 
a text. But not much attention has been paid to the actual online process of understanding a 
discourse.

A formal tree grammar is employed to give an account which is flexible enough to describe 
the processes which are performed when reading a text. As a result of this process we should 
get a coherent discourse structure representing the rhetorical dependencies.

1.2 Aims of the thesis

The aim of this thesis is three-fold: first, a linguistic analysis of German should provide us 
with a theory of the temporal and aspectual properties expressible by this language. Second, 
a formal system is to be developed which allows us to describe all conceivable temporal rela-
tions accurately. Finally, a discourse grammar presents an overarching frame for the several 
factors which have to be considered while processing a discourse.

This example was taken from Eberle (1988, p. 163).
1.2 Introduction

1.2.1 Temporal relations expressed by a German narrative

As already mentioned in the previous section, the temporal information conveyed by a sentence seems to differ with respect to the language under consideration. In particular, not much attention has been paid to how this information is encoded in German. My hypothesis is that this language presents the temporal structure of a described situation and the temporal relations which are derivable from a narrative discourse quite differently from English. Consequently, we cannot rely on models of the temporal and aspectual information in a narrative which were developed for English to provide us with a correct formal semantics for German narratives.

I will show that German has a more flexible approach in presenting the temporal features of a situation. English, on the other hand, forces the speaker to choose between two alternatives: progressive form and simple aspect.

This decision has further repercussions when we look at the expressed temporal relation. One aim of this thesis is to show the different ways that temporal information is encoded in German narratives, mainly in contrast to English. German is, aspectually speaking, an interesting language which unlike English does not possess an overt morpheme marking system to express aspectual differences. It seems therefore to be questionable whether discourse theories developed for English can simply be applied to German.

I intend to investigate short discourse sequences in German and analyse them with respect to their temporal structure. My findings will then be contrasted with the predictions we can make for the English translation. By making this comparison, I hope to highlight the different features of these two languages regarding the expressed temporal relations.

1.2.2 A time logic for underspecified temporal relations

The outcome of the linguistic analysis of the first part of this thesis has to be formalised and put into a logical framework. Although much work has been done in the field of time logic, little effort has been taken to combine a time logic with a discourse grammar to model the temporal relations. I claim that a fully fledged time logic is required to cover all conceivable temporal relations expressible by a narrative discourse instead of employing only a few possible relations.

The full analysis of German discourses will provide the required evidence that coarse as well as fine temporal relations are expressed by a narrative. In order to achieve an accurate and concise representation of the temporal relations, I will also carry out a further investigation of a time logic based on intervals which was proposed by James Allen. A sub-algebra, which is a computationally tractable sub-set of the full algebra, will be used to encode the temporal relations and I will investigate whether this formalisation is expressive enough to capture all temporal relations which are necessary to present the temporal relations in a German narrative adequately.

1.2.3 A discourse tree structure as a formal representation

The final part of this thesis deals with the question of how a formal representation can express the way the hierarchical discourse structure is built up while reading a text. In particular, a formalism is proposed to combine all knowledge sources which are required to derive the temporal relation. The temporal reasoning system as well as general world knowledge is combined by this discourse grammar.

My hypothesis is that the hierarchical structure of a discourse can be represented by a tree generation system called Tree Description Grammar (TDG). This grammar is used to provide a formal tool which is flexible enough to cover the data discussed, but, on the other hand, it also offers the possibility to represent the discourse understanding via a restrictive parsing mechanism. The proposed formalism has the advantage over former approaches that a computationally oriented formalism is used which exploits underspecification to present the hierarchical structure in an efficient way. Using this novel formalism, newly processed sentences can be easily incorporated into the discourse structure.

1.3 Methodology

The thesis starts with a linguistic analysis of mainly German sentences. Hence my own and other native speakers’ intuitions were necessary to collect reliable data. In particular, with respect to the question of what temporal relation is described by a narrative, the informers were explicitly asked about all conceivable temporal relations they could think of for the presented example discourses.

Moreover, many example discourse sequences were extracted from the online corpora maintained by the Institut für deutsche Sprache (IDS) in Mannheim. The URL for the COSMAS-system which allows a restricted access of 30 minutes for one session is http://www.ids-mannheim.de/ids/cosmas/intro.html. The corpora contain books including Ansichten eines Clowns by Heinrich Böll or Die Blechtrommel by Günter Grass as well as a collection of newspaper articles.

The representation of temporal relations is embedded in a model for time similar to the one proposed by Kamp and Reyle (1993). Focusing on the temporal reasoning system developed by Allen (1984) and refined in subsequent years by other researchers, I employ a well-understood theoretical framework. In particular, I bring together research in temporal reasoning with the modelling of temporal information in a discourse.

The final part of my thesis discusses the processing of a discourse which should be seen as similar to the syntactic analysis and parsing of a sentence. The Tree Description Grammar is used to describe the rhetorical dependencies within a discourse structure.

1.4 Overview of the thesis

The rest of the thesis is organised as follows:
• Chapter 2 provides an overview of previous work on discourse modelling with respect to the expressed temporal relations. The definition of aspectual classes, Aktionsart and aspect as well as the notion of reference time is given in this chapter. Moreover, this chapter contains a short introduction to common sense entailment introduced by Asher and Morreau (1991) and used by Lascarides and Asher (1993). This non-monotonic logic will be needed again in chapter 6.

• Chapters 3 and 4 focus especially on German. The analysis is carried out in two steps:
  – First, in chapter 3, the aspectual and temporal properties of German are investigated. Working within the cross-linguistic framework of Smith (1991), an account for German is given which emphasises the properties peculiar to this language and explains why it has been treated differently to English. The main result of this investigation is that in German the information regarding the end point of a situation is based on our world knowledge and may be overridden provided context knowledge forces us to do this.
  – Next, since the analysis in chapter 3 is mainly restricted to single sentences, the more complex discourse level is taken into account in chapter 4 in order to derive the temporal relations which hold between the described situations. This investigation gives us insights on the interaction of different knowledge sources like aspectual information and world/context knowledge. The effects of world/context knowledge can be seen more easily when a more elaborated discourse is under investigation. Moreover, this analysis shows the need for a time logic which is capable of expressing underspecified as well as strict temporal information. Such a logic is presented in chapter 5.

• Chapter 5 gives an account of how the findings of the previous chapter regarding the representation of temporal relations can be formalised. I use a time logic which is able to express underspecified (or coarse) temporal relations.

• Chapter 6 binds all the threads developed in the previous chapters together:
  – A hierarchical tree structure reflects the constraints which are imposed on a discourse by the rhetorical relations.
  – The temporal relations are encoded within this tree structure.

I discuss the fact that a discourse grammar needs to distinguish between the discourse structure used and the discourse processing. The latter term can be understood as navigating through the discourse tree, and reflects the process of how a discourse is comprehended.

• A fragment of German is given in chapter 7. Several phenomena discussed in earlier chapters recur here and a formal representation is given within the discourse tree grammar proposed in the previous chapter.

• The conclusion in chapter 8 discusses the outcome of the analysis carried out in this thesis and proposes likely areas of future research.

• An appendix contains the formal definition of the time logic and shows how this can be applied to some of the data discussed in chapter 4.
The aim of this chapter is to provide the reader with an overview of influential former approaches to the modeling of the temporal structure expressed by a narrative discourse. First, the definition of aspectual class, Aktionsart and aspect as well as the notion of a reference time will be introduced, because the understanding of those concepts is crucial for the presented approaches and the account proposed in this thesis. These concepts are used to explain how temporal information is encoded in language. On the one hand, I will present theories which rely on the given aspectual information and the reference times in order to model the forward movement of narrative time, but, on the other hand, I will discuss accounts which exploit the features of a non-monotonic reasoning system and use several rhetorical relations in addition to the purely temporal and aspectual information used by the other approaches in order to establish a coherent discourse structure.

2.1 Introduction

This chapter discusses former approaches which introduced influential concepts into the discussion on how the temporal relations of a narrative discourse can be derived. First, theories by Partee and Hinrichs as well as by Dowty have to be mentioned, because they show the crucial influence of aspectual information on the discourse structure. However, since these theories are mainly developed for English, the question has to be raised how aspectual knowledge is encoded in German. The following two chapters are mainly concerned with this question.

Apart from aspectual information, world and context knowledge has been found to be crucial for the determination of the correct temporal relation. Theories proposed, for instance, by Lascarides and Asher (1993) use a non-monotonic derivation system to model this information. A short introduction to their system is provided in this chapter. I will return to the question of what influence the rhetorical relations can have in chapter 4 and in a more formal way in chapter 6.

2.2 Former Approaches

The structure of the remaining part of this chapter is as follows:

- Section 2.2 gives a clarification of the three terms aspectual class, Aktionsart and aspect. Essentially these are lexical classifications of verbs (e.g. to run vs. to run a mile) or morphemes (e.g. -ing suffix). However, in this section I will only focus on the most influential categorisation of aspectual classes which goes back to Vendler (1967) and contains four different classes. Ensuing approaches build on this classification, adding further insights on the definition of aspectual information in general. For example, Moens (1987) proposes the nucleus model which provides a richer ontology which will be introduced in section 2.2.2. How the aspectual classes can be subsumed to different super-classes will be discussed as well.

- Section 2.3 introduces Reichenbach’s notion of a reference time for linguistically described situations. Possible problems with this notion will be pointed out.

- After introducing these indispensable terms for discourse modelling, three approaches to the temporal interpretation of a narrative discourse will be presented. Firstly, Partee’s and Hinrichs’ updating of reference times will be described in 2.4.1. Secondly, their approach will be contrasted with Dowty’s Temporal Discourse Interpretation Principle (TDIP) in section 2.4.2. Finally, a recent account which exploits non-monotonic reasoning systems will be reviewed in section 2.4.3 (Lascarides and Asher 1993).

- Section 2.5 summarises the problems and shortcomings of the approaches presented. Some requirements for a theory of the modelling of a discourse structure are pointed out.

Based on the investigation in this chapter, an analysis for German regarding the aspectual information conveyed by this language will be undertaken in chapter 3. I will investigate how well concepts developed mainly for English (cf. Vendler’s classification and the approaches presented in 2.4) can be applied to German by working in the cross-linguistic framework of Smith (1991).

2.2 Aspectual class, Aktionsart, aspect and the narrative

It has already been observed by Jespersen (1924) and Dry (1983) that the temporal and aspectual properties of a situation expressed by a sentence have an influence on the temporal relations encoded by a narrative discourse.

Considering a distinction of aspectual classes which will be explained later in more detail, different effects on the interpretation of a narrative discourse can be found. This can be illustrated, for example, by (2.1):

(2.1) a. John entered Mary’s office. He sat down.
    b. John entered Mary’s office. The report was on her desk.
2.2 Former Approaches Aspectual class, Aktionsart, aspect and the narrative

The second sentence in (2.1a) can be categorised as an instantaneous situation. In this case a mapping between the sequential ordering of the sentences and the temporal ordering of the actual events can be assumed. In (2.1b) the sequence reflects a scene where the situation described by the second sentence does not contain any definite end points and hence overlaps with the event expressed by the previous sentence.

Accounts of how the temporal structure of a narrative discourse can be derived clearly have to take into account the temporal and aspectual properties of the situations they describe. Hence it seems to be useful to give an introduction of how aspectual classes, Aktionsarten (‘kinds of action’) and aspect are defined. Unfortunately, the terminology used in the literature is rather confusing:

**aspectual class** The classification of a situation according to its intrinsic temporal properties.

These properties can be tested by linguistic tests as, for instance, proposed by Vendler (1967) (e.g. John was happy for 3 hours vs. *John was happy in 3 hours*). Vendler distinguishes four classes:

- **State** to love, to know, to cont
- **Activity** to run, to walk, to laugh
- **Accomplishment** to destroy, to create
- **Achievement** to notice, to win

**Aktionsart** There are two traditions which make use of this term:

**Germanic tradition** A lexicalisation of the classification of situations according to their temporal properties. The distinction is solely based on the inherent meaning of the situation (e.g. Steinitz 1981):

- **iterative** flattern, grübeln, plätschern (‘to flutter/to flap its wings’, ‘to brood’, ‘to babble/to patter’)
- **inchoative** abfliegen, einschlafen, losfahren (‘to take off’, ‘to fall asleep’, ‘to set/move/drive off’)
- **resultative** verbilden, verrosten, zerschlagen (‘to bleed to death’, ‘to get rusty’, ‘to smash to pieces’)
- **punctual** angreifen, finden, treffen (‘to attack’, ‘to find’, ‘to meet’)
- **mutative** sich erkälten, gesund werden, umleiten (‘to get a cold’, ‘to recover’, ‘to divert’)
- **factive** blondieren, reinigen, trocknen (‘to bleach’, ‘to clean’, ‘to dry’)
- **causative** fallen, legen, setzen (‘to fall’, ‘to lay down’, ‘to put/place’)

**Slavonic tradition** A semantic distinction of situations which is lexicalised according to a derivational morphology (e.g. Isačenko 1968). E.g. the Russian verb igrat’ (‘to start playing’) via the prefix za-.

Vendler wanted to provide a differentiation of verbs determined by linguistic tests. Later research, however, argued for a classification of the situation conveyed by the verbs and their arguments and adjuncts. In particular, Verkuyl (1993) and Kriška (1992) developed theories which showed the influence of arguments and adjuncts on the aspectual class of the whole sentence.

1Note that I will not pursue this issue any further in this thesis. Instead, I will assume a classification for the whole sentence regardless how this may have been derived considering the influences of verb arguments or adjuncts. See

---

10

---

11
2.2 Former Approaches Aspectual class, Aktionsart, aspect and the narrative

I will present several tests which can be used to obtain a classification of the four following example sentences:

(2.2) a. John loved Mary. (state)
   b. John walked. (activity)
   c. John walked to the station. (achievement)
   d. John reached the summit. (accomplishment)

Firstly, I will discuss the compatibility of sentences with a durative adverbial like for 2 hours and with time-span adverbials like (within) 2 hours (or the paraphrase it took (her) 2 hours to...). These two tests give rise to a two-way distinction between homogeneous (i.e. states and activities) and heterogeneous (i.e. accomplishments and achievements) situations. It is important to stress that those tests are employed to make a distinction between the situations described by the sentence. The sentence itself is not homogeneous, but it denotes such a situation. For the sake of brevity, however, I will occasionally write 'homogeneous sentence'.

Secondly, I will investigate when a habitual reading for the simple aspect can be perceived and when the progressive form can be used. Finally a test regarding the temporal properties of the progressive form and the time-span adverbials will be introduced. Note that the two last tests are language-dependent. For a language like German which does not possess a progressive form alternative tests have to be found (see section 3.2.1.2).

2.2.1.1 Homogeneity vs. heterogeneity

Two linguistic tests introduced by Vendler can be used to distinguish between homogeneous and heterogeneous classes: for-adverbials are compatible with states and activities which describe homogeneous situations, but not with accomplishments and achievements. On the other hand, accomplishments and achievements which refer to heterogeneous situations can be combined with in-adverbials, whereas states and activities are incompatible with this sort of adverbial:

(2.3) a. John loved Mary (for two years/*in two years). (state, homogeneous)
   b. John walked (for hours/*in two hours). (activity, homogeneous)
   c. John reached the summit (*for three hours/*in two hours). (achievement, heterogeneous)
   d. John walked to the station (*for one hour/*in two hours). (accomplishment, heterogeneous)

Some approaches to the classification of aspectual classes rely mainly on these two tests and consequently propose a dichotomy between two types, viz. homogeneous and heterogeneous situation (e.g. Herweg 1991). They sustain this distinction by the mereological properties which can be observed for these two classes. The so-called sub-interval property can be used to justify this (e.g. a state like being a blue object for 2 hours possesses this feature for any temporal subinterval of those 2 hours). Note that the sub-interval property holds for activities only to a certain lower bound (e.g. only lifting one's leg cannot be seen as walking any more).

However, it is still a controversial issue whether activities should be classified together with states as one class. A different view was taken, for instance, by Kamp and Reyle (1993). They categorise activities as heterogeneous events within a two-fold distinction of aspectual classes for their Discourse Representation Theory (DRT).

The question has to be raised which distinction can be justified with respect to the effect one can observe on a discourse level. The question how the different aspectual classes should be organised should be kept in mind until the effects regarding the derived temporal relation on a more complex discourse level are investigated in chapter 4. The next section shows how states and activities can be distinguished.

2.2.1.2 States vs. the other classes

States combined with the present simple tense in English refer to a situation where the expressed proposition holds (i.e. (2.4 a)), whereas this tense renders a habitual meaning for all the other aspectual classes:

(2.4) a. John loves Mary. (state)
   b. John walks. (activity, habitual)
   c. John reaches the summit. (achievement, habitual)
   d. John walks to the station. (accomplishment, habitual)

In addition, states can be distinguished from the other classes by the usage of the progressive form, since these verbs usually cannot occur with the -ing suffix.

(2.5) a. *John is loving Mary.
   b. John is walking.
   c. John is reaching the summit.
   d. John is walking to the station.

2.2.1.3 Accomplishments vs. achievements

These two classes differ with respect to their temporal extension: accomplishments are extended in time, whereas achievements are punctual. Consider again the following sentences introduced earlier:

(2.6) a. John walked to the station in two hours. (accomplishment)
   b. John is walking to the station.

(2.7) a. John reached the summit in two hours. (achievement)
   b. John is reaching the summit.

White (1995), for instance, for a recently developed computational approach to aspect composition.
2.2 Former Approaches  
Aspectual class, Aktionsart, aspect and the narrative

The accomplishment in (2.6a) is combined with a time-span adverbial which expresses the duration of this situation. When the achievement in (2.7a) is combined with the same adverb, the adverb refers to the time leading to the situation. The progressive form of the accomplishment in (2.6b) presents a situation which is part of walking to a station. On the other hand, the progressive of the achievement in (2.7b) describes a situation which can be seen as the preliminary stage just before John reached the summit.²

Concluding Remarks  I summarised the classification system proposed by Vendler (1967), mentioning some linguistic tests developed for English. I pointed out that for an investigation of the aspectual classes in German, different tests have to be designed, because this language does not offer a progressive form (or any other imperfective aspect).

Moreover, I drew attention to other classification systems which provide a hierarchical ordering of the aspectual classes. On the one hand, systems can be found which classify states and activities as homogeneous aspectual classes (ACs) and accomplishments and achievements as heterogeneous ones (e.g. Herweg 1991) (see figure 2.1). On the other hand, activities are assigned to a superclass of events (i.e. bounded ACs) subsuming accomplishments and achievements as well (see figure 2.2).

Figure 2.1: Hierarchical structure of aspectual classes according to the mereological tradition

Figure 2.2: Aspectual class hierarchy according to the stative/non-stative distinction

²Not all achievements can be combined with the progressive form. See page 47 for a further discussion and comparison with German.

In the following section I will introduce the nucleus model by Moens (1987) and the five aspectual classes which can be derived from this representation.

2.2.2 More aspectual classes

This section gives a brief overview about the nucleus model by Moens (1987). The structure proposed will be used later for the analysis of narratives (cf. section 4.2.1). Moreover, the five aspectual classes derived from this model are the same ones Smith uses for her two-level theory of aspect which will be introduced in the following chapter (cf. section 3.2).

Moens (1987) developed the nucleus model for describing certain parts of a situation: the nucleus consists of a preparatory process, a culmination and a consequent state (see figure 2.3).

Moens’ classification leads to the following aspectual classes: state, process (i.e. activity), culminated process (i.e. accomplishment), point and culmination (i.e. achievement). These five different classes each refer to different parts of the nucleus. Table 2.1 shows the categorisation of the aspectual classes and gives some examples.

<table>
<thead>
<tr>
<th>Events</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic</td>
<td>Extended</td>
</tr>
<tr>
<td>Culmination</td>
<td>Culminated</td>
</tr>
<tr>
<td>Process</td>
<td>Process</td>
</tr>
<tr>
<td>Recognise, spot</td>
<td>Build a house,</td>
</tr>
<tr>
<td>Win the race</td>
<td>Eat a sandwich</td>
</tr>
<tr>
<td>Understand,</td>
<td>Know, love,</td>
</tr>
<tr>
<td>Love</td>
<td>Resemble</td>
</tr>
</tbody>
</table>

*preparatory   consequent
  | process   | state     |
  | culmina- | tion      |
  | point     |           |

Figure 2.3: The nucleus developed by Moens (1987)


2.3 Reichenbach’s reference time

The notion of reference time was employed by Reichenbach (1947) for a description of natural language tenses. He argued for a tense system which contains three times: speech time, event time and reference time. If one assumed only the speech time (ST) (i.e. the speaker’s time of utterance) and the event time (ET) (i.e. the temporal extension of the situation), only three tenses referring to the past, present and future could be obtained. Hence, in order to give also a formal representation for the more complex tenses, a third time — the reference time (RT) — was introduced by Reichenbach. Consider the following two sentences:

(2.8) a. John arrived yesterday.

b. John had arrived yesterday.

For (2.8b) a third time has to be assumed which lies in between the ET and the ST. Figure 2.4 reflects this constellation, representing time as an arrow and the three time points respectively.

The following table summarises the constraints which are imposed on the three times for the six tenses in English.

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>She ate</td>
<td>She eats</td>
<td>She will eat</td>
</tr>
<tr>
<td></td>
<td>ET = RT &lt; ST</td>
<td>ET = RT = ST</td>
<td>ET = RT &gt; ST</td>
</tr>
<tr>
<td>Perfect</td>
<td>She had eaten</td>
<td>She has eaten</td>
<td>She will have eaten</td>
</tr>
<tr>
<td></td>
<td>ET &lt; RT &lt; ST</td>
<td>ET &lt; RT = ST</td>
<td>ET &lt; RT &gt; ST</td>
</tr>
</tbody>
</table>

Note that a “point of reference” is required to locate the ET according to the ST. The reference time becomes particularly important when we have a look at a discourse. A sentence like (2.9a) sounds odd as the beginning of a discourse. The RT which coincides with the ET is not given, but connected with a when-sentence, for instance, so the reader/hearer can relate the ET with the expressed RT (Isard and Longuet-Higgins 1973).

(2.9) a. Chapman breathed a sigh of relief.

b. When Nixon was elected, Chapman breathed a sigh of relief.

2.4 How to move narrative time?

In recent years, a substantial body of scholarship has presented a temporal interpretation of narrative discourse sequences as a sequence of reference times, following Reichenbach’s analysis of the English tense system (Reichenbach 1947). Using this notion of tense and understanding the meaning of it as an anaphoric reference in time, several proposals were developed. We have to distinguish two traditions: the first one allows only an updating of reference time when an accomplishment or achievement is added to the narration (cf. Partee 1984, Hinrichs 1986).

On the other hand, Dowty (1986) developed a Temporal Discourse Interpretation Principle (TDIP), which predicts a sequential ordering of reference times in a narration for every sentence. Semantics and further pragmatic principles linked to the aspectual classes may lead to an overlapping of the situations.

These theories could not cope with sequences which can be seen as an elaboration according to our world knowledge, since they were solely based on aspectual information. Lascarides and Asher (1993) and Eberle (1991) used a non-monotonic logic to express the influences world knowledge can have on the temporal ordering in a text, assuming that a temporal precedence relation is the default or most preferred relation which holds between two described situations in a narrative.
2.4 Former Approaches

2.4.1 Partee (1984) and Hinrichs (1986)

Partee (1984) and Hinrichs (1986) both give an account which uses the reference time introduced by an event (i.e. *accomplishment* and *achievement*) to advance the time in a narrative:

(2.11) Mary walked into the room ($e_1$). She switched on the light ($e_2$).

The *accomplishment* $e_1$ and the *achievement* $e_2$ introduce reference times $t_r$ and $t_r'$ respectively. The whole discourse is most naturally interpreted as a sequence of two situations, thence the constraint $t_r < t_r'$ is imposed.

Generally speaking, the updating of the reference time can only be done by events and only these aspectual classes can move the narration forward. *States*, *activities* and events described by the progressive form can only provide a background according to their approach.

(2.12) Peter entered the pub. The music was very loud.

A simplified graphical representation of these approaches can be given as follows (the RT of $e_1$ and $e_2$ is $t_r$ and $t_r'$ respectively):

\[ t_r \rightarrow t_r' \rightarrow e_1 \rightarrow e_2 \rightarrow \ldots \]

Problems There are two cases where the updating of reference times proposed by Partee and Hinrichs does not give the correct prediction:

(2.13) Mary switched off the light. The room was pitch dark.

(2.14) The council built the bridge. The architect drew up the plans.

In discourse (2.13) the *state* in the second sentence is a result of the first event. Hence a sequence of reference times has to be assumed, but the approaches do not allow an updating. The second examples in (2.14) describes an elaboration of the first situation by the second one. The theories imply a forward movement of narrative time though.

2.4.2 Dowty (1986)

The temporal discourse interpretation principle (TDIP) by Dowty (1986) gives a non-referential proposal. He explains the forward movement (and the non-forward movement) by the interaction between tense, temporal adverbials and aspectual classes. His theory avoids the machinery of updating reference times and gives a general principle for the interpretation of a narrative discourse.

A general principle is stipulated by him which assumes a progression of narrative time for every newly introduced situation:

**TDIP 1 (Dowty 1986)** Given a sequence of sentences $S_1, S_2, \ldots, S_n$ to be interpreted as a narrative discourse, the reference time of each sentence $S_i$ (for $1 < i \leq n$) is interpreted to be:

1. a time consistent with the definite time adverbials in $S_i$, if there are any;
2. otherwise, a time which immediately follows the reference time of the previous sentence $S_{i-1}$.

This approach assumes that the temporal structure given by the aspectual class and the aspect has a further influence on the interpretation of the discourse. Rather than an updating of reference times which do not possess any internal structure, the aspectual class allows further conclusions with respect to the temporal information reflected by the narration. Figure 2.5 tries to capture this observation in a graphical way:

\[ R1 \]
\[ R2 \]

Although there seems to be an obvious relation between the aspectual classes and the interpretation of the discourse, Dowty (1986) proposes a so-called Temporal Discourse Interpretation Principle (TDIP) which does not refer explicitly to them. He demands the sequence of reference times for every situation described in a discourse irrespective of whether this can be classified as *state* or *accomplishment*, for example. However, sentence semantics and further pragmatic principles have to be linked to the aspectual classes, such that a correct interpretation of a discourse like (2.1b) can be obtained (repeated here as (2.15)).

(2.15) John entered Mary’s office ($e_3$). The report was on her desk ($e_4$)

When applied to the sequence of sentences in (2.15) Dowty’s TDIP’s prediction is a sequence of reference times. However, the semantics of a stative predicate permits the conclusion that the event in the first sentence can be overlapped by the state in the second sentence.

Now consider (2.16):

(2.16) A copy of the budget was on Mary’s desk. Mary’s financial advisor stood beside it.

Again, the TDIP requires two subsequent references times even for *states*. Following only the TDIP a hearer is not compelled to assume that these two *states* do overlap. The knowledge about the semantical properties of *states* and *activities* are used to obtain the conclusion that the situations might take place at the same time.

Another interesting observation is made by Dowty (1986) about the progressive which allows a similar overlapping interpretation of a discourse, although the actual situation in the second sentence might describe an *achievement* or an *accomplishment*. Consider (2.17):
2.4 Former Approaches How to move narrative time?

(2.17) John entered Mary’s office. Mary was writing a letter.

However, the overlapping reading is the only conceivable reading in this case, something which the TDIP does not guarantee.\(^3\) Note that in (2.17) the presupposed sequential reading of two reference times cannot be derived as a correct reading, whereas the TDIP offers this reading as the first preferred reading. The prediction the TDIP gives is misleading, because there is no difference between states/activities and the progressive form observed by Dowty.

Generally speaking, the definition of the TDIP given by Dowty (1986) relies mainly on the notion of aspectual classes which allows the further conclusions about the temporal relations stipulated by the discourse. That is, states and activities allow an overlapping between another situation, because of their homogeneity property. On the other hand, this property does not apply to achievements and accomplishments which can be described as heterogeneous.

Summing up, Dowty distinguishes rigorously between temporal relations reflected by the discourse structure and further aspectual information provided by the sentence semantics.

Problems It can be concluded from the observation made earlier that the TDIP does not always give the most natural interpretation. For example the usage of the progressive form in a narrative discourse indicates an overlapping almost every time. Within Dowty’s system, however, this reading can only be derived together with the semantic properties of the progressive form. The definition of PROG Dowty stipulates leads to the same conclusion that can be drawn for states and activities, namely that the actual situation might expand even more and can allow an overlapping reading.

(2.19) John entered Mary’s office. She was sleeping on the sofa.

But the reading that the TDIP proposes cannot be derived for the situation in (2.19) at all.

Another criticism is mentioned by Dowty himself:

(2.20) Pedro dined at Mme. Gilbert. First there was an hors d’oeuvre. Then the fish. After the butler brought the glazed chicken. The repast ended with a flaming dessert.

In this discourse, the second and the following subsequent sentences can be seen as a elaboration of the first sentences and the described situations are therefore temporally contained within the first one. Hence Dowty proposes that the advancing of narrative time should be merely seen as a default which can be overridden provided other context knowledge suggests a different temporal relation. This problem with respect to the interpretation of a narrative discourse is discussed extensively by Lascarides and Asher (1991a).

A further problem was mentioned by Spejewski (1994, p. 12). She shows that also states can be seen as a further elaboration of an accomplishment or achievement.

Concluding remarks The TDIP provides an attempt to interpret a narrative discourse by a sequence of reference times, but it cannot give the correct or the most intuitive readings in the following cases:

1. Achievement or accomplishment followed by a state or activity are described as a sequence of two reference times, although an overlapping reading is more intuitive.

2. The progressive form allows only an overlapping reading, while a sequential reading as is suggested by the TDIP is not conceivable.

3. The elaboration of a first mentioned situation causes problems for the TDIP, since the precedence relation between the two reference times has to be overridden and therefore seen as a default interpretation for a narrative discourse.

The more intuitive reading for cases 1 and 2 can be derived by a system which uses a non-monotonic reasoning system. Approaches which rely on such a machinery cannot offer a preferred reading for those problematic cases, they furthermore allow an explanation for the elaboration of a first mentioned event. The following section provides a short introduction to such theories of discourse processing.

2.4.3 Defaults in discourse

This section gives a brief introduction to non-monotonic reasoning used for discourse processing. Theories using such reasoning show how the rhetorical relations can explain the coherence and the temporal structure of a narrative discourse. Lascarides and Asher (1993), for example, provide a system which uses the features of a non-monotonic reasoning system called DICE to describe the derivation of the rhetorical structure of a discourse. Another approach which combines discourse structure, world knowledge and non-monotonic reasoning in order to derive the expressed temporal structure was presented by Eberle (1991). He developed a similar system which, however, assumes a preference relation between the rhetorical relations. However, I will focus on the Segmented DRT (SDRT) developed by Lascarides and Asher (1993), because it combines a well-known semantics theory (i.e. DRT) with a theory of discourse attachment (i.e. DICE). A theory for this problem cannot be offered by Eberle (1991).

Section 2.4.3.1 provides the reader with some formal definitions, before in section 2.4.3.2 the general mechanism for deriving the correct temporal relation in a narrative discourse will be sketched. Finally, in section 2.4.3.3 some problems with these approaches will be discussed.

---

\(^3\) There are marginal exceptions like in:

(2.18) Peter gave the children the gift. They were bouncing for joy.

\(^4\) Interestingly enough, this observation cannot be made for the German translations as I will discuss in section 3.3.1.
2.4 Former Approaches

2.4.3.1 Non-monotonic reasoning

Non-monotonic logic systems have been developed in order to represent world knowledge or pragmatic maxims which seem intuitive to humans, but are impossible to express by standard predicate calculus. The following deduction is easily derived when we simply rely on our common sense. Consider the following derivation ($\rightarrow$ is the entailment relation for the monotonic predicate logic):

- Tweety is a bird.
- All birds fly.
- Penguins do not fly.
- $\neg$ Tweety flies.

However, if we add the information that Tweety is a penguin, we can also conclude that Tweety does not fly. Unfortunately, this leads to an inconsistency in our monotonic logic. The first derived assumption cannot be overridden. Our pragmatic world knowledge, on the other hand, tells us that Tweety must be a special case, since penguins are a sub-sort of birds and we can easily withdraw the conclusion that Tweety flies.

Hence non-monotonic logic systems like default reasoning (Reiter 1980) or circumscription (McCarthy 1980) have been developed and investigated since the eighties with the aim to provide a formalisation for so-called common sense reasoning.

A further development of the original default logic was proposed by Asher and Morreau (1991) (i.e. common sense entailment (CE)). The DICE system proposed by Lascarides and Asher (1993) is based on this system, but it is restricted to a propositional logic. This has an important advantage over more powerful systems, since DICE is proven to be decidable. A conditional $>_{\text{CE}}$ is introduced to represent defaults of the form $\phi \supset \psi$ (i.e. $\phi$ then $\psi$), unless there is information to the contrary.

The theory used in the next section has to be able to express the following common sense entailment principles ($\neg$ is the non-monotonic entailment relation):

- **Defeasible Modus Ponens:**
  $$\phi \supset \psi, \phi \models \psi$$
  (e.g. if birds fly and Tweety is a bird, then Tweety flies)

- **Penguin Principle:**
  $$\phi \supset \psi, \psi \supset \zeta, \phi \models \neg \zeta,$narration
  but not: $$\zeta$$
  (e.g. if penguins are birds, birds fly; penguins do not fly and Tweety is a penguin, then Tweety does not fly can be inferred, but not Tweety flies)

- **Nixon Diamond:**
  $$\neg \models (\phi \supset \psi, \zeta \supset \neg \psi, \phi, \psi \models \neg \psi)$$
  (e.g. there is an irresolvable conflict in the following: Quakers are pacifists, republicans are non-pacifists, Nixon is a quaker and republican)

2.4 Former Approaches

Although there are more common sense principles used by Lascarides and Asher (1993) I will restrict the introduction to these three, since these are the only ones used in the following.

Moreover, note that the logic proposed by Lascarides and Asher (1993) is modal, it therefore is capable of expressing axioms like “it is necessary, that if a text is a narrative, then the descriptive order of the events matches temporal order” ($\Box ((A \rightarrow \beta))$).

2.4.3.2 Lascarides & Asher (1993)

The framework by Lascarides and Asher (1993) provides a better explanation for some of the problematic cases discussed earlier. The shortcomings of the former approaches with respect to the overlapping/sequential reading of states and the elaboration of events can be overcome by SDRT, using the non-monotonic logic DICE in the following way:

Lascarides and Asher (1993) define rhetorical relations like narration, elaboration, and background as default rules which are based on our world and context knowledge. World knowledge contains general laws about typical information regarding situations (e.g. to switch off the light normally causes darkness) and rules about the derivation of the rhetorical relations (e.g. two situations described by two subsequent sentences normally indicate a narration).

The following examples which cause problems for the two previous accounts can be explained by the approach given by Lascarides and Asher (1993) ((2.13) and (2.14) are repeated here as (2.22) and (2.23)):

2.22 Mary switched off the light. The room was pitch dark.

2.23 The council built the bridge. The architect drew up the plans.

Before repeating their explanation, I will summarise the treatment of example discourses already discussed by the two former approaches, introducing the condition for the rhetorical relations narration and background.

**Narration** Lascarides and Asher (1993) assume the narration default as the most basic default. It can be derived from the information that two sentences occur in a sequence. They use an updating function $\psi$ to relate a newly processed sentence $\alpha$ to an already existing discourse $\gamma$ via a sentence $\beta$.

A rhetorical relation has to be derived for an SDR $\alpha$ in order to establish a coherent discourse:

- **Narration:**
  $$\gamma, \alpha, \beta > \text{narration}(\alpha, \beta)$$

If this discourse relation can be derived, the following axiom applies. (mc(\alpha) refers to the main eventualty described by $\alpha$ and $\sim$ is the temporal precedence relation).

- **Axiom on Narration:** $$\Box (\text{narration}(\alpha, \beta) \rightarrow \text{mc}(\alpha) \sim \text{mc}(\beta))$$

Normally a sequence of two situations can be derived for a narrative like (2.24):

---

3 The sentence $\beta$ does not have to precede sentence $\alpha$ immediately. See section 6.2.2 for the definition of open sentences which are determined by the discourse structure.

4 See Lascarides and Asher (1993) for a formal definition.
2.4 Former Approaches How to move narrative time?

(2.24) John entered Mary’s office. He sat down.

Background  However, if a *state* can be found as the second sentence, our world knowledge tells us that this kind of aspectual class normally overlaps with a preceding situati

(2.25) John entered Mary’s office. The report was on her desk.

This can be formalised by the following default:

- **States overlap:**
  \[ \langle a, \beta \rangle \wedge \text{state}(\alpha) \Rightarrow \text{overlap}(\alpha, \beta) \]

The background relation can now be derived due to the overlap information:

- **Background Relation:**
  \[ \langle \gamma, \alpha, \beta \rangle \wedge \text{overlap}(\alpha, \beta) \Rightarrow \text{background}(\alpha, \beta) \]

And finally, the following axiom confirms the temporal relation:

- **Axiom on Background:**
  \[ \Box(\text{background}(\alpha, \beta) \Rightarrow \text{overlap}(\alpha, \beta)) \]

Note that the two axioms for *narration* and *background* are incompatible. However, since the default for *background* is a more specific one than the one for *narration*, the rhetorical relation of *background* can be derived according to the Penguin Principle.

These examples were already sufficiently explained by former approaches, let us now consider the two problematic cases which involve the relation *result* and *elaboration*:

Result To explain the sequential order expressed by the situations described by (2.22) we have to take into account the world knowledge about the causal link which holds between switching off the light and being dark.

- **Light Law:**
  \[ \langle a, \beta \rangle \wedge \text{switch off}(x, \text{light}(\alpha)) \wedge \text{be dark}(\text{room}(\beta)) \Rightarrow \text{cause}(\text{on}(\alpha), \text{on}(\beta)) \]

The default rule on *result* means that if *me(\alpha)* causes *me(\beta)*, this normally implies that a *result* relation holds between the two situations. This can be derived via defeasible Modus Ponens.

- **Result:**
  \[ \langle \gamma, \alpha, \beta \rangle \wedge \text{cause}(\alpha, \beta) \Rightarrow \text{result}(\alpha, \beta) \]

Elaboration For the example discourse in (2.23) we have to assume that *me(\beta)* is part of the preparatory process of *me(\alpha)*, assuming a *nucleus* model following Moens (1987). The discourse relation *elaboration* yields therefore an inclusion of the second event into the preparatory state of the first event and, furthermore, the axiom on *elaboration* imposes further temporal constraints:

- **Elaboration:**
  \[ \langle a, \beta \rangle \wedge \text{prep}(\text{me}(\alpha), \text{me}(\beta)) \Rightarrow \text{elaboration}(\alpha, \beta) \]

- **Axiom on Elaboration:**
  \[ \Box(\text{elaboration}(\alpha, \beta) \Rightarrow \lnot(\text{me}(\alpha) < \text{me}(\beta))) \]

As for the derivation of *background* the inference can be drawn via the Penguin Principle: the more specific default overrides the more general one.

2.4.3.3 Problems

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.

The following problematic case cannot be explained by the theory of discourse modelling proposed by Lascarides and Asher (1993): an elaboration of an *elaboration* of an *event* by following the narrative time.
2.5 Former Approaches

I also would like to mention two shortcomings which can be overcome if some extensions to the existing theory are added: first, discourse sequences which involve a progressive form are not explained. If the progressive were considered as a stative, the overlapping relation could be derived. Furthermore Lascarides and Asher (1993) neglect the aspectual class of activities whose behaviour may differ from states. It is not clear whether they categorise activities as states or whether they define them as events (i.e. a bounded aspectual class).

Finally, I would like to point out the similarity which can be found with respect to the TDIP and the narration default, which applies for any narrative discourse without taking into account any further world knowledge. However, for the background default, on the other hand, this approach describes the more intuitive temporal relation of overlapping between an event and a state.

2.5 Conclusions

In this chapter the terminology and former approaches which are relevant for the investigation undertaken in this thesis have been presented. A first differentiation between the terms aspectual class, Aktionsart and aspect was given, focusing on the classification system proposed by Vendler (1967). Next, Reichenbach’s notion of a reference time was introduced. The presented approaches to discourse modelling are essentially dependent on these terms.

The theories discussed can be distinguished in the following way (cf. Moens 1987, p. 17–26):

referential theories by Partee (1984) and Hinrichs (1986) draw on the idea that only accomplishments and achievements introduce new reference times. An updating of the temporal structure is triggered by those aspectual classes, while states and activities do not invoke a new reference time.

non-referential theories expressed by Dowty’s TDIP assume a forward movement of reference time in any case, irrespective of the aspectual class. However, the semantic features of states, activities and the progressive form are taken into account to derive an overlapping for these situations.

non-monotonic approaches which rely on non-monotonic reasoning systems use the features of such systems to model defaults which reflect the rhetorical structure of a discourse. Assuming a general default (i.e. narration) the temporal precedence relation can be inferred for every sequence provided no specific knowledge overrides this first assumption (e.g. elaboration).

The review of the approaches proposed so far allows the following conclusions for a theory of discourse modelling:

- Aspectual information has to be taken into account for the derivation of the temporal relation which holds between two described situations.
- Forward movement of time in a narrative should be modelled by a reference time.

- A well defined time logic based on events, intervals and points has to be defined. In particular, this logic should be capable of expressing underspecified temporal knowledge.
- Rhetorical relations have to be stipulated to establish a coherent discourse structure. A distinction between the world/context knowledge and the derived discourse structure should be well-defined.

All former approaches show some shortcomings especially with respect to the last two mentioned criteria. I will present a theory in the following chapters which can provide some amendments regarding these requirements. After an analysis of the aspectual properties and the discourse structure expressed by a narrative in German in the following two chapters, I will introduce a time logic in chapter 5 and develop a formal approach to discourse modelling via a tree structure in chapter 6.

For the analysis of German, bear in mind that the temporal information about the situation may be presented differently in different languages. So far, discourse analyses have mainly been done for English which is a language with a clear-cut distinction between the perfective (i.e. simple aspect) and imperfective (i.e. progressive form) aspect. The question has to be raised whether German presents the temporal information to the reader in another way, since it lacks this fundamental feature. Therefore, it seems to be necessary to have a closer look at the aspectual properties of German. This will be done in the following chapter within the cross-linguistic framework due to Smith (1991).
German — a language which lacks any overt morphemes to mark aspect — will be investigated in this chapter and analysed within a cross-linguistic framework developed by Smith (1991). As a result of this, we will be able to describe how temporal and aspectual information is conveyed in German and we will understand when and how this sometimes has to be expressed quite differently in English. The findings will furthermore be used for a more elaborated analysis of short German discourse sequences in the following chapter.

3.1 Introduction

This chapter provides an analysis of the German aspect system, investigating the temporal properties expressible by this language. Furthermore this language will be compared with English regarding these properties. Previous research does not offer an appropriate account for German in this respect. One reason why German differs from English regarding the representation of situations in a narrative discourse, is the lack of any aspectual markers (e.g. the suffix -ing in English). This difference has not been given much attention. Although Eberle (1991), for example, presents a theory on temporal inferences similar to Lascarides and Asher (1993) and discusses examples in German, he does not point out this substantial difference between English and German. Since all other theories have been developed for English, we have to be careful about whether we can simply apply their analyses to German.

Former research on the German tense system did not explicitly distinguish between the two levels of aspectual class and aspect, because there is no obvious linguistic marker for this distinction. This approach seems to be justifiable as long as only German data is concerned. However, if a general theory of aspect is intended, it has to be clarified how the perfective/imperfective dichotomy corresponds to the German aspect system.

One proposal made for the German past tense — the Preterite — made by Bäuerle (1988) assumes an ambiguity with respect to the progressive form and the simple aspect in English (Bäuerle 1988). I will argue against this assumption.

In this chapter I will therefore argue for a different view of German and ask what temporal information is given by a sentence in German and how this differs from English. I will present linguistic data which suggests that the notion of a reference time cannot be used for German as it has been for English. Furthermore I will investigate translations from German to English and vice versa which will highlight the crucial differences between these two languages.

The starting point of my investigations is the work by Smith (1991) who offers a theoretical framework of aspect (or viewpoints in her terms) which can be applied to different languages. Using her notion of a neutral viewpoint and developing it further, I will present a new view on the German aspect system and argue for an open-perfective viewpoint. This newly developed concept will explain which eventualities and which of their temporal properties are described in a German discourse.

It will emerge from this chapter that the understanding of a narrative involves a whole set of different knowledge sources: aspectual information provided by the viewpoint and the aspectual class, world knowledge about a standard situation and rhetorical relations. Some of this knowledge may be non-monotonic as some earlier approaches required, but some may well be strict in every case. The next chapter will describe all these knowledge sources in more detail and will give an analysis of how they can be distinguished more precisely and how they interact to determine the temporal structure of a narrative.

The structure of this chapter is as follows:

- Section 3.2 provides an introduction to Smith’s theory of aspect. The two-component theory distinguishes two concepts: situation types and viewpoints. I will further develop Smith’s approach by investigating the features of German sentences in the Future tense and especially the Preterite (material from this section has appeared in Schilder (1995a, 1995b)).
- Section 3.3 discusses which further implications can be drawn, if we assume only one viewpoint for German. It will especially turn out that the discourse structure has to be taken into account, if we want to get a full picture of how aspectual information is encoded in German.
- Section 3.4 contains the conclusion of the chapter.

3.2 Situation types and viewpoints

The starting point of my investigations into how the German aspect system can be described is work by Carlota S. Smith (1991). She presents a theory of aspect, which is based on the investigation of five different languages, namely English, French, Chinese, Russian and Navajo.
Using her cross-linguistically motivated approach, I hope that a clearer picture will evolve with respect to what kind of temporal information is conveyed by a German narrative and what crucial differences to other languages, especially English, can be observed.

Smith (1991) presents two terms which are assigned to what she claims are two distinct phenomena in language: viewpoint and situation type. This two-level theory gives an explanation for the difference between aspectual information (a) expressed by the temporal features of a situation (i.e. Aktionsart in a Germanic tradition) and (b) understood as a view on a situation (i.e. aspect). The former is obtained from information stored in the lexical entry of a lexeme\(^1\) and the latter can be gained after applying a certain viewpoint chosen by the speaker. The following two sections provide the reader with an introduction to Smith (1991):

- **Section 3.2.1 contains the categorisation of the situation types Smith uses.**
  - In section 3.2.1.1, the linguistic tests Smith uses for English will be briefly introduced.
  - In the following section 3.2.1.2, four linguistic tests, which can be used to distinguish the different types in German, are presented. A categorisation system will be introduced and the crucial differences to English will be pointed out; in particular it will turn out that the stative/non-stative distinction is very difficult to make in German.
  - The findings of the comparison will be summarised in section 3.2.1.3.

- **Section 3.2.2 provides the reader with an introduction to the viewpoint system Smith proposes.**
  - In section 3.2.2.1, I will especially focus on her justification for a third viewpoint category, viz. the neutral viewpoint.
  - An account of the German past tense presented by B"auerle (1988) will be discussed in a subsequent section.
  - I will present my modified notion of a neutral viewpoint in section 3.2.2.3. This newly introduced concept will be backed up by discourse examples, in particular highlighting the differences between English and German discourses with respect to the expressed temporal relations.

The discussion on the aspectual properties in this section provides the basis for a further investigation of the aspectual properties in the following section 3.3. It will show in particular the need for a more discourse-oriented approach in order to explain the aspectual information expressible by German. Moreover, I will investigate in more detail how the temporal information rendered by the usage of the progressive form in English can be expressed by other means in German (i.e. paraphrase or change of situation type).

---

1. Besides the information stored in the lexical entry of the verb many other sentential constituents (e.g. object or subject NPs) may have an influence on the situation type of the sentence as a whole (e.g. Krifka 1992).

### 3.2 Aspectual Information Encoded in German

#### 3.2.1 Situation types

Smith introduces three so-called “conceptual features” of situation types which have binary values \([\_\_\_\_]\), namely static, durative and telic.\(^2\) On the basis of these features, five situation types can be distinguished, as shown in table 3.1.

<table>
<thead>
<tr>
<th>situation types</th>
<th>static</th>
<th>durative</th>
<th>telic</th>
<th>temporal schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>[+]</td>
<td>[+]</td>
<td>[-]</td>
<td>(I) — (F)</td>
</tr>
<tr>
<td>activity</td>
<td>[-]</td>
<td>[+]</td>
<td>[-]</td>
<td>I, F, ..., R</td>
</tr>
<tr>
<td>accomplishment</td>
<td>[-]</td>
<td>[+]</td>
<td>[+]</td>
<td>I, F, ..., (R)</td>
</tr>
<tr>
<td>semelfactive</td>
<td>[-]</td>
<td>[-]</td>
<td>[+]</td>
<td>I</td>
</tr>
<tr>
<td>achievement</td>
<td>[-]</td>
<td>[-]</td>
<td>[+]</td>
<td>… (R)</td>
</tr>
</tbody>
</table>

Table 3.1: Smith’s situation types and their temporal schemata

Each of the situation types has a temporal schema associated with it, indicating the nature of their initial points (I), their final points (F) and their internal structure (— refers to an unstructured and … to a structured phase).

As one can see from table 3.1, only states possess an undifferentiated period of time during which the state predicate holds, while all the other types have an internal structure, provided they possess a duration.

Brackets indicate a non-definite initial and final point, as this is the case for states. According to Smith, these points are not part of the state itself. They have to be introduced by an explicit change into or out of the state. Activities, however, have a definite initial point according to Smith (1991).

R denotes a result state, which may not be present for every situation. The dots in the schema for achievements represent preliminary and resultant stages (…). According to Smith, these stages are focussed on by the imperfective viewpoint provided this is possible (e.g. arriving).

Some of Smith’s example sentences for English are given in (3.1):

\(^2\) In the following I will use stative instead of static in order to use confusion with the use of the term stative in chapter 6.
3.2 Aspectual Information Encoded in German

Situation types and viewpoints

(3.1) a. Sam owned three peach orchards. (state)
b. Lily swam in the pond. (activity)
c. Mrs Ramsey wrote a letter. (accomplishment)
d. Lily knocked at the door. (semelfactive)
e. Mr Ramsey reached the lighthouse. (achievement)

This classification of situation types is similar to the one introduced by Moens (1987) who developed the nucleus model for describing certain parts of a situation (cf. section 2.2 on page 9).

In what follows, some of the linguistic tests Smith uses for English will be briefly presented. The ensuing section contains the four tests I will apply to German data in order to obtain the same situation types introduced earlier. I will focus only on four tests which are necessary to differentiate between these five situation types. A decision tree in figure 3.1 reflects, how the five situation types can be determined. A similar representation can be found in Androutsopoulos (1996).

3.2.1.1 Situation types following Smith (1991)

Smith (1991, p. 228–238) discusses how the five situation types can be distinguished in English. I will repeat here some, but not all, of the tests she describes.

Simple Present Test This test distinguishes between *stative and *non-statival. When the simple present tense is used for a state, it refers to a particular situation. All the other situation types combined with this tense indicate a habitual reading, as Smith’s example sentences show:

(3.2) a. John loves Mary. (+stative)
b. Sam strolls in the park. (habitual ⇒ −stative)
c. Tom eats a sandwich. (habitual ⇒ −stative)
d. Della taps on the desk. (habitual ⇒ −stative)
e. Tony shatters the glass. (habitual ⇒ −stative)

Expressions of Duration The following two tests distinguish between durative and punctual situation types (+durative). According to these tests instantaneous (i.e. achievements and semelfactives) fulfill the point criterion, whereas durative (i.e. accomplishments and activities) situation types do not: aspectual verbs which require a duration like to stop or durational adverbials are only compatible with a shifted interpretation of these former two situation types. They have to be seen as a multiple-event activity. The following example sentences are not grammatical for a single event reading:

(3.3) a. *We stopped reaching the top. (⇒ −durative)
b. *I knocked for an hour. (⇒ −durative)

Another test Smith does not mention works with respect to time point adverbials: achievements and semelfactives can clearly be combined with such an adverbials, whereas activities and accomplishments can only be reinterpreted as inceptive, if they are not ungrammatical:

(3.4) a. We reached the top at 2 pm. (⇒ −durative)
b. I knocked at midnight. (⇒ −durative)
c. Mary ran at 11 am. (⇒ +durative)
d. *Tom built a house at midday. (⇒ +durative)

The following two tests are used to single out the two telic situation types:

Time-Span Adverbials Such adverbials as in two hours can be felicitously combined with achievements in order to get an ingressive interpretation, which focuses on the duration it takes to reach the completion point. Semelfactives, on the other hand, are incompatible with this kind of adverbials:

(3.5) a. We reached the top within two hours. (⇒ +telic)
b. *I knocked in two hours. (⇒ −telic)

Durational Adverbials Adverbials denoting a duration like for two hours can be combined with activities, whereas accomplishments do not go with this adverbial type, unless an iterative reinterpretation can be found like in (3.6d).

(3.6) a. Sam strolled in the park for three hours. (⇒ −telic)
b. *Tom ate a sandwich for three hours. (⇒ −telic)
c. *Mary climbed the mountain for three minutes. (⇒ +telic)
d. Mary climbed the mountain for years. (iteration ⇒ −telic)

3.2.1.2 Situation types in German

The linguistic tests discussed in the previous section were mainly developed for English (Vendler 1967; Dowty 1979). The stative/non-stative distinction seems quite difficult to make. Nevertheless, I will present tests which can be used to obtain the categorisation for the five different situation types in German as well, discussing why some tests for English do not lead to the same classification in German.

I will discuss the four following tests: the combination with gerade (‘just’), point criterion, the combination with time-span and durational adverbials (see figure 3.1).

Usage of gerade A test similar to a syntactic test in English with respect to the progressive form can be applied to German as well. In English, states cannot be combined with the -ing suffix. In German, the use of the particle gerade leads to a similar effect:
3.2 Aspectual Information Encoded in German

To sum up, states can be distinguished from the other four situation types by testing on the compatibility with gerade. If the sentence allows only a marginal reinterpretation involving a change of state, the situation described by the sentence is a state.

**Point Criterion**

The following criterion differentiates between instantaneous and durative situations. Semelfactives and achievements denote situations which possess only a very short duration — they are perceived as punctual — whereas activities and accomplishments refer to a longer period of time.

In English, the test with time point adverbials (e.g. at 2 pm) can distinguish between these two classes, because the durative situation types are either not compatible with this sort of adverbial (i.e. accomplishments) or an ingressive reinterpretation is required (i.e. activities).

Conversely, German allows the combination with a time point adverbial for these two situation types. Activities are always acceptable with this adverbial, while accomplishments sound sometimes a bit odd (i.e. (3.8d)).

(3.8) a. Johann ging um 3 Uhr spazieren.
    *John strolled at 3 pm.

    b. Peter fuhr um 3 Uhr nach Hamburg.
    *Peter drove to Hamburg at 3 pm.

    c. Maria baute um 3 Uhr ihre Sandburg.
    *Mary built her sand castle at 3 pm.

    d. Maria baute um 3 Uhr ihr Haus.
    *Mary built her house at 3 pm.

It seems that this test works differently in German, since we cannot simply rely on the acceptability judgement for these adverbials. But we can in all cases add another time point adverbial like *und um 4 Uhr* provided the situation lasted that long.

Interesting enough, this test sheds some light on the different behaviour of English and German regarding activities and accomplishments. They can obviously be used in a more flexible way in German, whereas in English a closed situation is presented for accomplishments and only an ingressive reinterpretation for activities is conceivable. How this difference can be explained will be the purpose of the following section 3.2.2.

But it may be concluded that the point criterion allows us to distinguish between the instantaneous and the durative situation types, although we have to be more careful for German than in English where the acceptability test of of time point adverbials is sufficient.

**Time-Span Adverbials**

A time-span adverbial like in zwei Stunden can be combined with an achievement, but note that the time span described by this adverbial is usually the period of time before the event takes place:

(3.9) Johann erreichte den Gipfel (innerhalb von) zwei Stunden.
    John reached the summit (within) two hours.

---

Figure 3.1: The decision tree for the German situation types
3.2 Aspectual Information Encoded in German

3.2.1 Aspectual Information Encoded in German: Situation types and viewpoints

**Semelfactives**, on the other hand, cannot be combined with this kind of adverbial:

(3.10) *Maria hustete innerhalb von zwei Stunden.*
Mary coughed within two hours.

Sentence (3.10) could be amended by adding *zweimal* (‘twice’) though, but without this count adverbial the sentence sounds rather odd.

In short, *achievements* can be combined with time-span adverbials like *innerhalb von zwei Stunden*, whereas *semelfactives* cannot.

**Durational Adverbials** In order to distinguish between *activities* and *accomplishments*, we can use the test with a durational adverbial:

(3.11) a. Johann ging zwei Stunden lang spazieren.
John walked for two hours.

b. Johann ging zwei Stunden lang zur Bushaltestelle.
John walked to the bus station for two hours.

However, note that (3.11b) is not as bad as (3.10). As already pointed out in the previous section, *accomplishments* appear to be as clearly distinguishable as their equivalent in English. But for distinguishing *activities* from *accomplishments* (3.11) can be still seen as a minimal pair.

Summarising, the two remaining situation types *activities* and *accomplishments* can be differentiated as follows: *activities* can felicitously combined with durational adverbs like *zwei Stunden lang*, while *accomplishments* are less acceptable with this kind of adverbial.

3.2.1.3 Concluding remarks

For English and German, I presented four tests in order to obtain the five different situation types Smith uses for her theoretical framework. Note that there are also other problems I did not discuss (e.g. *imperfective paradox*). It should not come as a surprise that tests or problems discussed in the literature which rely on the *progressive form* cannot simply be transferred to German. But I was able to create a test with respect to the usage of *gerade* which leads to a clear distinction between *stative/non-statute* sentences in German.4

Another interesting difference should be stressed as well: adverbials which refer to a point in time can be combined with almost all situation types. In the English simple past, this adverbial construction allows only an inceptive reading of *activities* and is ungrammatical for *accomplishments*. One first conclusion I would like to draw from this observation is that the temporal structure of a situation is more easily accessible in German than it is in English.

3.2.2 Viewpoints

In this section I will present the crucial second part of Smith’s two-component theory of aspect, compare it with a proposal for the German Preterite made by Bäuerle (1988) and offer a further elaborated version of Smith’s *neutral* viewpoint, discussing German data on a discourse level.

---

4 But notice that a sentence containing this particle does not refer to a durative situation, hence this construction cannot be considered to be a *progressive form* in German.

---

3.2.2.1 Smith’s point of view

Smith postulates three different viewpoints based on her cross-linguistic investigation. According to her theory a viewpoint can offer a view on a certain part of a situation’s temporal structure. For example, the *perfective* view makes available the whole of the situation including...
3.2 Aspectual Information Encoded in German

Situation types and viewpoints

The imperfective viewpoint on an event works in the very same way. Uttering a sentence in the progressive form like Peter was walking to the beach, we cannot say for sure that Peter actually reached the beach.6

Two viewpoints correspond mainly to the well-known opposition perfective/imperfective. However, Smith also argues for a so-called neutral viewpoint which contains the initial point and at least one internal stage. She argues that aspectually vague sentences, which have neither a perfective nor an imperfective morpheme, should be analysed as having the neutral viewpoint (Smith 1991, p. 119). Moreover, the theory she developed can be extended to languages like Finnish and Eskimo. Her claim is hence backed up by empirical and theoretical reasons.

<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>Schema</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperfective</td>
<td>I./////...F</td>
<td>shows no end points</td>
</tr>
<tr>
<td></td>
<td></td>
<td>spans an internal interval</td>
</tr>
<tr>
<td>Perfective</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>includes end points</td>
</tr>
<tr>
<td></td>
<td></td>
<td>presents the whole situation</td>
</tr>
<tr>
<td>Neutral</td>
<td>I.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>includes initial point and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>first internal stage</td>
</tr>
</tbody>
</table>

Table 3.2: The three viewpoints according to Smith (1991)

The imperfective viewpoint in the French future tense in order to show that these aspectually ambiguous constructions can be categorised neither as imperfective nor perfective, because they can provide either an open (i.e. progressive form in English) or a closed (i.e. simple aspect) reading:

(3.12) Jean chantera quand Marie entrera dans le bureau.
John will sing when Mary will enter in the office.
John will sing/be singing when Mary enters the office.

Although an inceptive reading (i.e. closed reading with the initial point) is clearly preferred, an alternative reading where Jean will already be singing when Marie enters, is available as well. It appears that the preference we may have for a certain reading is due to our world knowledge. An example which leads more naturally to an open reading is given in (3.13).

(3.13) Jean dormira quand Marie entrera dans le bureau.
John will sleep when Mary will enter in the office.
John will sleep/be sleeping when Mary enters the office.

Smith (1991, p. 121) concludes from this data that the French future tense can neither be categorised as an imperfective nor a perfective and hence a different view is needed and she concludes that this one should be called neutral.

Secondly, another example regarding achievements seen from a neutral view is given by Smith. The neutral viewpoint has only the initial boundary of a situation in focus and hence cannot refer to any preliminary stages (cf. the temporal schema for achievements in table 3.1 on page 31 indicated as ...). Taking this consideration into mind, Smith consequently claims that sentence (3.14) is contradictory which is indicated by ².

(3.14) ² Le cheval gagnera la course mais il ne gagnera pas.
The horse will win the race but he will not win it.
The horse will be winning the race but he won’t win.

Her argumentation continues with the claim that the English translation, on the other hand, seen by an imperfective view is not contradictory. The preliminary state of such an event will be focussed by the imperfective viewpoint and a marked reading will be obtained, according to her.

The findings of her investigation suggest that the preliminary stages are not available for the neutral viewpoint, whereas the imperfective one allows these marked readings in some cases.

Finally, I would like to highlight a possible confusion which can be caused when the term neutral is interpreted as neither perfective nor imperfective and hence this viewpoint is understood as a superclass of the other two viewpoints. According to Smith, this is not the way this viewpoint has to be seen. The neutral viewpoint is defined as weaker than the perfective one, since it allows open readings (i.e. the end point can be overridden). But it is also stronger

6In contrast to the spatial example described we can conclude that he must have set off sometime earlier (i.e. a beginning point of the event must exist). However this is presented by the speaker as not included by the viewpoint which has certain effects on the discourse structure. That is, a situation described by the progressive form does not move narrative time forward. It functions as a background and gives an overlap reading.

²See Smith (1991, p. 119-125) for a general discussion about the neutral viewpoint and further linguistic data in Chinese and Navajo.
than the imperfective viewpoint, because it permits closed readings as well (i.e. the situation is presented as completed).

Although German at first appears to need an underspecified superclass as argued for by Bäuerle (1988), for example, in the following section I will show that this claim cannot be upheld. It will especially emerge that an analysis on a discourse level is required which allows us to determine the intended reading via the rhetorical relations.

3.2.2.2 Bäuerle’s perspective on the German Preterite

The following discourse example is the starting point for Bäuerle’s argumentation (Bäuerle 1986, p. 131):

(3.15) a. Der Angeklagte fuhr nach Hause. Dort trank er ein Glas Trollinger.
   The defendant drove home. There he drank a glass of Trollinger.

b. Der Angeklagte fuhr nach Hause. Am Lustnauer Tor hatte er einen schweren Unfall und musste ins Krankenhaus eingeliefert werden.
   The defendant was driving home. At the Lustnauer Gate he had a serious accident and had to be admitted to the hospital.

In (3.15a) the sentence *Er fuhr nach Hause* refers to a completed event and consequently contains an end point. For the English translation the simple aspect has to be chosen. However, in (3.15 b) the same sentence does not refer to a situation which includes the end point. Hence the English translation is only correct if an imperfective view is used.7

Based on the data in (3.15) Bäuerle (1988) concludes that the German Preterite is ambiguous with respect to a perfective and imperfective viewpoint (or in his terms: the single and expanded event reading). However, he has to point out that the sentence *Er fuhr nach Hause* on its own in (3.15) clearly has a preferred perfective reading. The ambiguous behaviour of the Preterite would therefore not be very balanced, and this needs a further explanation Bäuerle does not provide.

A similar example with a fatal result was discussed by Eberle (1988), however not involving a locative PP which indicates a goal for the movement verb:

(3.16) Hans überquerte die Straße. Ein Lastwagen schoß auf ihn zu und überrollte ihn auf der Höhe des Mittelstreifens. Er starb auf der Stelle.
   Hans was crossing the street. A lorry approached him at speed and ran him over in the middle of the road. Death was instantaneous.

The explanation he gives differs from the one Bäuerle can offer and involves a more technical definition of how we want to represent the discourse referents. Within Discourse Representation Theory a so-called embedding function f is required to map discourse referents onto entities in a model M. According to this function, the progressive reading of an accomplishment in English would derive a so-called “stop-point” instead of the normally assumed “culmination”.8

The formalisation of how this distinction can be put is therefore more precise than the description Bäuerle gives us. Additionally, Eberle (1988, p. 163) claims that “the question whether a corresponding expression in German is to be read as the progressive of an accomplishment or as a real accomplishment will not necessarily be decided on the sentence level.”

The subsequent discourse therefore has to provide more information as to whether the final event of the situation has to be interpreted as stop-event or culmination. We can conclude from this that Eberle’s approach, although providing a formalisation of the two possible readings, does not offer anything more. The actual interpretation for a single sentence is left open until further context information is added, as in Bäuerle’s account.

But we could improve Bäuerle’s and Eberle’s approaches by assuming that the perfective view can be seen as the default case for German and only a particular context might trigger a marked imperfective reading. By doing that, we can expect that a background reading is available for such cases where context knowledge indicates that reading. Bearing furthermore in mind that “imperfective sentences tend to have a backgrounding function” (Smith 1991, p. 130), the German translation of (3.17) should render the same temporal relation:

(3.17) The defendant had an accident. He was driving home (at this time).

Since the imperfective view explicitly excludes the beginning point, an overlapping is the most natural reading for (3.17). However, a direct German translation can only express two subsequent events rather than an overlapping of the two situations. First the defendant had an accident and then he drove home:

(3.18) Der Angeklagte hatte einen Unfall. Er fuhr nach Hause (’zu der Zeit’).

Adding the PP *zu der Zeit* (’at this time’) the situation described by the second sentence will be understood as a background for the first mentioned event, but this discourse sounds very awkward and the continuation with a state in (3.19) is clearly preferred.9

(3.19) Er war auf dem Weg nach Hause.

Similarly, Eberle’s example discourse cannot be described by such a text:

(3.20) Ein Lastwagen schoß auf Peter zu. Er überquerte die Straße (’zu der Zeit’).

The whole discourse is rather awkward and can only be amended by an explicit reference back to the first mentioned situation by während (’while’) or als (’when’). Interestingly enough, if we added gerade to the second sentence, we can actually draw the conclusion that the situation described by the first sentence is backgrounded by the second described situation:

(3.21) Ein Lastwagen schoß auf Peter zu. Er überquerte gerade die Straße.
The effects we can get by *gerade* are to a certain extent similar to the *progressive form*, but note that adding *zu der Zeit* or *Zeitpunkt* is still odd. See section 3.3.4.1 for a more detailed discussion.

Having shown that the German Preterite cannot provide a background for an earlier mentioned event, I will now investigate the *progressive form* in English, which always supports this backgrounding function in a discourse. It will turn out that this feature can furthermore be used to show that the translation of (3.15b) is not totally faithful to the German original text. Consider the following elaborated text:

(3.22) Der Angeklagte konsumierte einige Gläser Bier in einer Kneipe. Er fuhr nach Hause. Am Lustnauer Tor hatte er einen schweren Unfall. . .

The defendant consumed several glasses of beer in a pub. *He was driving home.* At the Lustnauer Gate he had a serious accident...

(3.22) shows that the German Preterite includes a definite initial point, since it allows narrative time to move, while the English *progressive form* explicitly excludes both end points (i.e. the final as well as the initial boundary) of a situation.

In short, the data presented shows that a background reading is not obtainable for the German Preterite, even when that reading is forced by a temporal anaphora like *zu der Zeit.* An *imperfective viewpoint* like the *progressive form* in English readily gives such a background reading. Note that this feature cannot be found in the German text in (3.22) where a forward movement of narrative time is expressed by the second sentence. Thus we cannot say that the German Preterite is ambiguous with respect to the *imperfective/perfective viewpoint*.

Although the conclusion that this tense is ambiguous with respect to the *imperfective/perfective viewpoint* has been proved to be wrong, the question remains how the discourse example in (3.15) can be explained. The data demands a different explanation.

Note that the reason why the *progressive form* became necessary for the English translation has to do with the lack of inclusion of the end point of the *driving home*-situation, which was inferred by the subsequent context. A different continuation in (3.15) allows another interpretation and the *simple aspect* can be used as the following discourse shows:


The defendant consumed several glasses of beer in a pub. Then he drove home. At the Lustnauer Gate he had an accident and he fled the scene (without waiting for the ambulance). The police, however, were able to arrest him at his house, because a witness had written down his registration number.

Interestingly enough, this discourse example can be translated into English without using the progressive form. The third and the fourth sentence elaborate the *driving home*-situation. This observation, that the sentences provide the reader with more detailed information about the first mentioned situation, allows us to solve the puzzle. Discourse sequences like (3.23) and (3.15b) reflect a situation that is described with more detail by the subsequent text. However, one important difference between German and English has to be highlighted: in German an *accomplishment* can be further elaborated even by overwriting the natural end point of the situation, while this is not possible in English. Since the *simple aspect* includes the end point, in a context like the one in (3.15b) the *progressive form* is preferred. Note that this furthermore leads to a different rhetorical structure for the English translation. While in German an elaboration is used, the *progressive form* in English indicates a background relation.

It may be concluded from the investigated data that Bäuerle’s generalisation cannot be upheld. His data can be better explained by an elaboration of the *driving-event*.

In short, the data presented shows that a background reading is not obtainable for the German Preterite. The first assumption that van Beethoven finished composing the sonata is not possible for the German. The second assumption that van Beethoven finished composing the sonata. The *simple aspect* would be correct with the *simple aspect*. This is obviously due to the fact that this kind of construction can be more freely interpreted even in English.

An *accomplishment* like *to compose a sonata* would be a better candidate. Consider the following discourse:

(3.24) Es war ein wunderschöner Morgen. Van Beethoven komponierte die Sonate für den Herzog in seinem Musikzimmer. Der schiele Gesang der Straßenmusikanten ließ ihn jedoch keinen klaren Gedanken fassen, so daß die Arbeit nicht fertiggestellt werden konnte.

It was a lovely morning. Van Beethoven was composing the sonata for the duke in his music room. The terrible singing of the street musicians, however, didn’t let him hear himself think so that the work couldn’t be finished.

In English, the *progressive form* has to be chosen, because the continuing texts overrides our first assumption that van Beethoven finished composing the sonata. The *simple aspect* would have presented a closed and completed situation containing the natural end point of it. The *simple aspect* would have presented a closed and completed situation containing the natural end point of it. **Summarising,** the proposals Bäuerle and Eberle gave does not explain the data discussed in this section. The discourse in (3.15b) can be better described as an elaboration of the *driving-situation*. I have furthermore shown that backgrounding is not possible for *accomplishments* in German.

The conclusion we can draw is that a notion for the German Preterite is required which predicts a *perfective reading* as a default case, but allows an overwriting of the natural end point of an *accomplishment* provided context knowledge permits that. The following section introduces such a notion, which is an improved definition of the *neutral viewpoint* stipulated by Smith (1991).
3.2 Aspectual Information Encoded in German

3.2.2.3 German and the open-perfective viewpoint

In this section I point out what Smith does not consider in her analysis of the neutral viewpoint by investigating which viewpoint is appropriate for the German Future tense and the Preterite.

First, I will apply the tests for the neutral viewpoint developed by Smith to the German Future tense and to the Preterite. In particular, the results for the latter will be more interesting, since the past tense of all the languages Smith investigated possess more than one viewpoint. Moreover, I will extend Smith’s approach with respect to discourse structure which will provide us with more insights about the German aspect system and I will introduce the open-perfective viewpoint as an improved notion of Smith’s neutral viewpoint.

The following section contains the analysis of wenn-sentences for the German Future tense. I will also discuss how achievements behave and whether the preliminary stages can be focussed on in German or not. The results are the same as Smith’s for the French Future tense. Nevertheless, I will take into account an alternative explanation proposed by Mellor (1995) and compare it with Smith’s.

The same tests will be applied to the Preterite in the next section. As for the Future tense the same results can be concluded for this tense. Moreover, I will apply another test suggested by Smith to German and point out the differences between English and German.

Later, in the section 3.3.1, I will present some more discourse examples which will show how the features of the open-perfective viewpoint can be described on a more complex level.

Future As explained earlier for the French Future tense on page 39 the neutral viewpoint can offer an open as well as a closed reading. The following test shows the same results for German.

(3.25) Wenn Maria morgen zurückkommt
When Mary tomorrow comes-back

When Maria comes back tomorrow,…

a. wird die Uhr 100,- DM kosten. (state)
will the clock 100,- DM cost.
The clock will cost 100,- DM.
b. wird Hans den Rasen mähen. (activity)
will Hans the lawn mow.
Hans will mow/be mowing the lawn.
c. wird Hans die Sonate komponieren. (accomplishment)
will Hans the sonata compose.
Hans will compose/be composing the sonata.
d. wird Hans husten. (semelfactive)
will Hans cough.

Preterite The same test can also be applied to the Preterite. Note that in the past tenses als has to be used as a translation for when, wenn is only correct for the present and future tense.

(3.27) Als Maria gestern zurückkam,…
When Maria came back yesterday,…

a. kostete die Uhr 100,- DM. (state)
the clock cost 100,- DM.
b. mähte Hans den Rasen. (activity)
Hans was mowing/mowed the lawn.
c. komponierte Hans die Sonate. (accomplishment)
Hans was composing/composed the sonata.
d. hustete Hans. (semelfactive)
Hans was coughing/coughed.

Hans will cough/be coughing.
e. wird Hans einen Fehler einsehen. (achievement)
will Hans his mistake recognize.
Hans will recognise his mistake.

With respect to the different situation types this test needs further explanation. For all durative types (i.e. states, activities, accomplishments) an open or closed interpretation of the situation is possible. Semelfactives allow a simultaneous reading, but a reinterpretation as an iteration is conceivable as well.

According to Smith’s description of the neutral viewpoint discussed earlier achievements are not applicable for a reinterpretation which focuses on the preliminary state. As a result sentence (3.25e) only allows a closed reading. This test shows that the German Future tense cannot be categorised according a imperfective/perfective dichotomy. The data suggests instead that the German Future tense has to be described by a more flexible viewpoint. The reader can choose between two readings. Either she has access to the internal structure of the situation (i.e. open reading) or she can refer to the beginning point and assume that the situations start at the same time (i.e. closed reading).

Note that this choice is not given for the achievement in (3.25e) and similarly to the French example in (3.14) the conjunction in (3.26) is contradictory:

(3.26) Das Pferd wird das Rennen gewinnen und es wird es nicht gewinnen.

In short German wenn-sentences in the future tense express an ambiguity with respect to an open and a closed reading unlike English when-sentences. The choice between the progressive form and the simple aspect offers two different readings regarding the temporal relation between the described situations.

In German wenn-sentences the preferred interpretation may differ depending on the native speaker’s intuition. To define a semantics of wenn is beyond the focus of this chapter. I therefore neglect the different effects especially semelfactives can have with respect to the temporal ordering of the main clause event in a wenn-sentence.

In German wenn also possesses a conditional meaning (i.e. if), which I will ignore here.

10 The preferred interpretation may differ depending on the native speaker’s intuition.
12 To define a semantics of wenn is beyond the focus of this chapter. I therefore neglect the different effects especially semelfactives can have with respect to the temporal ordering of the main clause event in a wenn-sentence.
3.2 Aspectual Information Encoded in German  
Situation types and viewpoints

e. sah Hans seinen Fehler ein. (achievement) 
Hans (*was recognising)/*recognised his mistake.

To sum up the results of this test, two readings for an al- sentence with the German Preterite are available, unless the situation type of the main clause event is an achievement. The focus on the initial point by this viewpoint does not allow the two different readings for this situation type, since it does not make available any internal structure.

A further test will show another interesting feature of the neutral viewpoint. Following Smith (1991, p. 106) I combined German sentences of all situation types with a clause stating that the actual situation continues. Smith’s exploration of the simple aspect expressing the perfective viewpoint in English proved that this view encompasses the final point of a situation, unless the situation is a state like in (3.28 a):

(3.28) a. John loved Mary and he may still love her. 
   b. John mowed the lawn and may still be mowing it. 
   c. John coughed and may still be coughing. 
   d. John composed the sonata and may still be composing it. 
   e. John left the pub and may still be leaving it.

For German the following picture emerges:

(3.29) a. Hans liebte Maria und liebt sie wohl immer noch. 
   b. Hans mähte den Rasen und mäht ihn wohl immer noch. 
   c. Hans hustete und hustet wohl immer noch. 
   d. Hans komponierte die Sonate und komponiert sie wohl immer noch. 
   e. Hans verließ die Kneipe und verläßt sie wohl immer noch.

A static situation in German like (3.29a) does not have any problems with this test, because this situation type does not have any intrinsic end points, as in English. In contrast to English activities containing an arbitrary end point are not contradictory. For the semiactive a habitual or iterative reinterpretation is conceivable. An accomplishment seems unacceptable to most native speakers, but compared with an achievement this type is at least slightly better. In addition to Smith’s explanation I would like to consider an alternative account by Mellor (1995) as well. Note that only a few achievements in English allow the combination with the progressive form like arriving or reaching the summit. Moreover, Smith’s argumentation does not provide an explanation for why, on the other hand, achievements like to find or to recognise, which cannot be found with the progressive, do not possess such preliminary stages. A more plausible explanation is given by Mellor (1995). He observes that sometimes one can ‘focus in’ on the internal structure of an achievement which makes a progressive form available. This is, for example, the case for arriving or leaving, but not for *recognising and *finding. Mellor (1995) points out that not all culminations allow access to their internal structure and hence not all take the progressive. A leaving-situation, for instance, can be conceptualised either as an instantaneous or durative event depending on whether the

author wants to focus on the internal stages of this situation. On the other hand, it is hard to imagine any internal structure for to notice.

This doesn’t seem to be the case for German, since an accomplishment will be presented as closed in any case. 

An achievement which can be focussed in on (e.g. leaving) shows a different behaviour with respect to overwriting the endpoint in German.

(3.30) Als Maria gestern zurückkam, verließ Hans das Haus. 
   Aber sie konnte ihn überzeugen zu bleiben.

When Mary came back yesterday, Hans was leaving the house (Hans left the house). 

But she was able to convince him to stay.

In German the discourse sounds odd, whereas in English we can chose between the progressive form and the simple aspect. The former one is allowed, whereas the later one renders the same contradiction as in German.

We can observe that the focus on the preliminary stages of an achievement is not allowed for the neutral viewpoint, if we followed Smith’s explanation for this phenomenon. Or if we accepted Mellor’s description, we can say that it is not possible to focus in on the internal structure of the situation. I would like to stress that future research is needed here to clarify the interaction of the progressive form with achievements, but note that both views are compatible with the notion of a neutral viewpoint. 

We conclude from this test that the neutral viewpoint allows an end point of the situation, but does not enforce this information like the perfective in English does. Therefore an activity which merely has an arbitrary end point leaves open whether the situation came to an end or not. Accomplishments, on the other hand, provide the information about a definite end point via our knowledge about the situation type and also present this to the reader of these sentences. Achievements, which are punctual, must include the final point seen by the neutral viewpoint and a cancellation of this point is not conceivable at all.

Let’s now describe how this data can be explained in more detail with the neutral viewpoint. On the one hand, states and activities fit nicely into the required schema. All the inferences regarding the end point have to rely on the knowledge we have about the situation type (cf. table 3.2). States do not possess an intrinsic end point and activities merely possess an arbitrary end point according to Smith’s description of the temporal schemata on page 31. Hence the information regarding the end point can easily be overwritten. Note furthermore that the results for semelfactives and achievements are in agreement with the assumption of a neutral viewpoint. Because of the punctuality of these situation types the end point can be derived from the focus on the initial point of the situation. On the other hand, accomplishments behave quite problematically with respect to the required overwriting of the end point. This type contains a natural end point which cannot easily be overridden (cf. (3.29d)). The temporal schema given by Smith leaves open what conclusions can be drawn with respect to the end point. In order to explain the data in (3.29), we have to show how the information about the natural end point comes into play and what kind of inferences we can draw.
3.2 Aspectual Information Encoded in German

It will be shown for accomplishments that the knowledge of an end point may only be over-written provided relevant information can be inferred from the context which is very difficult to obtain from a single sentence containing only information about a single situation. I therefore assume that the situation type provides only default information which cannot sufficiently be overridden in (3.29d). Hence it seems to be relevant for the processing of a sentence to consider the surrounding context. Tests like in (3.29) investigate only sentences which are not embedded within a context. A plausible situation where this sentence could have been uttered has to be made up by the reader. The accomplishment in (3.29d), for example, was only acceptable by an informant, when a specific context could be imagined. Hence an updating of the default end point of an accomplishment may only be provoked, if further information from the context or world knowledge can be obtained.

Activities, on the other hand, do not need more context knowledge for their termination. They can end at any time. Adding the information that the situation continues is consequently not perceived as contradictory in German. However, in English the end point is presented to the reader by the perfective viewpoint. Having just introduced the end point to the reader, the continuation which overrides this information must sound odd then.

Comparing this test for German with the results for the same test in English, we can stipulate the following different features of these two languages. In English, sentences (3.28b–e) are all contradictory for the simple aspect, because the perfective view includes the final point for every situation type, unless it is a state. In German, on the other hand, activities and semelfactives, which can be reinterpreted as iteration, go well with this test and only accomplishments and achievements show the same results as in English. However, bearing in mind that (3.29d) is slightly better than (3.29e) the results can be explained as follows: the contrast between (3.29b) (i.e. activity) and (3.29d) (i.e. accomplishment) is due to the default information given by the situation type. An activity has only an arbitrary end point, whereas an accomplishment provides the reader with the knowledge about a natural end point. I assume that this information is world knowledge based and should therefore be retractable provided enough information is given by the context.

Note that this conclusion can be seen as a clarification of Smith’s neutral viewpoint. I stipulate a clear distinction between the situation type and the viewpoint information with respect to the reasoning they allow. Information given by the situation type alone can be overwritten which presupposes a non-monotonic reasoning system. The viewpoint provides strict information which cannot be overridden. For instance, the end point of an activity once seen from a perfective viewpoint cannot be denied again, as in English (cf. (3.28b)).

Moreover, the data presented disproves Bäuere’s claim that the German Preterite is ambiguous with respect to the imperfective and the perfective aspect.

Finally, this investigation allows us to clarify Smith’s definition of a viewpoint. It is obviously a shortcoming of her description to define the viewpoint merely as a focus on parts or on the whole of a situation. It emerged from the discourse examples that a crucial function of the viewpoint is the commitment the speaker gives as to whether the end point has been reached or not. In English, the perfective view sets the end point14 and no cancellation is allowed afterwards.

An open-perfective view on a situation, on the other hand, only gives a confirmation of the initial point. It leaves open whether the end has been reached or not. Only the temporal knowledge provided by the situation type can provide further information which, however, may be overridden by the context. This explains why activities do not have problems with the continuation test in (3.29), whereas accomplishments require further context information which can deny the natural end point.

It is important to emphasise this difference between these two resources: The situation type can be seen as world knowledge, whereas the viewpoint is the perspective chosen by the speaker on an actual situation. She therefore confirms the existence of the end points.

A formalisation of these intuitions has to reflect this distinction.14

- The confirmation of the initial point.
  - Since semelfactives and achievements are punctual, the final point of the situation is included if seen from the open-perfective viewpoint.
  - Accomplishments may be seen from the open-perfective viewpoint as a whole event, unless the context cancels the existence of the final point.
  - Bear in mind that accomplishments and activities differ with respect to the features of the end point. An overriding of the end point of an activity can be done without further context information.

- Static sentences may trigger an open reading of an accomplishment.

The feature of the open-perfective viewpoint regarding the final end point is again represented in a slightly changed graphical representation in table 3.3 (cf. table 3.2). This figure highlights the fact that this viewpoint may focus on the end point or may not which can be verified by further context information.

<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>Schema</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-perfective</td>
<td>L...F</td>
<td>includes initial point and first internal stages</td>
</tr>
<tr>
<td></td>
<td>H/???</td>
<td>information about final point is world knowledge</td>
</tr>
</tbody>
</table>

Table 3.3: The open-perfective viewpoint revised

---

14 Provided that the situation type provides an inherent end point which is not the case for states.
3.3 Aspectual Information Encoded in German

Only one viewpoint?

However, it is necessary to investigate more how the overall discourse structure influence the inferences we can draw for these two systems. Hence the following section and in particular section 3.3.1 is concerned with a more detailed analysis of the neutral viewpoint on a discourse level. Since Smith restricts her analysis to single sentences and therefore does not consider the effects viewpoints can have in a discourse, I will especially focus on this issue. Moreover, I will investigate how activities are used in German narratives in more detail.

Note that this section will only give a first impression of what different effect we can get on the discourse level. A more elaborate analysis of German discourse sequences regarding the expressed temporal relations will be carried out in the following chapter.

3.3 Only one viewpoint?

This final section investigates in greater depth the aspectual features expressible in German. The main question this section is concerned with is what consequences the assumption of only one viewpoint has.

First, a detailed analysis of a discourse sequence containing an accomplishment and a state will describe a further effect which the open-perfective viewpoint can have. It will turn out that accomplishments are easily accessible provided a state indicates that. Note that this phenomenon is only observable on a discourse level and it shows a substantial difference between German and English.

Second, a cross-linguistic comparison of the temporal relations expressed by states will indicate that a choice between two (or more) viewpoints has a crucial influence on the temporal structure of the presented situations. Languages like English which allow only one viewpoint — only the simple aspect goes with states — offer different conclusions with respect to the intended temporal relation. This relation has to be determined by our world knowledge rather than the syntactic clues we can derive from the text. Languages like French offer a choice between an imperfective and a perfective viewpoint. Russian requires the imperfective viewpoint to be combined with states. The results obtained for the three different languages will be compared with German which does offer an open-perfective viewpoint for all situation types.

After this investigation I will focus on activities in German and show, in particular, how the findings from the previous section on the (non-)choice between viewpoints can be applied to this situation type. Finally, I will ask the question how paraphrases in German like *dabei sein zu* (‘to be in the middle of’) or *gerade* (‘just’) can render a reading which focuses on the middle of a situation, but do not exactly reflect the same meaning the progressive form in English does. I will also evaluate the question whether certain constructions like an-PPs can be seen as a progressive form for German (e.g. *Peter schrieb an einem Buch/ein Buch*). Claims by Krifka (1992), who introduced the notion nominal progressive for this construction, will be discussed.

The rest of this section is organised as follows:

• Section 3.3.1 reveals more differences between the German and the English discourse structure which can only be explained if we assume an open-perfective viewpoint for German.

• Section 3.3.2 discusses the question which influence the choice between two viewpoints has on the features given by the situation type. German allows only one viewpoint in contrast to other languages which offer the writer/speaker two alternatives in presenting the temporal information to the reader/hearer. I will compare data in English, French and Russian. A compilation of the differences observed can be found in section 3.3.2.4

• Section 3.3.3 reanalyses the situation type activities, especially contrasting with the recent view on this type by Smith (1995).

• Section 3.3.4 is concerned with a few constructions in German which somehow render a “progressive meaning”. I will describe the similarities to the progressive form in English, but also point out the differences.

  • Section 3.3.4.1 contains an analysis of the paraphrases *dabei sein zu* and *gerade*.

  • Section 3.3.4.2 discusses an-constructions which are only allowed for a small set of verbs.

3.3.1 Discourse structure

This section presents further discourse examples which can be seen as evidence for the requirement of a neutral viewpoint in German. In particular, I will investigate the effects which can be observed, when background information is expressed by an accomplishment or activity sentence. I will describe how stative predicates can lead to an open reading of an accomplishment.

Magic Moments Whether an accomplishment is described as closed or open depends very much on the context. Supplying a stative continuation makes it, for instance, possible to focus on the ongoing event. The writer signals that she wants to add further information about the first mentioned situation. As a side effect, the German discourse in (3.31) sounds rather incomplete.15

(3.31) Der Zauberer goß eine silberne Flüssigkeit in das Gefäß. Sie war in einem Krystalbecher.

The magician poured a silver liquid into the container. It was in a crystal beaker.

The second sentence allows the author to remain with the focus of the narration on the first event. Related to this phenomenon is the observation made by Sandström (1993, p. 156) that an episodic structure can be held by a state (or a progressive form) and be resumed later.

15The English discourse sequence is taken from Spijewski (1994, p. 12). Note that her example contains the simple subject as discussed on page 20.
‘If I only could paint the front door!’ she said, as the three of us went into the vicarage after Evensong. ‘It looks dark and drab. A vicarage ought to be a welcoming sort of place with a bright entrance.’ Julian was hanging up his biretta on a peg in the narrow hall. Next to it hung a rather new-looking Panama hat. (…) ‘A welcoming sort of place with a bright entrance,’ Julian repeated. (Pym, Excellent Women, p. 13)

The second paragraph adds to the description of the place, but the narration remains open until the speech event in the third paragraph resumes the narrative structure of the first paragraph.

A similar effect can be found in German, but not only the discourse structure will remain open, but a whole situation, even an accomplishment, can be “opened up”. As a consequence, the internal structure of the situation becomes accessible. Moreover, it sounds absolutely natural to continue the discourse in (3.31) with the information that the beaker was only half filled by the magician. In contrast, the progressive form and not the simple form is obligatory in English.

In there, he was pouring a silver liquid. It was in a crystal beaker. Suddenly he stopped pouring (more of) the liquid into the container and transformed the beaker into a pigeon.

Note furthermore that the stative sentence is necessary in order to allow the focus to be in the middle of the situation. Compare with (3.34) as a contrast to (3.31) where the second sentence can only provide redundant information, since the first described situation is interpreted as completed:

Der Zauberer goß eine silberne Flüssigkeit in das Gefäß. Er hörte auf, mehr in das Gefäß zu gießen und verwandelte den Becher in eine Taube.

To sum up, a state in German provides context information which allows us to focus on the middle of the situation. On the other hand, if the speaker wanted to express that the beaker was empty after the first sentence, the imperfective would have to be used.

Der Zauberer goß eine silberne Flüssigkeit in das Gefäß. Sie war in einem Kristallbecher gewesen.

The magician poured a silver liquid into the container. It was in a crystal beaker.

It may be concluded that this behaviour can only be explained by a neutral viewpoint. The neutral viewpoint can make accessible the internal structure of a situation, whereas the perfective view presents the situation always as completed. The imperfective viewpoint, on the other hand, does not provide any end points at all. The beginning of a narrative somehow requires a starting point, which can be derived from the German discourse in (3.31). Thus the translation into English by the progressive form sounds slightly awkward, although it expresses the correct information regarding the final end point. The paraphrase The magician started pouring a silver liquid into the container reflects more naturally the German discourse in (3.31) and (3.33). Consider a more elaborated discourse which shows this crucial difference between the two languages (cf. example (3.22) on page 42):

Der Assistent gab dem großen Zanussi ein schwarzes Gefäß. Da hinein goß er eine silberne Flüssigkeit. Sie war in einem Kristallbecher. Plötzlich hörte er auf, mehr von der Flüssigkeit in das Gefäß zu gießen und verwandelte den Becher in eine Taube.

The assistant gave the great Zanussi a black container. In there, he was pouring a silver liquid. It was in a crystal beaker. Suddenly he stopped pouring (more of) the liquid into the container and transformed the beaker into a pigeon.

It is important to stress that the second sentence of the German text moves forward the narrative time, but not the English translation which suggests somehow an overlapping reading. The German Preterite can obviously render an inceptive reading provided the reader is inclined to assume this because of context knowledge. This reading of the pouring-event, for example, is triggered by the stative sentence in (3.31), whereas in (3.34) only the information about the natural end point of an accomplishment is provided, so that this sentence reflects a completed event.

It has emerged from the data discussed that German discourse structure behaves quite differently to English. The concept of a neutral viewpoint can provide an explanation for the phenomena considered.

In particular, it may be concluded from these short discourses that the use of the Preterite in German does not commit the speaker to saying anything about the end point. This is consistent with Smith’s graphical representation of the neutral viewpoint, although she does not point that out. Every inference regarding the ending of a situation is due to the context or the default information given by the situation type.

To sum up, these discourse examples can be seen to show that the German aspect system offers an open-perfective view on every situation.

Assuming this, the following section will present an investigation of the inferences we can draw when only one viewpoint is applicable.

Having presented the open-perfective viewpoint for German as the only applicable viewpoint for this language, the question should be raised which further consequences this has. Is German a less expressive language? Which conclusions can be drawn with respect to the temporal properties presented by only one viewpoint?

I will investigate states in this section, because there are some languages which do not allow a choice between two viewpoints for this situation type and some languages which require a choice regarding the imperfective/perfective dichotomy. Moreover, some languages only allow an imperfective view on states, and others only a perfective viewpoint.
3.3 Aspectual Information Encoded in German

3.3.2.1 English

I would like to draw the reader’s attention to *state* sentences in English. This situation type cannot be combined with the progressive form (i.e. imperfective viewpoint) and offers an ambiguity between an overlapping (i.e. (3.37a)) and a sequential reading (i.e. (3.37b)):

(3.37)  

| a. Peter entered the room. Mary was angry. |
| b. Peter broke the vase. Mary was angry. |

The state of being angry does not have any definite beginning points and can therefore allow an overlapping reading like in (3.37a). However, a sequential reading is also possible as example (3.37b) shows.

Interestingly enough, *states* can only be combined with the *simple aspect*. It seems likely that the *choice* between two (or more) viewpoints has a significant influence on the temporal interpretation of the described situations. However, before I come to a final conclusion, I would like to present data from other languages which seem to suggest that, if there is a choice between viewpoints, the chosen viewpoint indicates either a sequential (i.e. *perfective*) or an overlapping reading (i.e. *imperfective*).

3.3.2.2 French

French was investigated by Smith (1991, p. 253–295) and analysed as a language which has two different viewpoints for the past tense. One interesting observation which can be drawn from her data is the contradiction of state sentences in the *Passé Composé* (p.c.):

(3.38) Jean a été malade ce matin et il est malade maintenant. 
Jean was ill this morning and he is ill now.

Oddly enough, although Smith notices that the English and French perfective viewpoints differ on the treatment of states, she concludes that the notion of the viewpoint for French has to be altered. That is, she stipulates that in French the *perfective viewpoint* imposes the end points on *states*, while in English the *simple aspect* does not make available any definite ending points for this situation type.

Smith does not see that the *choice* of another viewpoint (i.e. the *Imparfait*) for *states* may have an additional influence. Note that this viewpoint can be combined with *states* in French:

(3.39) Il croyait aux fantômes quand il était petit, et il y croit maintenant. 
He believed in ghosts when a child, and he believes in them now.

3.3.2.3 Russian

This language is particularly interesting, because *stative* verbs in Russian appear only in the *imperfective viewpoint*:

(3.40) Peter entra dans la pièce. La musique était très forte. 
Peter entered the room. The music was very loud.

These data suggest that as soon as one available viewpoint is chosen, the other one is automatically excluded and the temporal inferences for this viewpoint cannot be drawn.

3.3.2.4 The viewpoint and the *states*

After presenting data from three different languages, I would like to compare the findings with German:

(3.44)  

| a. Peter betrat den Raum. Maria war wütend. |
| b. Peter zerbrach die Vase. Maria war wütend. |

The second situation seen from the *open-perfective viewpoint* may overlap with the first mentioned situation or the whole discourse may describe a sequence. It has to be stressed that the derivation of the temporal relation is due to our world knowledge. What we can say about the German example discourse in (3.44) recalls exactly what was shown earlier regarding the English discourse examples.

---

16 There are some exceptions like Fred is being silly. See Comrie (1976, p. 36) for discussion.
17 The # indicates that one cannot refer to the same illness.
18 Note that *Passé Simple* is needed for (3.38) in order to get the contradiction, but the usage of this tense is considered to be old-fashion in French nowadays. Smith’s claim that *Passé Composé* and *Passé Simple* are virtually indistinguishable is therefore difficult to uphold (cf. Smith (1991, p. 267)).
3.3 Aspectual Information Encoded in German

<table>
<thead>
<tr>
<th>Choice?</th>
<th>View on States</th>
<th>Language</th>
<th>Temporal Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td></td>
<td>French</td>
<td>overlap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sequential</td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td>English</td>
<td>ambiguous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>German</td>
<td>ambiguous</td>
</tr>
<tr>
<td></td>
<td>I—I—I—I—I—I—I</td>
<td>Russian</td>
<td>(ambiguous)</td>
</tr>
</tbody>
</table>

Table 3.4: States in different languages

Considering the other two languages I would like to present the following conclusions regarding states:

In French the speaker has to make a choice between an imperfective or perfective viewpoint even for states. Consequently, definite end points of a state will be set if the Passé Composé is chosen. It is not necessary to change the notion of the perfective viewpoint for French as Smith suggested (Smith 1991, p. 257). She notices correctly that the “French perfective includes the end points of all situations, including statives”, but does not point out that this is due to the choice between two viewpoints even for states. Hence definite end points are assumed for the perfective viewpoint, because there was a choice between two viewpoints. If the speaker had wanted to present a state with open end point, she could have chosen an imperfective viewpoint.

Finally, the Russian data shows that states seen from an imperfective viewpoint are open according to the temporal schema of this viewpoint, which explicitly excludes the initial and final boundaries of the situation. The indication given by the imperfective viewpoint may be overridden by context knowledge. But bear in mind that this is only possible because states do not possess explicit end points (cf. temporal schema).

3.3.3 Activities revised

The previous section showed that the choice between viewpoints plays an important role for states. Since German is a language which does not offer a choice between viewpoints for all situation types especially activities, this should receive more attention. It can be observed that in (3.45) only a rather underspecified temporal relation between the two situations is described:

(3.45) Peter gab Maria ein Geschenk. Sie weinte.
     Peter gave Mary a present. She was crying/cried.

The situation described by an activity verb may overlap with a preceding event or follow it. Determining which of these two relations is the appropriate one depends on our world knowledge. But in (3.45) not enough context is given to decide whether Maria was already crying or cried after obtaining the gift. If such knowledge is not provided, we can only assume a rather underspecified temporal relation for this kind of constellation. In (3.46), however, we can conclude that the second situation follows after the first one which is due to our world knowledge:

(3.46) Maria gab Peter eine Ohrfeige. Er weinte.
     Mary slapped Peter’s face. He cried.

The temporal schemata Smith gives for the situation types unfortunately do not reflect the observation just made. For activities an initial bound was indicated, whereas for states the boundaries are not part of the situation. However, no explanation is presented which could justify such a difference between the two situation types. Whether an activity presents an initial bound to the reader, depends heavily on the context and world knowledge. In (3.46) the beginning of the crying can only be inferred, since we have the painful experience about being slapped on one’s face, whereas in (3.45) no further conclusions can be derived from the situations described by the two sentences. Note that German differs in this respect to English where a further clue is given by the mandatory choice between the imperfective and perfective view on the situation. In German the only assumption we can make has to be based on our context/world knowledge as this was shown in the previous section for states in English.

Furthermore taking into account that states and activities are cumulative, I assume that neither type can provide a definite beginning (I) or end point (F). The only difference between these types can be found in their internal temporal structure. Activities provide internal stages (i.e. ...), whereas states do not (i.e.—) (cf. table 3.1 on page 31).

Since the internal structure is somehow richer for activities, information about a beginning or end point can easily be added. Example discourses presented in recent work by Smith (1995) and by Depraetere (1995) can show that:

(3.47) In the Manchester airport, Clinton spoke to Hillary from a pay phone. When he hung up, he was serene and unclouded. He began campaigning with a new resolve.

(3.48) There was a small ivory push button beside the door marked ‘405.’ I pushed it (... and waited. The door opened noiselessly about a foot. (variant in Depraetere 1995)

In both examples the information about definite end point is added via inference which is based on the information given by the context. In (3.47) the end of the activity is indicated by the following achievement sentence. The next example in (3.48) reflects a situation where an activity is enclosed by two situations which mark the beginning and the end of the writing situation.

It may be concluded from these example discourses that the temporal information presented by an activity depends on the surrounding context. Other situations might add further information with respect to the boundaries of the activity. In cases like (3.47) or (3.48) a situation with definite end points can be presented. If no further context knowledge is provided, no inferences regarding the boundaries of the activity can be drawn. Note that in English one important syntactic clue is given by the choice between the two viewpoints unlike in German.

To sum up, Smith’s assumption that activities contain an initial bound proved to be too strong. A representation similar to the schema for states seems to be more appropriate, as the investigation in 3.3.2 has shown.
3.3 Aspectual Information Encoded in German

The new proposed temporal schema is shown in table 3.5. The crucial difference between states and activities is covered by the different internal structure.

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>temporal schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity</td>
<td>[−]</td>
<td>[+]</td>
<td>[−]</td>
<td>(I)...(F)</td>
</tr>
</tbody>
</table>

Table 3.5: The revised temporal schema for activities

3.3.4 No progression in German?

This section is concerned with the question how particular constructions in German which render a "progressive meaning" at first sight can be classified. First of all, paraphrases like gerade dabei sein and jetzt will be compared with the usage of the progressive form in English. Then I will discuss an-constructions which are defined as nominal progressive by Krifka (1992). I will show that all these constructions lack certain properties a progressive form has to fulfill.

3.3.4.1 gerade dabei sein etwas zu tun

As I have already shown earlier in section 3.2.1.2 on page 34, the particle gerade can be used to obtain a view on a situation which shows only a part of a situation. A test was designed with this particle to distinguish stative and non-stative situation types. Since states do not possess an internal structure, this particle is not compatible with this situation type.

But the usage of gerade or similar paraphrases like gerade dabei sein (‘being in the middle of’) cannot be seen as a substitute for a progressive form. The main difference is concerned with the duration of the situation. Note that the sentences in (3.7c–f) (here repeated as (3.49)) cannot be combined with a durative adverb construction like zwei Stunden lang (‘for 2 hours’):19

(3.49) a. Johann ging gerade zwei Stunden lang zur Schule.
John went just two hours long to the school.

b. Peter arbeitete gerade zwei Stunden lang im Garten.
Peter worked just two hours long in the garden.

c. *Maria erreichte gerade zwei Stunden lang den Gipfel.
Mary reached just two hours long the summit.

3.3 Aspectual Information Encoded in German

Incidentally, the test for English — the simple present test — does not convey the same result. In English, a habitual meaning is indicated by the simple present form. Because of the lack of a continuous form for German this test cannot be applied and, furthermore, most of the sentences in the simple present in German are ambiguous:

(3.50) a. Er raucht Zigarren.
He smokes/is smoking cigars.

b. Sie spielt Fußball.
She plays/is playing football.

c. Köln liegt am Rhein.
Cologne lies on the Rhine.

Moreover, this crucial difference between the English progressive form can be shown by the combination with a time frame adverbial. The progressive form, unless it is combined with the present tense, always presents a period of time, while gerade or dabei sein etwas zu tun is restricted to a point in time. Hence a combination of a sentence containing gerade, for instance, with a time interval expressed by a time frame adverbial like von 2 bis 3 Uhr (‘from 2 to 3 pm’) is not felicitous (cf. also with the examples in (3.49) on page 58):

(3.51) a. *Peter lief gerade von 2 bis 3 Uhr.
Peter was running from 2 to 3 pm.

b. *Maria hustete gerade von 2 bis 3 Uhr.
Mary was coughing from 2 to 3 pm.

c. *Paul komponierte gerade die Sonate von 2 bis 3 Uhr.
Paul was composing the sonata from 2 to 3 pm.

d. *Johann erreichte gerade den Gipfel von 2 bis 3 Uhr.
John was reaching the summit from 2 to 3 pm.

Durative situation types seen from the imperfective viewpoint in English can be combined with a time frame adverbial though. Unsurprisingly, only punctual situations have problems with this kind of adverbial.

These data show that the particle gerade or the more elaborated phrase gerade dabei sein etwas zu tun do not refer to a period of time; consequently they do not refer to the progression of a situation. These constructions rather denote a point in time. Interestingly enough, this reference time or more precisely reference point can be used to express background like in the following discourse:

(3.52) Peter betrat das Zimmer. Maria strickte gerade einen Pullover.
Peter entered the room. Mary knit just the jumper.

Peter entered the room. Mary was knitting the jumper.

Note that what seems to be like a backgrounding like it is for the English counterpart, relies on different discourse influences. In English, the lack of definite end points allows an overlap

19Note that the translation of the for-adverbial into German is not für + duration, but duration + lang.
reading, while in German the anaphoric reference by the reference point of the second situation triggers further inferences. The particle gerade refers back to the first mentioned punctual event, which can be paraphrased as there was a point of time of entering the room, which coincides with the reference point of Mary knitting the jumper. Since the knitting of a jumper takes more time than the entering of a room, we are able to conclude that the situation described by the second sentence surrounds the first mentioned punctual situation.

The only case where the usage of gerade is the same as for the progressive form in English is the present tense. In particular, when one is asked: “Was tust Du gerade?” (“What are you doing?”), normally the answer contains the particle gerade or the paraphrase gerade dabei zu:

(3.53) a. Ich laufe gerade.
I’m running.

b. Ich klopfte gerade an die Tür.
I’m knocking at the door.

c. Ich komponiere gerade die Sonate.
I’m composing the sonata.

d. Ich erreiche gerade den Gipfel.
I’m reaching the summit.

But this should not come as a surprise, since the English progressive form is simply more general. Because it always refers to a period of time, it can also be used for a point in time which is formally speaking only a very small interval without internal structure. The issue about the formal representation of time, however, will be further pursued in chapter 5. For the time being, I assume a rather informal distinction between instantaneous and durative time intervals. An instantaneous interval should not be seen as a mathematical point without any extension. Later, it will be defined as an interval without any internal stages between the end point.

3.3.4.2 The nominal progressive

This section is concerned with a notion called nominal progressive for German which was introduced by Krifka (1992) and elaborated by Filip (1989). They claim that this special form of a progressive can be seen as similar to the progressive form in English. However, it can only be derived from a limited number of verbs. Below, I will discuss whether this construction can in fact fulfill the requirements for an imperfective view or whether this can be better described as a change of situation type (i.e. from achievement to activity).

Krifka defines (3.54 b) as the nominal progressive of (3.54 a). Note that the NP sein neues Buch changes to a PP an seinem neuen Buch:

(3.54) a. Der Autor schrieb sein neues Buch.
The author wrote his new book.

b. Der Autor schrieb an seinem neuen Buch.
The author was writing his new book.

Krifka allows only verbs with an accusative object and a patient theta role θ for this transformation. θ has to be gradual. That is, the object has to be unique and a mapping from the object to the event and vice versa is required (e.g. every moment of writing a book can be mapped to a different state of the book). Furthermore the event has to be unique. That is, one cannot write the same book twice, but it is conceivable to read the same book again. Filip restricts the notion of the mapping condition further and shows that finer-grained semantic properties have to be taken into account. She points out that “(i) telicity, (ii) graduality, (iii) non-resetability of event/uniqueness of object, and (iv) incremental change, have to be attuned.” Furthermore the construction is only grammatical for durative events and it requires a gradual transition from one internal stage to the next, which is governed by a subject agent.

Consider the following cases which cannot satisfy one or more of the above mentioned constraints:

(3.55) a. Alex sah* an einer Katze.
Alex saw on a cat.

b. Berta spielte* an einer Sonate.
Berta played on a sonata.

c. Ich entdeckte* an einem Schatz.
I discovered on a treasure.

d. Marco kochte* an Spaghetti.
Marco cooked on spaghetti.

e. Die elektrische Mühle mahle* an den Kaffeebohnen.
The electric mill ground on the coffee-beans.

No incremental theme relation is given in (3.55a), furthermore the verb is a state (in Filip’s term: atelic). The object in (3.55b) is not unique. The same sonata can be played again and again. In (3.55c) no internal stages are available, since the situation type of this sentence is an achievement.

Although the conditions on graduality, uniqueness of the object and the non-resetability of the event are fulfilled for (3.55d), the sentence is ungrammatical as well. Consider that the object has gradually come into existence or to disappear. In (3.55d) the object is only internally changed. Finally, note that the an-construction is not obtainable for sentences where the subject NP is not an agent and is instead linked to the instrument or cause role like in (3.55e).

Filip claims that the an-construction can be seen as a progressive form in German. She points out that although the potential terminal point is included in the denotation of the described process, the construction itself has to be categorised as atelic, because it can be combined with durational adverbials. Hence the German an-construction allows a progressive reading, in which the inherent end point of the situation is implied, but cannot be derived as actually reached. However, she has to admit that this aspectual opposition “progressive vs. non-progressive” “is limited to a very restricted class of predicates, it cannot compensate for the lack of the grammatical expression of aspect in German.” (Filip 1989, p. 27)

Additionally, I would like to mention a similar construction rule for movement verbs. Closely related to the an-construction seem to be the in Richtung-construction (‘towards’):
3.4 Aspectual Information Encoded in German

(3.56) a. Peter fuhr nach Hamburg.
   Peter drove to Hamburg.

(3.57) Peter fuhr zwei Stunden lang in Richtung Hamburg.
   Peter was driving to Hamburg for two hours.

I would like to turn the reader’s attention to the question of whether these constructions can be considered as an imperfective view for German or not. The evidence presented to sustain the claim that the an-construction is in fact an imperfective view can be summarised as follows: the nominal progressive denotes with its an-construction an inherent end point that is implied, but not necessarily reached.

Concluding Remarks

It may be concluded from the discourse example and the two counterexamples that it is debatable that the term nominal progressive can be seen as an imperfective view. The an-construction seems to be only idiosyncratic and hence restricted to only a few cases. But can we, on the other hand, assume that the an-construction simply changes the situation type from an accomplishment to an activity? Before we can decide on this issue, we have to investigate the usage of activities on a discourse level more closely. The next chapter is concerned with these questions in more detail.

3.4 Conclusions

In this chapter, I have discussed the German aspect system and proposed a new aspectual concept for this language: the open-perfective viewpoint.

My starting point was the theory of aspect by Smith (1991) who argues for the so-called neutral viewpoint which can be applied to languages without explicit aspectual markers. Focusing especially on the German Preterite, I investigated how this approach can explain the temporal information conveyed. I was able to develop her notion further and use the open-perfective viewpoint as a clarification of her approach. The following properties were shown for this viewpoint and explained by several discourse examples:

- A clear distinction between world knowledge provided by the situation type and the strict information given by the viewpoint.
- The confirmation of the initial point for accomplishments and semelfactives and achievements:
  - The initial point does not allow a backgrounding for accomplishments.
  - Achievements and semelfactives are presented as closed situations (for their single event reading).
- The internal structure of an accomplishment is easily accessible:
  - The end point can be overridden by context knowledge.
  - A stative sentence may allow the reader to focus on the internal structure of the situation.

I argued furthermore against the claim by Bauerle (1988) that the German Preterite is ambiguous with respect to the perfective and imperfective viewpoint. In particular, discourse examples were used to show that an accomplishment seen from the open-perfective viewpoint not necessarily including the end point can still move narrative time forward.

The cross-linguistic data I presented showed that there is firm ground for concluding that the choice between two viewpoints has a crucial influence on the temporal relation. Languages which offer the choice between the perfective and imperfective viewpoint allow one to set the end points of activities (e.g. French) or activities (e.g. English).

However, the situation type of activities had to be investigated in more detail, because an interesting difference between English and German can be observed. This type allows an overlapping with a preceding event in German, whereas in English a forward movement of narrative time is assumed. In agreement with the observations made I changed the temporal schema of activities. The inferences regarding the end points are now restricted to the world/context knowledge. How these knowledge sources interact with the different situation types, however, is the subject of the following chapter.

The analysis carried out so far allows us to describe the temporal properties described by a single sentence, but a more detailed investigation of how to grasp the interplay of different knowledge sources like situation type, viewpoint, tense and world/context knowledge more precisely and formally will be described in the remaining part of this thesis. The need for this investigation became especially apparent when the temporal properties of activities were investigated.

The analysis of German discourses showed furthermore that the temporal relations are sometimes ambiguous with respect to an overlapping or sequential reading. Given this, it seems to be useful to employ a temporal reasoning system which allows us to represent underspecified or coarse knowledge. Chapter 5 explores the use of a time logic which can express underspecified (or coarse) temporal relations.

Finally, the more complex dependencies imposed by the rhetoric structure of the text have to be represented. Although I will furthermore take into account of the temporal constraints of rhetorical relation like narration or elaboration in the next chapter, a formal account how the interaction of all the different knowledge sources can be tied together while processing a discourse is still needed. A formalisation reflecting a hierarchical discourse structure and incorporating the temporal, aspectual and rhetorical influences which have to be considered will be given in chapter 6.
4.1 Discourse Sequences

Based on the investigation given in the previous chapter, we are now able to pursue the question of how the temporal relations between the described situations are expressed in German. Taking the theoretical findings of the previous chapter into account, I will analyse the interactions on a two sentence discourse level. However, as former approaches discussed in chapter 2 have already suggested, aspectual information as well as world and context knowledge have to be considered as well. Moreover, an informal description of the different temporal relations which can be found between the situations will be given. The formal framework for a time logic I am going to employ will be presented in the next chapter.

4.1 Introduction

This chapter deals with the various factors which have to be taken into account while processing a narrative discourse. Different clues are provided by a narrative for the reader to determine the temporal relations which hold between the described situations.

It is commonly supposed that tense, temporal adverbials, aspectual information, world knowledge and rhetorical relations influence the processing of a narrative discourse and taking these clues into account, a temporal relation can be derived. However, it is not obvious how they interact and which exact influence they have on the derivation of a temporal relation.

In this chapter I will investigate short discourse sequences in German and describe how these different information sources contribute to the temporal relations expressed in a narrative discourse. Earlier theories concentrated mainly on tense and aspect information as described in chapter 2 (Partee 1984; Hinrichs 1986; Dowty 1986) and overemphasised their impact. More recent approaches introduce rhetorical relations which ensure the coherence of a narrative text and as a consequence the temporal relations between the situations (Eberle 1991; Lascarides and Asher 1993). These approaches rely heavily on world knowledge which is exploited by the proposed non-monotonic reasoning systems to ensure the correct temporal relation. However, the derivation of the temporal relation is consequently dependent on the non-monotonic reasoning. Lascarides and Asher (1993), for instance, stipulate a general default for two subsequent sentences which leads to a temporal precedence relation between two described situations.\(^1\)

I will present evidence against this assumption that the precedence relation has to be seen as a default for a narrative text. My approach assumes instead a temporal relation which is at first totally underspecified and after considering certain clues from tense, aspectual information, world knowledge and rhetorical relations, this relation becomes more specific.

First of all tense is used to situate a described situation relative to the speech time. However, since I am only concerned with narratives, and I will focus on the simple past tense (i.e. simple past for English and Preterite for German). I will not analyse, for example, simple past/pluperfect sequences. Note furthermore that the usage of the perfect differs for the two languages I investigate. The perfect can be more freely used in a German narrative discourse. In fact, it can be quite often found in spoken language describing past events.\(^2\) The influence of temporal adverbials or connectives will not be considered for the analysis in this chapter.

Secondly, another restriction can be derived from the aspectual information (i.e. situation type and viewpoint). In narrations, only bounded events allow a progression of narrative time, while unbounded states provide a background for the story. Former approaches did not pay much attention to the aspectual class of activities and especially the different viewpoint systems of different languages. As the preceding analysis of the aspectual information in German has shown, the findings for English cannot simply be transferred to German. I will in particular focus on the question of how the five situation types are used in a German discourse regarding the advancing of narrative time and which further assumptions have to be made for German, which allows only one viewpoint, namely the open-perfective viewpoint.

In this chapter, I will especially investigate the effects activities can have in more detail. It will turn out that this aspectual class can be used as a background in German. Furthermore a closer look has to be taken at the effects the viewpoint can have on the progression of narrative time. The notion of the open-perfective viewpoint will give an explanation of why German narratives express the temporal information in a slightly different way than English ones do.

Thirdly, world knowledge normally supplies links between the described events. A further temporal restriction can be derived from our general knowledge on typical event sequences or the influences certain events can have on other earlier mentioned situations. We know, for example, that the expected course of a meal is starter, main course and dessert. There might be exceptions to this sequence, but we normally assume this as a default.

Generally speaking, the situations described in a narrative have to be connected expressing a certain continuity of the story. The fact that an enablement relation (i.e. the first situation must be able to evoke the second situation) has to be derived between two situations is the clue we get to infer a temporal precedence relation between them. Theories like the one proposed by Lascarides and Asher (1993) only relied on the sequence of the sentences in the discourse in order to derive this temporal relation between the two situations.

\(^1\)See section 2.4.3.2

\(^2\)But the two tenses are not interchangeable as Ehrich (1992, p. 93) shows.
Instead I will follow Caenepeel and Sandström who claim that a narration has to be contingently connected. The world knowledge has to provide a special connection between the described situations. Using Caenepeel’s contingency structure I will show how this concept can be used to link aspectual knowledge and world knowledge which leads to the rhetorical relations. Consequently, a discourse structure has to be established with respect to the rhetorical relations between the situations. Rhetorical relations can be derived according to the aspectual information and the world knowledge. These relations build up the discourse structure of the text and introduce further temporal constraints. However, how these clues actually interact is still an open question to be investigated in this chapter. I will cast more light on this issue in chapter 6 after introducing a formal time logic in chapter 5. This chapter provides an analysis of discourse sequences and the different influences of the discourse clues are shown with respect to the conceivable combinations of the situation types. Figure 4.1 reflects the various knowledge sources and suggests how an interplay between the knowledge sources could be represented. How they can be formally connected and how the rhetorical relations play a crucial role for the construction of a coherent discourse structure will be presented in chapter 6 in the form of a Tree Description Grammar.

4.2 One viewpoint

In this section I will introduce a semi-formal representation for the temporal properties of the different situation types seen from one viewpoint. Based on the differentiation of the situation types in German in section 3.2.1.2 and the discussion about one viewpoint in German in section 3.3, I will introduce a graphical presentation of closed and open intervals reflecting the different properties of the situation types. In the following section 4.2.1 I will develop such a presentation for the five situation types, inspired by the theory proposed by Caenepeel (1989). Furthermore her notion of a contingency structure will be introduced to explain how narrative time can be moved forward. Section 4.2.2 will discuss the influence the open-perfective viewpoint has on the open or closed intervals. It will be described as an interface between our knowledge about typical situations and what the actual sentence refers to.

4.2.1 Temporal schemata as intervals

Although Smith (1991) has already given an informal characterisation for each of the five situation types she assumes, I want to develop a more formal model which incorporates insights of other researchers — in particular with respect to the more complex matter of discourse processing. Firstly, I will propose an elaborated system of open and closed intervals which reflects more precisely the features of (in)definite end points, following Caenepeel (1989, p. 68–76). Section 4.2.1.1 discusses briefly how she represents the temporal information expressed by the aspectual classes. Secondly and more importantly, I will use her notion of a contingency structure which is based on the nucleus model by Moens. The next section 4.2.1.2 incorporates the...
interval notion and the contingency structure into the proposal Smith made for the temporal schemata for the five different situation types.

4.2.1.1 The typology of Caenepeel (1989)

This section provides an introduction to Caenepeel (1989) who proposed a theory of how aspect, temporal ordering and perspective interact in narrative fiction. I will present briefly her typology of aspectual classes, because I will later use her notion of open and closed intervals to represent the five situation types.

Moreover, her definition of a contingency structure will be used to explain the forward movement of narrative time in section 4.4.

Five aspectual classes can be distinguished as follows according to the underlying nucleus-model. The situation types introduced by Smith (1991) can be seen as equivalent to the terminology developed by Moens (1987): culmination (i.e. achievement), culminated process (i.e. accomplishment), point (i.e. semelfactive), process (i.e. activity) and states.

The reference times referring to the aspectual classes are formally represented as open (i.e. [a, b]) or closed (i.e. [a, b]) intervals. For an open interval, the end points of the interval do not belong to the interval, whereas the end points a and b are part of the closed interval. Consequently, culminated processes, culminations and points are described as closed intervals, while processes and states are denoted by open intervals. The reason why these mathematical features reflect exactly the properties of the defined aspectual classes is not provided by Caenepeel. I give a justification based on the formal definitions of open intervals in the following chapter which is concerned with the time logic I want to use.

Note furthermore that reference times can be categorised according to their temporal extension: they may be atomic or extended. The reference times corresponding to culminated processes, processes and states are extended and the reference times which refer to culminations and points are atomic.

In contrast to the classification given by Moens (1987), a more fine-grade distinction of states is assumed by Caenepeel (1989). Additionally she discusses so-called 'contingent states' which supposedly introduce a culmination point. As a consequence, even for states a forward movement of time can be derived. Consider the following example (Caenepeel 1989, p. 73):

(4.1) We turned the corner and the village was out of sight.

Caenepeel (1989, p. 73) claims that this state introduces a culmination. However, the actual change of state is introduced by the preceding achievement which marks the beginning of the state. Comparing this with the description of states as given by Smith (1991), we can describe this state as a situation where an end point was contextually inferred. The end point became

Figure 4.2: The contingency structure by Caenepeel (1989) allows the second situation to be embedded into the consequent state of the first one.

This model is used to relate two situations with each other with respect to the relation of contingency — a term which describes consequentiality between situations. Given this relation for two subsequent described situations a temporal ordering can be assumed. That is, the second situation follows the first one and is embedded into the consequent state as well. Contingency, however, can only be derived for a limited number of aspectual classes. Processes and states do not shift the reference time, they introduce a stable reference time and no result state. In order to ensure the forward movement for other aspectual classes, Caenepeel has to allow context to coerce the aspectual class like in (4.2) (Sandström 1993, p. 37):

(4.2) (a) He raised the glass to the mouth, (b) emptied it in one gulp, (c) burped loudly, (d) and set the glass back on the counter.

A point as in (4.2c) does not have a contingency structure associated with it, but in this sequence it adds to the temporal ordering of events. According to Caenepeel the context coaxes the point into a culmination which can provide a consequent state for the following situation in (d).

It can be deduced from this discourse example interpreted according to Caenepeel that she mainly relies on the aspectual features to explain the forward movement in a narration. Only aspectual classes associated with a contingency structure can progress the narration. If this structure is not given, the aspectual class has to be shifted to an accomplishment or achievement in order to progress the narration. However, the structure of a narration cannot be explained by

---

4.2 Discourse Sequences One viewpoint

Figure 4.2: The contingency structure by Caenepeel (1989) allows the second situation to be embedded into the consequent state of the first one.
aspectual features alone, as Sandström (1993, p. 41–72) points out. The underlying discourse structure which also refers to pragmatic knowledge (i.e. rhetorical relations, world/context knowledge) plays a crucial role. Admittedly, the derived rhetorical relation may make use of those features given by the situation type, but is has to be stressed that the discourse structure actually binds the situations together. The rhetorical relation which can be derived for two situations can be seen as the glue for the narration, however this might be a double component glue which sometimes requires a specific combination of two different types. States, for example, trigger normally a background relation, but only if this situation is combined with a bounded situation. How the rhetorical relations establish a coherent discourse will be discussed in more detail in chapter 6.

In section 4.4 the concept of a narrative seen as a connection of contingency structures will be further discussed. I will maintain the idea of a notion of consequentiality, but I will introduce a more relaxed notion of this structure in order to (i) accommodate for the German data and (ii) avoid the coercion into other aspectual classes. The contingency structure will be used as an underlying construct which models the forward movement of narrative time, but it is merely used by a rhetorical relation which involves pragmatic knowledge as well. That means this structure is a necessary condition for forward movement, but it is not a sufficient one.

4.2.1.2 Intervals and situation types

Similar to the system described by Caenepeel, I will propose the following description for the situation types represented as intervals. I will furthermore discuss in more detail how Smith’s insights can be incorporated into the formalisation.

In what follows, this formal mathematical representation will be enriched with respect to the internal structure of the intervals. Caenepeel does not elaborate on this issue any further apart from assuming the tripartite nucleus structure. I will incorporate the definitions Smith proposes into the nucleus model as follows: Smith points out that some situation types provide internal stages indicated by her informal representation as a sequence of dots (…). I would like to transfer this indicator of an internal structure to the plain interval representation. A complex structure of initial, intermediate and final stages is described by it. On the other hand, an interval with a stative internal structure is represented as —. Additionally, an atomic interval (i.e. []) used for a culmination (or point) does not have any internal structure at all. However, this kind of interval still has a duration. The nucleus model conjoined with the Smithian features stative, durative and telic is represented by the following interval structure:

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>nucleus</td>
<td>[±]</td>
<td>[±]</td>
<td>[±]</td>
<td>I-IH</td>
</tr>
</tbody>
</table>

A more precise formalisation will be given when I introduce a time logic in the following chapter (see section 5.2.3).

Activities This situation type is described as a durative and non-telic according to Smith. According to the nucleus structure we can assume an open and extended interval for the formal representation. Compare also with section 3.5.3 where I introduce and discuss a different representation for activities to the one originally proposed by Smith.

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>activities</td>
<td>[-]</td>
<td>[+1]</td>
<td>[-]</td>
<td>I-I</td>
</tr>
</tbody>
</table>

Accomplishments This durative situation type contains explicit boundaries. Hence the chosen interval representation is closed and extended. Again an internal structure distinguishing various stages is assumed for this type. Note furthermore that the assumed culmination — the inherent end point of the accomplishment — also presupposes a result state. However this state does not actually belong to the situation types, but will play an important role when it comes to a narrative. The presupposition of having a result state is indicated by a shadow box.

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>accomplishments</td>
<td>[-]</td>
<td>[+1]</td>
<td>[-]</td>
<td>I-I</td>
</tr>
</tbody>
</table>

Semelfactives In contrast to the two previous situation types, this type does not possess a perceivable temporal extension. However, this should not lead to the conclusion that this type is to be represented as a point. Bear in mind that even a very short situation where no internal structure is distinguishable for humans has a certain duration. Following Caenepeel in her description, I will call these intervals atomic. Semelfactives are therefore represented as closed and atomic intervals without any internal structure.

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>semelfactives</td>
<td>[-]</td>
<td>[-]</td>
<td>[-]</td>
<td>[]</td>
</tr>
</tbody>
</table>

Achievements Since this type involves a culmination a more complex structure has to be assumed. There is a process leading to the culmination and a result state. The preparatory process is actually not part of the situation, but can be classified as inferred knowledge. Consequently, a contingency structure is evoked by this type:

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>achievements</td>
<td>[-]</td>
<td>[-]</td>
<td>[+1]</td>
<td>I-I</td>
</tr>
</tbody>
</table>

*See section 5.2.3.3 for a more detailed formal discussion on this topic.*
4.2 Discourse Sequences

**States** This situation type is described as stative and therefore without any internal structure. The interval used for the semi-formal representation is extended and open.

<table>
<thead>
<tr>
<th>situation type</th>
<th>stative</th>
<th>durative</th>
<th>telic</th>
<th>interval schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>states</td>
<td>[+ ]</td>
<td>[- ]</td>
<td>[- ]</td>
<td>H</td>
</tr>
</tbody>
</table>

We have obtained a representation based on open/closed intervals which allows us to distinguish between given and inferred knowledge about the situation types. The following section will show how the open-perfective viewpoint can be used to filter this information.

4.2.2 Viewpoint-interface

As already described in section 3.2.2.3, the viewpoint describes strict knowledge, whereas some of the information given by the situation types can be seen as inferred knowledge which can be overridden. This is, for example, the case for the Preterite in German which allows only the conclusion that an inherent end point of an accomplishment like der Angeklagte fuhr nach Hause might be reached, but as shown this conclusion can easily be overridden.

In the following, I will use the interval representation to explain which parts of a situation are shown to the reader/hearer and which parts are assumed. The parts which are included by an open-perfective viewpoint are the initial and the first stage of the situation. The first stage can cover the whole situation, but it does not have to. Hence the end point is not necessarily included. Any inferences with respect to this point rely on our world knowledge. The viewpoint can consequently only grasp an open end point.

How the five situation types are seen from an open-perfective viewpoint is compiled in the following paragraphs.

**Activities** This situation type does not provide any definite end points, hence the viewpoint information presents an open and extended interval as well. The beginning point is open as well as the end point. Note that the viewpoint allows access to the internal structure which is indicated by the question marks (??) in the following table. The reference with respect to the end point can easily be overridden, as shown in the continuation test on page 46. More data which supports the claim that in particular an ingressive reading is easily obtainable in German is presented in section 4.3.2.1.

<table>
<thead>
<tr>
<th>activity</th>
<th>L-</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>open-perfective view</td>
<td>???</td>
<td></td>
</tr>
</tbody>
</table>

**Accomplishments** The behaviour of this situation type with respect to the possible overriding of the end point has to be explained by the explicit exclusion of the end point. However, note that this is again different to the imperfective where no further reference with respect to the end point and the result state can be made. For the open-perfective viewpoint a strong indication that the inherent end point has been reached is given.

4.3 Situation types

As the data presented in section 3.2.2.3 has already shown, this culmination can be overridden provided context knowledge suggests that this is the case. Therefore the criteria for a contingency structure are not fully given. I will therefore call the structure invoked by accomplishments a weak contingency structure.

<table>
<thead>
<tr>
<th>accomplishment</th>
<th>[ ]</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-perfective view</td>
<td>???</td>
<td></td>
</tr>
</tbody>
</table>

**Semelfactives** Since the open-perfective viewpoint includes the initial part of a situation, it can be inferred for an atomic interval that the end point is shown as well. The output for a semelfactive is consequently a bounded and atomic interval.

<table>
<thead>
<tr>
<th>semelfactive</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-perfective view</td>
<td>???</td>
</tr>
</tbody>
</table>

**Achievements** This situation type is a bit more complex than the previous one, since it includes a culmination which leads to the further assumption that there has to be a result state as well. A preparatory process which led to the culmination has also to be assumed, but this is not necessarily the case for all achievements which should be reflected by the respective lexical entry. The assumed occurrence of the preparatory process and a result state together with a culmination establishes a contingency structure. The context has to be interpreted with respect to this given structure. Since the culmination of the achievement is included by the viewpoint, I will call this a strong contingency structure in contrast to the structure imposed by accomplishments.

<table>
<thead>
<tr>
<th>achievement</th>
<th>[ ]</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-perfective view</td>
<td>???</td>
<td></td>
</tr>
</tbody>
</table>

**States** This situation type seen from an open-perfective viewpoint renders an open interval which is durative, but does not have an internal structure unlike activities.

<table>
<thead>
<tr>
<th>state</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-perfective view</td>
<td>???</td>
</tr>
</tbody>
</table>

The following section discussed in more detail how the contingency structure can be used to advance the narrative. I will especially focus on the two structures introduced for German, the usage of semelfactives which lack this structure, but allow a forward movement under certain circumstances and the question of how states and activities can contribute to the progression of a narrative.

4.3.1 Situation types

Although we have already seen that aspectual classes are only a contributing factor, a detailed analysis of narratives in German with respect to the five different situation types will be carried
4.3 Discourse Sequences

Table 4.1 describes how the following sections are structured:

<table>
<thead>
<tr>
<th>bounded</th>
<th>durative</th>
<th>punctual</th>
<th>durative</th>
</tr>
</thead>
<tbody>
<tr>
<td>sb act</td>
<td>sb act</td>
<td>sb act</td>
<td>sb act</td>
</tr>
</tbody>
</table>

Table 4.1: The structure of the following sections regarding the different situation types

4.3.1 state/activity

Note that states and activities show a similar behaviour, they do not advance narrative time provided they occur together.


(4.4) Der Weg zu Großvater war weit, anstrengend und oft gefährlich, die Kekse aus der Blechbüchse schmeckten muffig (act), und abends fürchtete ich mich in dem alten Mietshaus (act). (De Bruyn, *Folezen*, p. 72)

A similar observation can be made if an activity sentence is sequenced with a state:

The following section investigates in greater detail how states and activities overlap, if they occur together. Neither a state nor an activity can actually evoke each other. Consequently, these two situation types cannot describe a sequence of two situations.

Activities in German show a slightly different behaviour to English. This is due to the lack of any progressive form. This form can be used in English to force an overlap between two situations.

The following section investigates in greater detail how states and activities overlap. Consequently, activities can be used as a scene setting tool for a narrative as in English. In example (4.4) the author used the habitual meaning of the activities stressed by the adverbs like *abends* (‘at night’) to express a stative description.

This behaviour of activities is not only restricted to habitual readings. Consider the following discourse:

(4.5) Ich lehnte mich über die Reling. Die Delphine stimmten jedenfalls, die sich aus den Meereswogen, so schien es, in Tiere verwandelt haben. Sie *begleiteten* unser Schiff. (Penzoldt, *Der Delphin*, p. 22)

I was leaning over the rail. It was true about the dolphins at least — waves of the sea, one might think, that have turned into creatures. They *were accompanying* our ship. (Penzoldt, *The Dolphin*, p. 23)

The activities in this sequence are perceived as overlapping. Moreover, one important feature of German is the lack of any progressive form. Considering that there is no choice between a perfective and an imperfective viewpoint this passage, expressing an overlapping of two activities and a state should not come as a surprise. The discourse in (4.5) exemplifies how the lack of a choice between two viewpoints allows an overlapping reading for German, whereas in English the progressive form can be used to indicate this.

The example discourses suggest the following preliminary assumptions:

- States and activities overlap, if they occur together. Neither a state nor an activity can actually evoke each other. Consequently, these two situation types cannot describe a sequence of two situations.
- Activities in German show a slightly different behaviour to English. This is due to the lack of any progressive form. This form can be used in English to force an overlap between two situations.

The following section investigates in greater detail how states can be used to indicate a so-called descriptive mode. Smith (1995) introduces this term in order to explain passages of narratives where time seems to be irrelevant. However, I will strengthen this claim and show that the situations are described as happening at the same time. Furthermore, a situation supplying definite end points can indicate the end a description and consequently move forward the narration.

Stative Sentences and descriptive mode According to Smith (1996, p. 18) descriptive passages do not describe a particular movement of time. She claims that time is suspended in those passages. She furthermore points out that such descriptions contain states or progressives
which do not involve any changes. Starting with a locative (e.g. on the big land in (4.6)) a scene is set, which is described in what follows with more detail:

(4.6) On the big land below the house a man was ploughing and shouting admonitions to the oxen who dragged the ploughshares squeaking through the heavy red soil.

On the track to the station the loaded wagon with its team of sixteen oxen creaked and groaned while the leader cracked his whip that reached to the horns of the leader oxen and yelled on a note only they understood (…). On the telephone wires the birds twittered and sang (…). The wind sang not only in the wires, but through the grasses, and the wires vibrated and twanged. (Lessing, Under My Skin, (Smith 1996, p. 21))

Although no forward movement of the described situations can be perceived, one conclusion can be drawn: the situations described temporally overlap in some way or another. It is not the case that no temporal relation at all was derived. This is a description of situations which are temporally connected to the utterance time (i.e. they are located before the point in time) and they happen all at the same time.

Consider the following German example which provides a description of a river.11

(4.7) Zu erzählen gibt es genug, und wenig zu reden, hier unten am Wasser. Die Barsche springen ein bißchen nach den Fliegen und den grünen Mücken, andere Fische steigen herauf aus der Dämmerung unten, aber bewegen sich kaum, stehen und lassen sich die dunklen Rücken bescheinen. (Bobrowski, Lohelbenwälchen, p. 186)

There is plenty to tell, and little to discuss, down here by the water. The perch leap now and again for flies and green midges, other fish come up from the twilight down below as well, but they scarcely move, they simply float and let the sun fall on their dark backs. (Bobrowski, Lohelben Große, p. 187)

Similar to the English example the text starts with a locative (i.e. hier unten am Wasser) and a stative statement. The second sentence contains several activities, but they simply add to the stative description indicated by the first introductory state. However, although the first sentence refers to a statement which can in fact be seen as everlasting, this should not lead to the conclusion that time is suspended (i.e. the following situations do not happen in time). The next paragraph introduces a time frame for the story:

(4.8) Sonntag heißt Sonntag, weil da die Sonne scheint. Es ist so gut hier, daß einem nichts Vernünftigeres einfällt. Sunday is called Sunday because the sun shines. It is so pleasant here, that no more sensible explanation occurs to you.

Again, the narration continues with two states, but the reader is reminded of the day this description takes place: a Sunday. Interestingly enough, the author decided to move the narration forward, but still maintaining the descriptive mode by using the modal verb können (‘can’):

Note that the whole passage is written in the present tense which can be more freely used for a narration in German (a historic present).

11Note that the whole passage is written in the present tense which can be more freely used for a narration in German (a historic present).

The narrative continues with some more stative descriptions involving activities as well as states until it becomes clear that the narrator adds an end point to the scene setting introduction:

(4.10) Der Heinrich, der eigentlich Franz Kirschnick heißt, steht bei den Pferden. Willst wieder kopfschellen12, fragt Bauer Bussat hinüber. Heinrich, whose real name is Franz Kirschnick, is standing by the horses. ‘Thinking of a bit of horse-trading, then?’ shouts farmer Bussat to him.

The semiaactive (i.e. to shoot to him) in the second sentence together with the indirect speech provides the reader with a situation which contains definite end points. As a consequence, the activity described in the first sentence was translated by the progressive form in English. The changed context requires a different viewpoint in order to express the overlapping in English.

A further example taken from another text exemplifies that activities generally lead to an overlap reading:

(4.11) Hinter mir schnatterten, brüllten, lachten, weinten und tobten meine sogenannten Mitschüler. Man warf mit Papierkugeln nach mir, aber ich drehte mich nicht, hielt meine Trommel, die bisher keinen Schlag lang vor, fest zwischen den Knien und den Schulern, und wanderten von Nordwest nach Südost aus, als habe jene Richtung den Wolken etwas Besonderes zu bieten. Behind me my so-called schoolmates snarled, roared, laughed, wept, and raged. They threw spitballs at me, but I did not turn around; it seemed to me that the tranquil purposive clouds were better worth looking at than a horde of grimacing, hopelessly hysterical louts. (Grass, The Tin Drum, p. 74)

Note also that the English translation obviously does not require the progressive form for the activities in the first sentences. This causes problems for Smith’s account, because the context this passage is placed in cannot be described as a descriptive mode, as the preceding sentences of (4.11) prove:


Cheated of the coveted view by the insidious architecture, I gazed up at the sky and was soon appeased. New clouds kept forming and drifting south-westwards, as though that direction had some special attraction for clouds. I wedged my drum firmly between knees and the desk, though it had never for so much as a beat thought of wandering off to south-westward (…).

12E. kopfschellen — to shake hands at the conclusion of a deal.
4.3 Discourse Sequences

Situation types

<table>
<thead>
<tr>
<th>unbounded</th>
<th>durative</th>
<th>sta</th>
<th>act</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>??</td>
<td>??</td>
</tr>
</tbody>
</table>

Table 4.2: Stative and activity sentences and their temporal relation

4.3.2 event.state/activity.

This section is concerned with a context where first a bounded situation (i.e. semelfactives, achievements and accomplishments) is mentioned and next a state or an activity. The achievements and the accomplishments introduce a contingency structure so that the subsequent situation has to be interpreted with respect to this structure. Semelfactives, however, can be seen in two different ways: since this type possesses a definite end point, it allows an advancing of narrative time as well. However, this situation type can easily be reinterpreted as an iteration which has to be categorised as an activity though. This reinterpretation will therefore not be considered in this section.

Two cases are conceivable:

- The subsequent unbounded situation was caused by the earlier mentioned event. As a result, narrative time is moved forward.
- No consequence relation can be established between the two situations. Hence the state as well as the activity provide a background.

It will turn out that activities in German allow this background reading more easily than this situation type does in English.

The following two sections discuss in particular the findings by Smith (1996) who claims for activity sentences in English that this type moves narrative time forward by comparing it with German narratives. Based on this investigation I will give an alternative explanation regarding the contribution of activities to the advancing of narrative time.

4.3.2.1 Consequence

Subsequent research of Smith (1991) presented in Smith (1995) focuses on activities, investigating whether this situation type can move forward narrative time or not. I will compare her findings with my investigation of German discourses.

The following section reviews briefly Smith’s argumentation for why activities advance narrative time in English. The subsequent section contrast the results of my investigation of German narratives with her analysis.

Smith on Activities

According to Smith (1995) activities are presented as bounded situations and they can be used to move narrative time forward. Her claim is backed up by examples from the literature like (4.13) (Smith 1996, p. 14):

\[(4.13)\] He stared at me morosely. He stood up slowly, graceful as a panther. He walked across the room and looked into my office. He jerked his head at me and went in. He was a guy who owned the place where he happened to be. I went in after him and shut the door. He stood by the desk looking around, amused. ‘You’re small-time,’ he said. ‘very small-time.’ (Chandler, *The long Good-bye*, Smith 1996, p. 16)

\[(4.14)\] There was a small ivory push button beside the door marked ‘405.’ I pushed it (...) and waited. The door opened noiselessly about a foot. (variant in *Depraetere 1995*)

These examples presented by her show that activities in fact can advance narrative time. But this should not come as a surprise, because all activities in these examples have an event before and after it. The associated contingency structure indicated the forward movement, whereas the activities are placed between the culminations. Compare with a text which lacks this structure after deleting all events (and the progressive form) and shuffling around the remaining sentences and expresses no advancement of narrative time:
4.3 Discourse Sequences

Situation types

(4.15) He was a guy who owned the place where he happened to be. He **stood** by the desk (…), amused. (He) **looked into** my office. He **stared** at me morosely.

Note furthermore that the advancing of narrative time can even be expressed by a state as discussed earlier:

(4.16) We turned the corner and the village was out of sight.

Smith also discusses and rejects other possible interpretations for activities, namely an ingressive reading. She shows that activity sentences in the main clause of a before or after-clause describe terminated situations. A continuation that the activity is still going on like in (4.17) sounds strange (indicated by ²):

(4.17) a. ²We rehearsed before Mary left but we weren’t finished when she returned.
    b. ²We rehearsed after Mary left but weren’t finished when she returned.

She consequently argues against the view of Herweg (1991a) that activities have to be categorised as stative. Her claims also contradict the thesis of Hinrichs (1986) that states and activities cannot introduce a new reference time and do not move narrative time (cf. section 2.4.1).

In the next section, I will present an investigation of German discourses involving activity sentences and, contrast my results with the observations just made and provide a different explanation which is based on the aspectual properties of the two languages, and the contingency structure introduced by the events rather than the activities.

**Activities in German** The previous section discussed only English data. In this section I want to investigate whether the observations made earlier can simply be transferred to German.

At first sight, German data seems to confirm Smith’s claim regarding activities:

(4.18) Nur weil der Weg zum Kobyella über Jan Bronski führte, stellte ich mich fast jeden Nachmittag gegen sechs, selbst bei drückendster Augusthitze in der Nähe der Polensiedlung auf (ach) und wartete auf den nach Dienstschluß zumeist pünktlich heimkehrenden Jan (act). Er kam nicht. (Grass, Die Blechtrommel, p. 172)

The path to Kobyella led through Jan Bronski. That was the only reason why I took to waiting (lit: **stood**) for Jan near the Polish settlement toward six in the evening. Even in the most stifling August heat I waited, but Jan, who normally started punctually for home at closing time, did not appear. (Grass, The Tin Drum, p. 208)

(4.19) Ich hob mein Glas (ach) und unterbrach: ‘Prosit!’ (sem) und wir tranken (act). . . (Frisch, Homo Faber, p. 137)

I raised my glass and interrupted, ‘Prosit!’ and we drank . . . (Frisch, Homo Faber, p. 119)

However, the actual forward movement is conveyed by the contingency structure of the events. In (4.18) the protagonist went to the Polish settlement and stood there (i.e. **sich aufstellen**) which marks the beginning of the waiting. In (4.19) the **Prosit!** indicates the start of the drinking.

Moreover, the observation that the event is responsible for the forward movement can also be made for states as well. As for English, this type can be interpreted as triggered by a culmination (or even a point):

(4.20) Peter schaltete das Licht aus. Es war stockfinster im Zimmer.
    Peter switched off the light. It was pitch dark in the room.

(4.21) Der Lehrer klatschte einmal in die Hände. Die Schüler waren sofort still.
    The teacher clapped his hands once. The pupils were silent immediately.

Let us now consider the question whether activities are presented as bounded situations in German by turning again to the before and after examples on page 80 and by comparing them with the German translations:

(4.22) a. Wir probten, bevor Maria wegging, aber wir waren noch nicht fertig, als sie zurückkehrte.
    b. Wir probten, nachdem Maria wegging, aber wir waren noch nicht fertig, als sie zurückkehrte.

These constructions are not ill formed in German, unlike their English counterparts. It may be concluded from these examples that the end points of activities in German are not presented to the reader as in English. This can be explained by the open-perfective viewpoint, whereas the perfective viewpoint of the English simple aspect does include the end point and therefore presents activities as bounded.

Moreover, an ingressive reinterpretation is conceivable for activities even in the nachdem-clause. Herweg (1990) observes that sentences which describe an accomplishment or an achievement are demanded by this clause. Activities and states are normally not allowed, because these events are unbounded. But reinterpretations are possible in German like in (4.23). A reading can be inferred where Peter schlief refers to the ingressive event of Peter falling asleep.

(4.23) Nachdem Peter schlief, gingen seine Eltern ins Theater.
    After Peter fell asleep, his parents went to the theatre.

Interestingly enough, the English translation after Peter slept for (4.23) would refer to a bounded sleeping event and mean that Peter woke up and his parents left which sounds rather odd. Note furthermore that in German the present perfect and pluperfect are the preferred tenses for the conjunctive clause depending on the tense in the main clause (i.e. present tense and past tense). The pluperfect Peter hatte geschlafen, for example, would express the same rather strange temporal relation expressed by Peter slept for English.

A further example is discussed by Herweg (1991b, p. 73) involving another activity sentence:

(4.24) Nachdem die echte Vase in Gestalt von echten Scherben auf dem Teppich lag, wollte ich Matzerath (…) mit der Hand schlagen. (Grass, Die Blechtrommel, p. 60)
    When the genuine vase lay on the carpet in the form of genuine fragments, Matzerath (…) raised a hand to strike me. (Grass, The Tin Drum, p. 71)
4.3 Discourse Sequences

### Situation types

Again, the German text expresses an ingressive reading which allows the author to bring into focus the result state and the event causing it as well. The English translator, however, cannot use this reinterpretation, because activity sentences are seen as bounded when they occur in an after-clause. S/he had to express the temporal relation via a when-sentence, unfortunately losing the inference to the event which caused the fragments lying on the carpet.

This observation backs up the viewpoint introduced earlier for German. The open-perfective viewpoint includes the initial point in its focus and therefore quite naturally allows an ingressive reading. The confirmation of the completion point via the pluperfect is necessary to present a closed situation to the reader in German, while in English the simple aspect already provides a perfective view on the situation including both end points.

To sum up, activity sentences in a German narrative can express an advancing of time, just as was observed by Smith for English. However, the examples presented led to this reading because the activities occurred together with an event indicating specifically the beginning of the activity.

Furthermore, I was able to show that activities are seen differently in nachdem/bevor-sentences. They allow an ingressive reading in German, while the English translations present the activity sentences as bounded. Moreover, even an activity sentence in a nachdem-clause can be reinterpreted as ingressive in order to meet the semantic requirements of this clause. The open-perfective viewpoint provides an explanation for this phenomenon.

To sum up the findings of this section, activities as well as states can move narrative time, provided they can be seen as a consequence of the preceding event.

The following section discusses the cases, when a background is provided by a state or an activity. I will present data which will prove that activities quite naturally convey such a reading in German, while in English only states normally allow an overlapping with an earlier mentioned event.

#### 4.3.2.2 Background

This section discusses the constellation when states or activities provide a background for a preceding bounded situation.

First I will present event.state sequences which indicate an overlapping between the two situations. As shown earlier, only when a contingency structure is given which actually causes the state is a forward movement perceived.

Next I will show that the constellation event.activity in German conveys quite often an overlapping relation as well. Again, only for cases which allow a consequent to be derived is a forward movement possible, as discussed in the previous section.

**event.state.** Most naturally states provide a background for an event. The lack of any definite beginning points leads to the assumption that the two situations overlap.

(4.25) Als ihr Vater hereinkam, hatte ich mich gerade gesetzt, ich stand sofort auf (ach). Er war so verlegen wie ich, auch so schüchtern (sta) (…) (Böll, Ansichten eines Clowns, p. 78)
4.3 Discourse Sequences  

Situation types

hence a sequential reading is preferred. So the translator for (4.29) tended to this reading and marked this by the simple aspect in English. It is important to stress that the English translator was forced to choose between two forms dictated by the English Grammar, while the German original text renders a rather underspecified temporal relation.

Note that although the focus on the initial boundary should convey a progression of narrative time for activities according to Smith’s characterisation of activities, the discourse examples in (4.28) and (4.29) showed that only underspecified temporal knowledge is presented to the reader and further world knowledge has to be taken into account. This can be explained with respect to the indefinite beginning point of activities. In order to advance narrative time, this initial boundary of an activity has to become definite. As shown in the English and German example discourses in (4.13, 4.14) and (4.18, 4.19) the definiteness of these boundaries can be contextually inferred. If activities occur together, they provide only background information, because they cannot contingently be connected. However, note that activities in English have the tendency to forward narrative time, even if the activity is not necessarily a consequence of the event. Consider the following alternative translation of (4.28):

(4.30) (…) and he at once reached toward the shelf behind him and gave me two boxes.

He cried.

The activity in this translation is seen from a perfective view. It is important to note that a sequence of two situations is the most naturally perceived interpretation of this discourse, because it seems to be quite difficult to obtain a background reading. However, if a manner adverbial like miserably is added, this reading is easier to get. Unfortunately, I cannot offer an explanation for this observation.

But there are also examples in English which do not imply a forward movement of narrative time either, although the activity is given in the simple aspect form and the passage is not in a descriptive mode:


Moira was furious. She stood up again and stamped her foot violently. She waved her clenched fist threateningly at the sea. (Penzoldt, The Dolphin, p. 39)

Note that the English translation renders a possible overlapping of the stamping15 and waving as well. But one important difference between (4.31) and (4.30) has to be emphasised: in (4.30) the activity follows an accomplishment seen from a perfective viewpoint while in (4.31) a definite end point is presented in English. Given this information the simple aspect can only lead to the conclusion that two subsequent situations are described, whereas the progressive form refers to an overlapping.

In German, this information is not present in the text discussed: no definite end point of the accomplishment and no choice between another viewpoint.16

In order to explain this difference between English and German, I would like to refer back to the results of the comparison of states in different languages (see section 3.3.2.4 on page 55). It was shown that the possible choice of two viewpoints has a crucial influence on the temporal interpretation of a sequence event.state. Since German lacks this choice in general, the similar observation can be made for activities as well. While in German a rather ambiguous temporal relation is expressed, in English the sequential or overlapping reading is marked by the choice of the viewpoint.

Hence these data suggests that the perfective view includes the beginning point, because the imperfective view (i.e. progressive form) explicitly excludes this point. The data regarding activities in before/after sentences presented by Smith can be interpreted along these lines. The perfective viewpoint presents activities as bounded.

There is only one constellation left to consider which is a semelfactive combined with an activity. This bounded situation type can be reinterpreted as an activity, since an iterative reading is suggested by the following activity:

(4.32) Maria stampfte mit den Füßen, klatschte in die Hände und lachte.

Mary stamped her feet, clapped her hands and laughed.

Nevertheless, if the semelfactive is forced to be interpreted as a single event by an adverbial like einmal (‘once’), the same observation can be made as for the other two situation types: an overlapping of the second described situation (i.e. activity) with the first one can be derived.

(4.33) Ich klopffe einmal an ihre Wand. Hanna tat, als schließe sie. (variant in Frisch, Homo Faber, p. 182)

I tapped once on her wall. Hanna pretended to be asleep. (Frisch, Homo Faber, p. 156)

Again, it is not important, whether Hanna was pretending to be asleep all the time or whether she quickly closed her eyes when she heard the knock for the understanding of the German text.

My investigation of activity sentences in German discourses in this section has shown that an overlapping reading between an activity and another situation is more easily obtainable in German than it is in English. Activities apparently behave quite similarly to states in this respect. The observation raises the question of how this difference between German and English can be explained. Bearing in mind the cross-linguistic investigation regarding states in section 3.3.2.4, it may be concluded that the choice or (non-choice) between viewpoints may have an influence on the temporal information given.

To sum up, two interesting observations can be made: the activity sentence in (4.28) offers an underspecified temporal relation. A fuzzier temporal relation is expressed, whereas a state like in (4.25) suggests a stricter temporal relation (i.e. ). Activities obviously exhibit a more ambiguous behaviour than states. This is due to the internal structure of activities: while states are described without any internal structure, activities possess internal stages. This difference is reflected by the graphical representation in the following table by ??? The curly bracket (i.e. )) indicates the case when a forward movement can be derived. That is the beginning point of the open interval representing the state or activity is the end point of the event.

---

15 Although to stamp is actually a semelfactive, it is interpreted as an activity in the context given. See below for further explanation.

16 Note that the whole German text in (4.31) contains only unbounded situations. Sie stand nun wieder (lit: she stood now again) refers to the result state of standing up. Hence the four described situations are perceived as overlapping.
4.3 Discourse Sequences

### Situation types

<table>
<thead>
<tr>
<th>bounded</th>
<th>durative</th>
<th>sem</th>
<th>sta</th>
<th>act</th>
</tr>
</thead>
<tbody>
<tr>
<td>punctual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: A bounded situation followed by a state or an activity and the expressed temporal relations

The following section discusses the combination of an accomplishment with any event type. An accomplishment introduces a contingency structure, however, since an open-perfective viewpoint is assumed for German, the end point can only be derived by inference.

#### 4.3.3 Accomplishment.event.

We can again observe two possibilities: the subsequent situation can follow the culmination of the contingency structure or it can be seen as part of the preparatory process. The former case indicates an advancing of narrative time, while the latter presents the second situation as a temporal subpart of the first one.

It will turn out that further pragmatic knowledge (e.g. physical laws which prevents human beings from doing certain activities simultaneously or script knowledge) is taken into account to forward narrative time. On the other hand, if an elaboration of the accomplishment is given, the inherent end point can be overridden unlike in English where the perfective viewpoint sets this point (cf. the example discourse in section 3.2.2.2 on page 40).

#### 4.3.3.1 Consequence

Accomplishments convey only a weak contingency structure in German which is due to the open-perfective viewpoint. Although a progression of two events normally is assumed, if the two situations can be linked, a tendency can be observed to confirm the end point of the accomplishment by different means. This can either be done by a reference to the location (e.g. dort ('there') in (4.35)) or by a PP expressing a point in time like nach dem Frühstück ('after breakfast') in (4.36).17

(4.34) Maria stieg die Treppe hinauf bis zum 8. Stock. Sie klopfte an der Tür mit der Nummer 88 (sem).

Mary climbed up to the eighth floor. She knocked at the door with the number 88.

(4.35) Der Angeklagte fuhr nach Hause. Dort trank er ein Glas Trollinger (acc).

The defendant drove home. There he drank a glass of Trollinger.

(4.36) Ich setzte mich sofort hin und schrieb ihr einen langen Brief (acc), nach dem Frühstück noch einen (acc) (…)(Böll, Ansichten eines Clowns, p. 96)

I sat down at once and wrote her a long letter, after breakfast I wrote her another one (…). (Böll, The Clown, p. 72)

(4.37) Peter ging in das Café auf der anderen Straßenseite (acc). Er setzte sich an den Tisch neben dem Eingang (ach).

Peter went to the cafe on the other side of the street. He sat down at the table next to the entrance.

(4.38) (Wir) gingen zu einer der Buden auf der Venloer Straße (acc), kauften uns eine Flasche Rotwein (acc) und gingen nach Hause (acc). (Böll, Ansichten eines Clowns, p. 196)

We went to one of the booths on the Venlostrasse, we each had (lit: ate) two portions of goulash, bought ourselves a bottle of red wine and went home. (Böll, The Clown, p. 158)

(4.39) Ich schaltete meinen Apfel (acc). (…) Ich aß meinen Apfel (acc). Ich nahm meinen elektrischen Rasierapparat aus der Mappe (acc) (…)(Frisch, Homo Faber, p. 10)

I peeled my apple. (…) I ate my apple. I took my electric shaver out of the briefcase. (Frisch, Homo Faber, p. 12)

Not only an indication via a location or a temporal reference can be helpful to situate the second situation within the consequent state of the accomplishment. Further knowledge about the typical sequence of situations is needed. This knowledge can be either explicitly expressed by temporal adverbs or conjunctions like then, after or before or the inference of a sequence is implicit. Note that for all previous examples where this conclusion can be drawn it is not conceivable that the second situation overlaps with the first one. If this inference were not given, a text like (4.34) would sound odd:

(4.40) Maria stieg die Treppe hinauf bis zum 8. Stock. Peter klopfte an der Tür mit der Nummer 88 (sem).

Mary climbed up to the eighth floor. Peter knocked at the door with the number 88.

The following inferences can be drawn for the examples (4.34) to (4.39):

- (4.34) The same person cannot climb up the stairs and knock at a door at the same time.
- (4.35) The anaphoric reference (dort) refers to the end point of the preceding accomplishment. Note that you could drink a glass of Trollinger while driving home, although you definitely should not do so.
- (4.36) The same person cannot write two letters at the same time. The second situation is temporally located after the breakfast (nach dem Frühstück).
4.3 Discourse Sequences  
Situation types

- (4.37) The same person cannot go to a café and sit down at a table at the same time. Note the indirect inference to the café by the entrance which is part of a building.

- (4.38) The sequence is backed up by script knowledge about going to a booth. Another indicator for this seems to be the elliptic construction. Note that going to a booth and eating a portion of goulash as well as buying a bottle of wine might overlap.

- (4.39) A sequence can be derived between peeling and eating an apple, however it is still conceivable that the eating of the apple and the taking of the shaver out of the briefcase might have happened simultaneously.

Summing up, accomplishments combined with other events advance narrative time provided the second situation can be seen as a consequence of the first one. The term consequentiality will be discussed in more detail in section 4.4.

Nevertheless, accomplishment sentences can precede another event that is part of it. The following section discusses such constellations where the second situation elaborates the first one further.

4.3.3.2 Elaboration
As we have already seen, accomplishments can be elaborated by another event. In contrast to English, however, for German the observation can be made that the natural end point of an accomplishment can be overridden by the subsequent context. I repeat here the example (3.23) which illustrates this phenomenon:


The defendant consumed several glasses of beer in a pub. Then he drove home. At the Brandenburger arch he had an accident and he fled the scene (without waiting for the ambulance). The police, however, was able to arrest him at his house, because a witness had written down his registration number.

Other examples where the second sentence elaborate on the first situation are the following ones:

(4.42) Mitten in jenem Winter kam er mit Fahrrad und Auftrag hierher (acc) (…) Mühsam kam er den Dorfweg herauf (acc), der an der Schule vorbeiführte (…) Durch die Fenster der Schulklasse sahen wir ihn näherkommen (…) (Lenz, Der Verzicht, p. 110)

It was in the middle of that winter when his bicycle and his orders brought (lit: came) him here (…) He toiled up the road into the village which runs past the school (…) We saw him approaching through the classroom windows (…) (Lenz, The Renunciation, p. 111)

(4.43) Plötzlich war’s Mittag —.
Wir standen draußen auf einem Damm, (…) und allen unsere Ananas (acc), wir

As in English an elaboration of an accomplishment is possible which does not lead to a progression of narrative time. Furthermore, German allows the overwriting of the final end point by further context information. This is not permitted in English, since the perfective viewpoint includes the end point. Such a cancelling of the end point has to be expressed by other means in English (e.g. background by progressive form).

The following table contains the possible temporal relations for a accomplishment.event sequence in German. Note that } refers to the inherent end point of the accomplishment. This end point may be overridden and/or the accomplishment may last longer than the second situation.

<table>
<thead>
<tr>
<th>bounded event</th>
<th>punctual</th>
<th>durative</th>
</tr>
</thead>
</table>
| event | durative | acc |...
| sem | ach | acc |
| [] | [] | [] |
| [] | [] | [] |
| [] | [] | [] |

Table 4.4: The temporal relations between accomplishments and other events

The following section is concerned with the two other bounded situation types which are punctual: semelfactives and achievements. These types are a strong indicator for the forward movement of narrative time.

4.3.4 punctual.event.event.

Punctual events (i.e. achievements and semelfactives) cannot be elaborated. However, if an iteration is conceivable, an overlapping is possible, but this behaviour is mainly restricted to semelfactives which do not introduce a result state.

A contingency structure is only introduced by achievements, but semelfactives can forward narrative time as well. This, however, relies on the world knowledge we have about typical
4.3 Discourse Sequences

A sequence of achievements reflects the temporal sequence of the situations. This can be emphasised by an elliptic construction again like in (4.44).

(4.44) Lichtenberg setzte sich an den Gartentisch (ach), griff zu seinem Federkiel (ach) und bestellte bei dem englischen Mechaniker Edward Nairne (1726-1806) eine Luftpumpe (ach), die erste in Deutschland. (Hofmann, Die kleine Stichardin, p. 22)

Lichtenberg sat down at the garden table, reached for his quill and ordered a pump from the English mechanic Edward Nairne (1726-1806) — the first one in Germany.

A semelfactive like in (4.45) which is embedded by other events moves narrative time as well. Note that Maria’s hesitation can be classified as a semelfactive since it lasted only for a moment:

(4.45) (Ich) ging zum Badezimmer rüber, klopfte an (sem), bevor sie ja sagte, dann ging ich rein (…) (Böll, Ansichten eines Clowns, p. 54)
(l) went over to the bathroom, knocked, Maria hesitated a moment before she said ‘Yes, then I went in (…)’ (Böll, The Clown, p. 37)

A sequence of punctual events is a strong indicator for a forward movement, because we can conclude by referring only to our temporal knowledge about the situations that an overlapping is excluded.

However, there are also cases where the second described situation happens at the same time as the first one:

(4.46) Die Bombe explodierte (ach). Ein ohrenbetäubender Knall erschütterte die Innenstadt (ach).

The bomb exploded. An ear-splitting bang shook the city centre.

This conclusion has to be backed up by further world knowledge. Normally, punctual events allow only a subsequent reading, as the following example shows.

Another achievement indicated by the prefix zer- followed by an accomplishment can be found in the next discourse. Note that a consequence relation can be derived between the two situations:

(4.47) (Die) runde geschliffene Scheibe (…) zer sprang (ach), fiel, teilweise nochmals zerscherbend, auf die braunroten Dielen (acc), splintering, on the reddish-brown floorboards.

(Grass, Die Blechtrümmer, p. 52)

The polished round crystal (…) burst and fell to the floor(…), where the destruction was completed. (Grass, The Tin Drum, p. 62)

4.3.4.2 Iteration

It is commonly supposed that semelfactives can be easily iterated, even achievements allow such a reading provided the iteration takes place over a long enough period of time. In (4.50), one normally gets an iteration of single knocking-events. In order to force an achievement into an iteration more context knowledge has to be made explicit. However, since we can assume that the situation type has been determined before the temporal relations are derived, a sentence like in (4.51) is actually to be considered as an activity without taking into account any further clues coming from other situations in the discourse.

(4.50) Pater Wunibald wurde wütend (sta), klopfte mit dem Finger aufs Pult (sem), berief sich auf seine Autorität und verbat sich eine “derartige Beleidigung”. (Böll, Ansichten eines Clowns, p. 55)

Father Wunibald was furious, struck the desk with his finger, invoked his authority, and said he would not put up with being “insulted.” (Böll, The Clown, p. 37–38)

(4.51) Maria bestieg den Berg immer wieder. (ach)

Mary climbed the mountain again and again.

I will not consider these iterative interpretations in this thesis any further. But one interesting observation can be made for the semelfactive in (4.50). The preceding sentence describes a state. It may be concluded that this situation type allows an iterative interpretation, but future research will show which context condition lead to which interpretation of semelfactive. For the time being, I assume such an iteration as already resolved and consider the whole situation as an activity.

Table 4.5 summarises the possible temporal relations:

Interestingly enough, if such a consequence relation cannot be obtained for a given text, it is not always clear, whether a sequence is described or not. Semelfactives which refer to a perception render quite often an overlapping reading.

(4.48) Maria blickte aus dem Fenster (sem). Peter baute eine Sandburg in dem Sandkasten vor dem Haus (acc).

Mary looked out of the window. Peter was building a sand castle in the sand pit in front of the house.

But not only perception verbs allow this reading in German, whereas a progressive form in English has to be chosen. Another example is given in (4.49):

(4.49) Johann betrat das Zimmer. Maria las ein Buch.

John entered the room. Mary was reading a book.

The accomplishment is presented as open which is conceivable assuming an open-perfective viewpoint. However, how these open interpretations can be triggered is not at all clear. Future research is needed here and should focus on the perceived perspective of the protagonists of the story.

4.3.4.3 Clues coming from other situations in the discourse.

This conclusion has to be backed up by further world knowledge. Normally, punctual clues coming from other situations in the discourse.
4.3 Discourse Sequences

<table>
<thead>
<tr>
<th>bounded event</th>
<th>punctual event</th>
<th>durative event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sem</strong></td>
<td><strong>act</strong></td>
<td><strong>acc</strong></td>
</tr>
</tbody>
</table>

Table 4.5: Punctual events followed by any bounded event

In what follows the constellation state/activity.event is discussed. Again, activities can be seen as moving narrative time, if the following event can invoke an end point for this situation type.

4.3.5 state/activity.event.

This constellation is actually the reverse of the one in section 4.3.2. The analysis shows similar results: a forward movement is possible, if a termination of the state or activity is caused by the subsequent event. In all other cases this sequence renders a backgrounding of the bounded event by the unbounded situation.

4.3.5.1 Consequence

This constellation can be used to express a progression in the narration, but only if the event leads to an end of the state or activity. That is, the inference with respect to the end point of the first situation is required:

(4.52) Ich hielt den Hörer noch in der Hand, hörte das Tuten (act), wartete (act), legte nach langem Zögern erst auf (act). (Böll, Ansichten eines Clowns, p. 138)

I went on holding the receiver, heard the buzzing tone, waited, finally replaced it after a long pause. (Böll, The Clown, p. 108)

(4.53) Der Raum war stockfinster. Peter knipste das Licht an.

The room was pitch dark. Peter switched on the light.

Note that again activities as well as states can contribute to the forward movement of narrative time. This suggests that these unbounded situation types are presented as bounded with a definite boundary, because they are limited by an event which introduces the end point for the first situation. However, the setting before such an event leads to that inference. The states and activities on their own do not allow this.

4.3.5.2 Background

If no consequentiality relation can be derived, the unbounded situation is perceived as a background for the second bounded one.

4.3 Discourse Sequences

<table>
<thead>
<tr>
<th>bounded event</th>
<th>punctual event</th>
<th>durative event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sem</strong></td>
<td><strong>act</strong></td>
<td><strong>acc</strong></td>
</tr>
</tbody>
</table>

Table 4.6: States and activities precede a bounded event

18Surprisingly enough, the translator simply omitted this sentence.

Note that again activities as well as states can contribute to the forward movement of narrative time. This suggests that these unbounded situation types are presented as bounded with a definite boundary, because they are limited by an event which introduces the end point for the first situation. However, the setting before such an event leads to that inference. The states and activities on their own do not allow this.

4.3.5.2 Background

If no consequentiality relation can be derived, the unbounded situation is perceived as a background for the second bounded one.
4.4 Forward movement of narrative time

In this section I would like to reconsider the factors which indicate a forward movement of narrative time. In particular, I will investigate how the contingency structure and the bounded situation types contribute to such a movement. It will turn out that the contingency structure plays an important role when we connect two situations. The derivation of consequentiality, which can involve a causal relation, script knowledge about typical sequences or triggering/terminating a situation will prove to be crucial.

Firstly, I will discuss the contingency structure and I will point out the importance of distinguishing two structures in German: a weak and a strong one. Secondly, I will investigate in more detail the influence the content can have on the temporal interpretation of *sensitivates*, and finally I will emphasise the interaction between unbounded situation types (i.e. states and activities) and events providing end points for those situations.

4.4.1 Contingency structures in German

As discussed in the previous sections 4.3.4 and 4.3.3, the situation types of *accomplishments* and *achievements* introduce a structure which indicates a forward movement in a narrative. However, this conclusion must furthermore be sustained by an enablement relation which has to hold between the two situations. Only if the two situations are contingently connected, is an advancing of time perceived.\(^\text{19}\)

(4.58) Peter öffnete die Keksdose. Er nahm sich zwei Kekse.

Peter opened the biscuit box. He took two biscuits.

The first sentence in the sequence (4.58) introduces an *achievement*, which establishes a structure with a culmination and a result state. The subsequent discourse has to be interpreted with respect to this structure. Only situations which seem to be conceivable regarding the result state lead to a coherent discourse, because the reader has a certain expectation of what happens next. A continuation which violates this expectation sounds odd:

(4.59) Peter öffnete die Keksdose. \(^\text{2}\) Er nahm einen kräftigen Schluck.

Peter opened the biscuit box. \(^\text{2}\) He took a long drink.

However, sentences which do not come up to our expectations set by the first sentence can easily be amended. In (4.59) the information that the biscuit box contained a liquid can be added. If we simply mentioned a glass, for example, in the second sentence, the discourse would still sound slightly odd though. However, supplying a context which connects the two described situations allows a coherent reading:

(4.60) Peter öffnete die Keksdose, während er einen kräftigen Schluck aus dem Glas nahm.

Peter opened the biscuit box, while he took a long drink from the glass.

---

\(^{19}\) See section 6.2.1.1 for a formal definition of this relation.

\(^{20}\) Compare with Comrie (1976, p. 46-47) who presents more examples.
4.4 Discourse Sequences Forward movement of narrative time

**perfective viewpoint.**

(4.62) a. Maria kochte den Fisch. Die Katze schaute gierig auf den Topf. Mary was cooking the fish. The cat was looking greedily at the pot.  

 b. Maria zerkoche den Fisch. Die Katze schaute gierig auf den Topf. Mary overcooked the fish. The cat was looking greedily at the pot.

(4.63) a. Peter las den Brief. Maria überraschte ihn bevor er ihn zu Ende lesen konnte. Peter was reading the letter. Mary surprised him and he was not able to finish reading it.  

 b. Peter las den Brief fertig. Maria überraschte ihn bevor er ihn zu Ende lesen konnte. Peter read the letter. Mary surprised him and he was not able to finish reading it.

(4.64) a. Maria redete ununterbrochen. Peter unterbrach sie. Mary was talking all the time. Peter interrupted her.  

 b. Maria zerredete das Thema. Peter unterbrach sie. Mary flogged the topic to death. Peter interrupted her.

In (4.62b) the achievement described by *zerkoche* cannot overlap with the cat’s looking at the pot. One may furthermore draw the conclusion that the fish has dissolved in the water, so that the sequence is even contradictory, because there is nothing left to look at. Sequence (4.63b) contains such a contradiction, because the first sentence indicates that Peter has finished reading the letter.

Finally, the first sentence in (4.64b) describes a completed situation which cannot be intercepted by Peter’s interrupting her. Note furthermore that adding *dauernd* (‘always’) leads to an habitual interpretation and a subsequent sentence would have to be habitual as well.

### 4.4.2 Semelfactives

As seen in the previous section 4.3, *semelfactives* can advance narrative time as well, however they do not supply a contingency structure, since they do not introduce a result state. But in a single event reading, this type contains two definite end points which is a necessary, but not sufficient, requirement for a forward movement. The enablement relation must therefore be derived from the context. This is only possible if an *achievement* or *accomplishment* can establish this connection. A typical example where we get this information from the script knowledge is (4.65):  

(4.65) Maria klopte. Peter öffnete die Tür. Mary knocked. Peter opened the door.

However, in (4.66) we cannot derive a connection between the three described situations. Neither of them can be seen as a consequence of the other. Hence we interpret the *klopfen* (‘to knock/struck’) as an iterated *activity* rather than a single event.


Father Wunibald was furious, struck the desk with his finger, invoked his authority, and said he would not put up with being “insulted”. (Böll, *The Clown*, p. 37–38)

To sum up, the temporal interpretation of a *semelfactive* is highly context dependent. The contingency structure of an *accomplishment* or *achievement* normally suggests a single event reading. If this context is not given and no consequence relation can be inferred, the *semelfactive* is interpreted as an *activity* and overlaps with the second situation.

### 4.4.3 States and activities looking for an end point

Another constellation where a forward movement can be observed was mentioned earlier (see section 4.2.1.1 on page 68). Caenepeel gives an example which contains a *state* introducing a contingency structure. However, I disagree with her analysis that the culmination is part of the state. Consider the following discourse again:

(4.67) a. Maria klopfte. Peter öffnete die Tür.  

Her representation sees the culmination (i.e. the turning the corner) as part of the *state* of the village being out of sight. But from the narrator’s point of view this state begins only after they have turned the corner. The *state* is therefore a result state of the culmination.

This observation suggests that a *state* can move forward narrative time provided the state is triggered by a preceding culmination. This culmination adds the definite beginning point to the state in (4.67). Similarly, an end point can be set, if a transition marks the end of the *state* like in the following example:

(4.68) a. Maria klopfte. Peter öffnete die Tür.  

How end points can be derived in a similar way for *activities* and consequently how this situation type can advance narrative time has been discussed in section 4.3.2.1.

### 4.4.4 Forward or backward?

Having summarised the different cases, when a narration conveys a forward movement in narrative time, I want now to reconsider whether a general principle like Dowty’s TDIP can be upheld for a German narrative. To sum up, the forward movement of narrative time can be indicated as follows:

- The occurrence of an event with a culmination evokes a so-called contingency structure. For German we have to distinguish two forms:
  - The weak structure is conveyed by an *accomplishment*. The culmination can easily be overridden. Furthermore, the internal structure of this type is accessible and can be elaborated by another situation.
4.4 Discourse Sequences

Forward movement of narrative time

- The strong structure indicated by an achievement allows a forward movement in any case. The culmination indicates a point in the flow of time and situations described by the following text are situated within the result state.

  - Semelfactives provide definite end points in a single event reading. If such a situation is contingently combined with the previous and subsequent situation, a forward movement is perceived.

  - Indefinite end points can be turned into definite ones provided a culmination which is contextually connected to the described state or activity is mentioned. However, there are also a number of cases where an overlapping or a subset relation can be observed.

  - Background: unbounded situations supply background information. This reading can be justified because these situations are presented with indefinite end points. Activities show a fuzzier behaviour than states.

  - Elaboration: accomplishments can be elaborated by a subsequent event which is seen as part of the preparatory process. States as well as activities can provide more background information, but they must be somehow linked to the preceding situation (e.g. anaphoric reference). The examples discussed present a strong counterexample for Dowty’s TDIP.

  - Iteration: semelfactives can be iterated, since they do not have a result state. As a consequence they have to be classified as activities.

Dowty’s TDIP demands a new reference time for every new situation regardless of the situation type. I discussed the problematic cases and the counterexamples in section 2.4.2. However, taking the findings of the previous section into account we can make at least one prediction for a sequence of two sentences in the Preterite. Although a fairly large set of temporal relations is conceivable, one relation is not allowed: the situation described by the second sentence cannot have happened entirely before the situation described by the first sentence. Even strong pragmatic knowledge suggesting this cannot allow such a temporal reading:

(4.69) Peter fiel hin. Maria stieß ihn.
Peter fell. Mary pushed him.

For English, Lascarides and Asher (1993) propose for (4.69) that a result relation forces the reader to interpret the reverse temporal relation for this sequence. But it seems to be debatable whether a two sentence sequence rendering such an interpretation could be found in a narration. In spoken English this reading is conceivable, but the second sentence has to be marked with a different intonation.21

In order to express the reverse temporal ordering the pluperfect has to be used:

(4.70) Peter fiel hin. Maria hatte ihn gestoßen.

4.5 Conclusions

This observation leads to the conclusion that the following temporal relation can be assumed when the reader encounters a Preterite.Preterite sequence. There must be at least one point of the first described situation which precedes at least one point of the second described situation. In order to ensure this constraint, the left boundary of the first situation has to occur before the right boundary of the second one. Or to put it another way, referring to the end points: the beginning point of the first situation (i.e. α₁) precedes the end point of the second situation (i.e. ω₂).22

Considering this constraint, a revised version of Dowty’s TDIP can be stipulated:

**TDIP 2 (revised)** Given a sequence of sentences S₁, S₂, ... Sₙ to be interpreted as a narrative discourse, the interval Iᵢ of a situation Sᵢ described by the sentence Sᵢ (for 1 ≤ i ≤ n and αᵢ referring to the beginning point of Iᵢ) and ωᵢ₊₁ to the end point of Iᵢ₊₁ is interpreted to be

1. a period of time consistent with the definite time adverbials in Sᵢ if there are any;
2. otherwise, a period of time which fulfils the following constraint: αᵢ < ωᵢ₊₁, provided this does not conflict with 1.

This interpretation principle is similar to the one proposed by Eberle (1988). He uses a relation not-before between events which expresses the same intuition that there is no backward movement perceived. In particular, his system demands for two events, which have to be accomplishments, that the beginning points precede each other. Translated into the definition just given, the temporal relation would be αᵢ < αᵢ₊₁.23

The following chapter will show how this restriction can be translated into the interval calculus proposed by Allen (1984). This investigation will furthermore prove that Eberle’s definition is too restrictive. Intuitively, this should already become obvious, when we consider an example discourse where the second situation describes an elaboration of the preceding one. A constellation is conceivable where the second situation starts at the beginning of the first one. Generally speaking, the examples given in section 4.3.3.2 do not allow the conclusion that the second situation has to start after the beginning of the first one.

4.5 Conclusions

This chapter has provided a detailed analysis of German discourse sequences. After developing a formal description of the five situation types and the open-perfective viewpoint introduced in the previous chapter, I investigated which temporal relations are perceived with respect to the possible combinations.

The following observations were made:

- **Forward Movement:** A progression of narrative time can only be inferred, if the following conditions are fulfilled for two situations A and B described by the discourse:

  21Compare with van den Berg (1996b).
  22Compare with the formal definition of end points for intervals in the following chapter.
  23Cf. section 5.5.4 for how this can be expressed within the time logic introduced by the next chapter.
Definite endpoints must be present. This can either be two adjacent end points of two situations of type *event* or the one situation A of type *event* presented in the discourse, which supplies the beginning or end point of an unbounded situation B (i.e. state or activity).

A contingency structure allows the second situation B to be connected with the first one evoking this structure. The structure opens a space of possible subsequent situations. An enablement relation has to be established to get the two situations linked.

- **Non-Forward Movement**: There are two possible cases which have to be distinguished:
  - The two situations can overlap. However, this can be a rather fuzzy relation where only one common period of time can be inferred. One important prerequisite is that at least one of the situations must have an indefinite end point. Hence *states* and *activities* normally show this behaviour of overlapping with another situation. But also *semelfactives* can overlap provided they are reinterpreted as an iteration.
  - The second situation can be seen as a *subset* of the first one which has to be an *accomplishment*. Further information whether the second situation can be part of the *preparatory process* of this situation type is needed. Note that this is actually the mirror situation to the forward condition regarding the consequent state.

- **No Backward Movement**: Compiling all possible temporal relations which are conceivable for two sentences in the *Preterite* regardless of the situation type or the derived pragmatic information, at least one prediction can be made: the situation described by the second sentence cannot have happened before the first one.

Moreover, in this chapter the concept of the *open-perfector* viewpoint has been used to explain the following phenomena peculiar to German narratives:

- **Activities** are more flexible than in an English narrative, because
  - they are perceived as unbounded in the main clause of a *bevor/nachdem* sentence.
  - they can be reinterpreted as ingressive if they occur in the *nachdem* clause.
  - they can be used as a background similar to *states*.

- Although *accomplishments* and *achievements* both introduce a contingency structure as in English, two forms had to be distinguished in German:
  - The weak form is introduced by *accomplishments*. The *open-perfector* viewpoint does not necessarily include the end point. Consequently the internal structure is easily accessible.
  - The strong form can be established by an *achievement* as in English. Note that German provides many *achievement* verbs marked by prefixes like *ver-, zer-* or *er-*. However, the usages of these prefixes is not derivational, but lexical.

<table>
<thead>
<tr>
<th>unbounded</th>
<th>bounded</th>
<th>durative</th>
<th>punctual</th>
<th>durative</th>
</tr>
</thead>
<tbody>
<tr>
<td>sta</td>
<td>act</td>
<td>sem</td>
<td>acc</td>
<td>sta</td>
</tr>
<tr>
<td>??-??</td>
<td>??-??</td>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
</tr>
<tr>
<td>bounded</td>
<td>punctual</td>
<td>sem</td>
<td>acc</td>
<td>sta</td>
</tr>
<tr>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
</tr>
<tr>
<td>event</td>
<td>durative</td>
<td>acc</td>
<td>sta</td>
<td>act</td>
</tr>
<tr>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
<td>[??-??]</td>
</tr>
</tbody>
</table>

Table 4.7: All combinations of situation types and the associated temporal relations

Two main requirements regarding a formal semantics of a narrative discourse can be derived from the investigation carried out in this chapter. First, there is a need for a precise time logic which is capable of formalising strict as well as coarse temporal knowledge. In particular, the analysis of *activity* sentences in section 4.3.2 has shown this. Second, the pragmatic knowledge needs to be grasped and expressed by a formal structure which reflects the rhetorical structure of the whole discourse.

The following chapter provides an expressive time logic, which enables us to describe the temporal relations needed for an adequate description of a narrative. The subsequent chapter is concerned with the more complex discourse level and I take into account discourses of more than two sentences, proposing a discourse grammar which, on the one hand, describes a hierarchical tree structure for the discourse, but, on the other hand, also offers the precise defined interface between this structure and the required pragmatic knowledge.
5.1 Time Logic

The two preceding chapters provided the linguistic analyses of short narrative discourse sequences in German with respect to the expressed temporal structure. It turned out that there is a need for a formal system which can account for the temporal relations more accurately than former approaches did. In particular, a flexible time logic is needed which is capable of expressing coarse as well as fine temporal relations, as shown in the previous chapter. This chapter introduces such a formal system, which will be employed to represent the temporal relations more precisely. In order to allow the temporal reasoning to be monotonic, a totally underspecified temporal relation will be assumed at the beginning of the discourse processing. The knowledge sources which can impose further constraints (viz. situation type, viewpoint, tense, rhetorical information, and world and context knowledge) are used to narrow down the temporal relation in the way discussed in the previous chapter. This chapter shows how the effects of the different influences can be formally expressed within a temporal reasoning system.

Moreover, it will turn out that the temporal relations can be ordered in a hierarchy with respect to their underspecification. These different levels of underspecification have been proven necessary by the analysis of German discourses, because it was shown that some constraints may lead to strict (i.e. temporal precedence by a coarse relation) or coarse temporal relations (i.e. unbounded situations).

5.1 Introduction

This chapter provides the theoretical background for the earlier investigation of temporal relations expressed by a narrative discourse. It should be stressed here that previous approaches do not offer an appropriate time logic incorporated into their formalisms. Many approaches assume only two temporal relations, namely a temporal precedence and an overlap relation (cf. Lascarides and Asher (1993)). More elaborate systems proposed by Song and Cohen (1988), for instance, allow coarse relations, but do not offer an appropriate analysis of the interplay of the different knowledge sources which may have a further effect on the temporal relation. Moreover, they are not able to provide a detailed analysis of narratives as presented in the previous chapters.

I therefore see the need for a formal system which is expressive enough to describe all temporal constellations discussed earlier. But the computational tractability of such a system should not be disregarded. Hence the main aim of this chapter is to present a temporal reasoning system which is expressive enough, but also computationally tractable.

Firstly, I will define a theoretical framework for a time logic which includes situations and intervals as well as points. I will define the situation type features stative, bounded, punctual and telic and specify how this information interacts with the open-perfective viewpoint. After comparing the three different levels with each other and discussing how my definition differs from the theoretical framework used in Kamp and Reyle (1993), I will mainly focus on Allen's interval calculus (Allen 1984).

Taking the definition of the sub-algebra of convex relations and the notion of conceptual neighbourhood relations into account (Freksa 1992), a temporal reasoning system will be presented, which is proved to be computationally tractable and provides an intuitively adequate representation of temporal relations in narratives.

Secondly, I will present a hierarchy of the 82 convex relations, which reflects the different levels of (in)complete temporal knowledge. This hierarchy can furthermore be used to determine the minimal point relation sets (i.e. the minimal number of point relations). It will be shown that 18 relations introduce new constraints in order to get finer temporal relations and that these relations can be connected to the temporal restrictions expressed in a narrative discourse.

The proposed time logic possesses the following advantages over other logics used for the representation of temporal relations in narratives:

- All three levels of temporal knowledge (i.e. situations, intervals, points) are taken into account: properties of the situation type may impose further constraints on the intervals and point relations. Point relations allow an efficient way to encode the temporal relations.
- Coarse and fine knowledge can be expressed within a computationally tractable reasoning system.

Finally, I will apply the time logic based on Allen's interval calculus to the results obtained in the previous chapter. These relations are furthermore constrained by the knowledge which is encoded on a more complex situation structure level. Unboundedness and punctuality will play a crucial role for narrowing down the possible temporal relations. However, some disadvantages which come from the chosen sub-algebra of the full Allen algebra will be pointed out. It will turn out that the convex relation algebra is for some cases not expressive enough to define exactly the required temporal relation. The remaining part of the chapter is organised as follows:

- Section 5.2 provides the formal frame which is needed to combine the situation type in-
5.2 Time Logic  Points, intervals, situations and their temporal relations

formation with the temporal knowledge. A three level system is presented distinguishing situations, intervals and points.

- Allen’s interval calculus is discussed in section 5.3. The algebra for intervals he developed contains all 13 conceivable relations between two intervals. In subsequent years several sub-algebras were evolved in order to restrict the full algebra to be computationally tractable. In particular, the so-called point algebra will be described in this section, focusing on the convex relations and the conceptual neighbourhood relations, which were stated by Freksa (1992).

- An inheritance hierarchy of the convex relations is proposed in section 5.4. Although the point algebra consists of 82 different relations, including the Allen’s 13 fine relations, it will turn out that only a handful of relations stand out (material from this section has appeared in Schäfer (1997)).

- Section 5.5 applies the time logic developed earlier to the results from the previous chapter. The temporal constraints imposed by situation type and rhetorical information can now be expressed by point relation constraints. A few marginal cases are discussed where the convex relations are too coarse.

- The concluding section 5.6 summarises the results of this chapter and points out that the rhetorical relations which establish the discourse structure are crucial for deriving the temporal relation which holds between the described situations.

Although the time logic discussed in this chapter allows to represent the required coarse and fine temporal relations for almost every case, it is still unclear how the temporal restrictions are introduced within a complex discourse. The following chapter addresses this issue and shows how the proposed temporal reasoning system can be used and incorporated into a discourse grammar. In particular, I will show how the rhetorical relations impose further constraints and how the discourse structure of a text sequence restricts the temporal relations even further.

5.2 Points, intervals, situations and their temporal relations

This section is not concerned with the question of how to find the most appropriate way of modelling time and temporal knowledge. However, I will propose a model which can give a formal answer to the questions touched on in previous chapters as far as I can. Where further research is needed this will be pointed out and possible choices will be briefly discussed.

In section 5.2.1 I will mainly follow the proposal made in Kamp and Reyle (1993, p. 664–674) with respect to a model theory for DRT. But I will assume a richer ontology which contains a set of situations (or eventualities) and I will show, in particular, how this leads to a deeper understanding of the five situation types introduced in chapter 3.

Additionally, in section 5.2.2 I will increase the number of possible relations which can hold between the time intervals from what was assumed in the original DRT account. This enlargement of temporal relations possesses a two-fold advantage. Firstly, strict temporal relations can be expressed if needed, and secondly, the set of coarse (or underspecified) relations is larger than in the DRT proposal. According to my analysis in the previous chapter on German discourses, this more flexible set of temporal relations seems to be required, if we want to represent the expressed temporal relations suitably.

Finally, I will discuss the influences of the situation types on the interval and point representation. This investigation will give rise to a formal definition of the features (i.e. stative, bounded, punctual and telic) used in the previous chapters and the open-perfective viewpoint.

5.2.1 A model for time

The formal language I want to propose consists of three sorts of symbols, the sort of situations (\( S \)), the sort of intervals (\( I \)) and the sort of points (\( P \)). I furthermore assume the following binary relation symbols \( \prec, \subset, \leq, > \) (i.e. precedence, inclusion and “overlap”-relation) for the situation structure, before, overlap, subset for the interval structure and for the point structure.

The relations associated with the situation structure also exhibit the internal dependencies between the situations. The relations between intervals and points are purely temporal.

5.2.1.1 Situation structure

Before defining a situation structure, I have to discuss the issue of whether the basic primitives should be events and states or events alone. I will argue for a conjoined view and introduce the term situation which will form the primitive for the formal structure instead. Note that this is not only a notational difference, but also motivated by a different choice of structuring the situations. Kamp and Reyle (1993) distinguish between events and states along the lines of the stative/non-stative distinction (cf. figure 2.2 on page 14). Consequently they introduce two types of discourse referents: \( e, s \) referring to events and \( s, e \) referring to states. I will argue against this view. Instead I will assume situations \( s, e \) based on the distinction of situation types made in chapter 3. The actual situation can be of type state, activity etc.

The idea of assuming events as a basic notion for the representation of time is motivated by a philosophical tradition initiated by Davidson (1967). He introduces the notion of events by formalising the famous sentence:

(5.1) Jones buttered the toast in the bathroom at midnight.

in the following way:

(5.2) \( \exists t \exists x \exists y (\text{buttering}(x, y, e) \land \text{toast}(x) \land \text{bathroom}(y) \land \text{at}(e, t)) \)

In order to avoid confusion caused by the terms event (or state) in italics refers to the situation type, whereas event (and state) in Roman type refers to the usage of these concepts in the given context.
Introducing events can be backed up by evidence given by the anaphoric reference we can make to an event:

(5.3)  
   a. Fred buttered the toast. He did it in the bathroom. He did it at midnight.
   
   b. Fred buttered the toast. That was strange.

Semantic theories like DRT are influenced by this tradition. Consequently, DRT introduces events as discourse referents. However, Kamp and Reyle (1993) differentiate between states and events and treat them differently within their construction algorithm. We have already seen that states and the other situation types behave differently, especially regarding the temporal relations which are conveyed in a narrative discourse. But the question has to be asked how this fundamental distinction between events and states for the assumed ontology can be justified. Kamp and Reyle (1993, p. 508) stress that a change of state is expressed by an event. States, on the other hand, describe only a certain “condition” or “state of affairs”. Compare (5.4) with (5.5):

(5.4) Mary wrote a letter.

(5.5) Mary was ill.

However, they have to admit that context allows us to conceptualise a state like that in (5.5) as an event in the following text:

(5.6) I only corrected the paper last night. First I had to finish the grant proposal. Then I was ill. Then we had the project review which took three days and more than a week of preparation.

But it seems to be debatable whether the context leads to a change from a state to an event discourse referent. The context rather adds an end point to the state of being ill via the temporal conjunction then. Note furthermore the effect we get when the second then is omitted. In that case, an overlapping with the last situation is the most natural reading. But this is impossible if we assume only events and states as possible discourse referents. The discourse referent introduced by the sentence I was ill would be interpreted as an event in the first case, but as a state in the second case.

Note too that it is totally unclear how a conceptualised change from a state to an event can be achieved and formally represented within the proposed framework of DRT. It seems to be more natural to represent events and states as distinct types of situations (or eventualities). As discussed in the third chapter, states are seen as situations which lack definite end points. By explicitly referring to those boundaries of the situation they can be inferred by the reader. Example sequences where a bounded situation introduces or terminates an unbounded situation are given in the previous chapter (i.e. section 4.3.2.1). It is not the case that I was ill sometimes is conceptualised as an event and sometimes as a state.

Interestingly enough, other proposals have been made which draw a slightly different picture of event and state realms. Herweg (1991a) suggests a distinction where events are described as individuals like in DRT, but states are represented merely as propositions over times. Recent proposals build on this idea of a multi-sorted description language and enlarge the set of different realms by adding processes (Sandström 1993).

We can now return to the main purpose of this section and give a definition of a situation structure. A situation structure is a tuple $S$ which represents the following:

$S = (\langle s, S, s \rangle)$

where $S$ is the temporal precedence structure. A situation structure is a tuple $S$ and

$S = (\langle s, S, s \rangle)$

The following axioms have to hold:

$S_1 \forall s, s' (s \prec s' \rightarrow \neg (s' \prec s))$ (asymmetric)

$S_2 \forall s, s', s'' ((s \prec s' \land s' \prec s'') \rightarrow s \prec s'')$ (transitive)

$S_3 \forall s (s \prec s)$ (reflexive)

$S_4 \forall s, s' (s \prec s' \rightarrow (s' \prec s))$ (symmetric)

$S_5 \forall s, s', \forall s'' ((s \prec s' \land s' \prec s'') \rightarrow s \prec s'')$ (transitivity)

$S_6 \forall s, s' \forall s'' ((s \prec s') \lor (s \prec s') \lor (s \prec s'))$ (generalised transitivity)

Note that the axioms $S_1$ and $S_2$ establish a partial ordering for $S$ and $\prec$. It will turn out, however, that another relation will be quite useful, namely inclusion (i.e. $\subseteq$). A slightly different ontology for time proposed by van Bentham (1983) introduces this relation beneath the precedence relation.

The following axioms have to hold:

$S'_9 \forall s, s' ((s \subseteq s' \land s' \subseteq s) \rightarrow s' = s)$ (anti-symmetric)

$S'_9 \forall s, s', \forall s'' ((s \subseteq s' \land s' \subseteq s'') \rightarrow s = s'')$ (transitive)

$S'_{10} \forall s (s \subseteq s)$ (reflexive)

The structure just defined does not provide information about the actual time of the described situations nor does it offer a particularly impressive set of temporal relations. Furthermore, a notion of time points is lacking. The following section describes briefly how this structure can be defined.

---

\footnote{Rhetorical relations like result and termination provide the formal justification for this behaviour. See section 6.2.1 for more details.}

\footnote{Note that the latter relation is a rather coarse temporal relation which only has to fulfil the following axioms.
(cf. the overtapping relation between intervals defined by Allen which is more restrictive in section 5.2.2.)}

\footnote{The same set of axioms is found in (Kamp and Reyle 1993, p. 667). $S_3$ (transitivity) can be derived from $S_9$ (reflexivity) and $S_{10}$ (generalised transitivity).}
5.2 Points, intervals, situations and their temporal relations

5.2.1 Point structure

There are two ways to define a point structure. Either one can give a formal definition of how to derive a point structure from a given situation structure or one can simply assume a primitive category of points independently from the situation structure. I will adopt the latter possibility in the following.\(^5\)

Modelling a point structure \(P = (\mathcal{P}, \prec)\) as a second irreducible primitive, we can assume an abstract structure of points which fulfils the following axiom system:

\[
P_1: \forall p \,(-p < p)) \text{ (irreflexive)}^6
\]

\[
P_2: \forall p \,(p < p' \Rightarrow -[p' < p]) \text{ (asymmetric)}
\]

\[
P_3: \forall p,p',p'' \,(p < p' \land p' < p'') \Rightarrow p < p'' \text{ (transitive)}
\]

\[
P_4: \forall p,p' \,(p < p') \lor (p < p'') \lor (p = p') \text{ (linear)}
\]

The derived point structure can be shown to be a strict linear order.

Such a structure does not have to be dense. However the way we want to model time, such a structure should have this property. Hence the following axiom is added:

\[
P_5: \forall p,p' \,(p < p' \Rightarrow \exists p'' \,(p < p' < p''))
\]

Taking the given axioms into account, we can take the set of real numbers (\(\mathbb{R}\)) or rational numbers (\(\mathbb{Q}\)), which fulfill the requirements for a point structure. Kamp and Reyle (1993) mention only the real numbers, but I will remain agnostic about the choice between the two structures.\(^7\)

Having defined two irreducible primitives for modelling time, I will now introduce the notion of an interval which will serve as a connection between the two other structures. The explicit link between them is made via a function \(\text{LOC}\) which assigns to each situation a maximal time interval. The definition of the interval structure will be introduced in the following section.

5.2.1.3 Interval structure

After showing how a situation structure and a point structure can be independently proposed having certain properties, we now define the interval structure \(I = (I, \text{before}, \text{meets}, \text{subset})\), where \(\text{before}\) is the temporal precedence ordering, \(\text{meets}\) the temporal meets relation (i.e. two

\^5According to Kamp and Reyle (1993, p. 668), a point structure could be induced from a situation structure. Generally speaking, a point can be seen as a maximal subset of pairwise overlapping situations. This procedure quite naturally yields a definition of the precedence relation between points (i.e. \(\prec\)) and additionally it gives a clear definition of a situation occurring at a point.

\^6This axiom is strictly speaking superfluous, since it follows from \(P_2\).

\^7The choice between these two structures would be motivated by the decision between a continuous or non-continuous time structure. The consequences implied by this choice are not taken into account for the proposed time logic. But see Hubel (1994) for further discussion of this topic.

5.2 Time Logic

intervals \(i_1\) and \(i_2\) meet if they share one common time point\(^9\) and the temporal subset relation. I do not give a precise definition of these temporal relations here, because the exhaustive set of temporal relations will be presented later in section 5.2.2.2.

An interval is defined as a convex set of points, indicated by a pair of points. I already used intervals for the semi-formal representation of the situation types in the previous chapter. A formal definition can now be provided which also distinguishes between open and closed intervals:

Definition 1 (Open and Closed Intervals) Given a point structure \(P\) and the temporal precedence relation \(\prec\), the following definitions can be given (note that \(p_1 \leq p_2\) is defined as \(p_1 < p_2\) or \(p_1 = p_2\)):

- **Open Interval**: \([p_1, p_2) \triangleq \{p \mid p_1 < p < p_2\}
- **Closed Interval**: \([p_1, p_2] \triangleq \{p \mid p_1 \leq p \leq p_2\}
- **Right Semi-Open Interval**: \([p_1, p_2) \triangleq \{p \mid p_1 \leq p < p_2\}
- **Left Semi-Open Interval**: \([p_1, p_2) \triangleq \{p \mid p_1 < p \leq p_2\}

The open intervals are used for representing the temporal extension of unbounded situation types, whereas the closed ones refer only to the bounded ones. Interestingly enough, it now becomes obvious that the use of the term unboundedness is a bit misleading, since even an open interval is defined via a boundary. However, it has to be stressed that an unbounded situation is not a situation without any boundaries (i.e. everlasting), but one where the boundaries do not belong to the situation. This intuition is reflected by the definition of an open interval.

In order to establish the connection from the situation structure to the interval structure, we have to introduce a function \(\text{LOC}\) which maps each situation \(s\) of \(S\) to an interval of \(I\). Following the approach described by Kamp and Reyle (1993, p. 671), I assume a point structure \(P(\mathcal{S})\), which is a substructure of \(P\). I stipulate furthermore that the situation structure \(s\) and the point structure \(P\) are related by the function \(\text{LOC}\). This function assigns to each situation \(s\) of \(S\) an interval \(I\) of the interval structure \(I\) which is derived from the point structure \(P(\mathcal{S})\).

This function \(\text{LOC}\) has to fulfill the following requirements: 8

1. \(s \prec s' \Rightarrow \text{LOC}(s) \cap \text{LOC}(s') \neq \emptyset\)
2. \(s \subseteq s' \Rightarrow \text{LOC}(s) \subseteq \text{LOC}(s')\)
3. \(s \cap s' = \emptyset \Rightarrow \text{LOC}(s) \cap \text{LOC}(s') = \emptyset\)
4. \(\forall p \in \mathcal{P}(\mathcal{S}) : (p \in \text{LOC}(s) : s \in p) \neq \emptyset\)

There has been an extensive discussion in the literature how this function\(^10\) is to be defined with respect to the different situation types. I will not repeat an overview about the different systems which can be found elsewhere (e.g. Eberle (1991)).
5.2 Time Logic

Points, intervals, situations and their temporal relations

But the conditions when the \( \text{LOC} \) function holds for the set of situation types I introduced earlier have to be named. Section 5.2.3 deals with this subject.

Additionally to the formal definitions which are to a large extent already proposed in Kamp and Reyle (1993), with the exception that I assume situations instead of events as primitives, I would like to assume two functions which extract the end points of an interval, called \( \alpha, \omega : I \rightarrow P \). These relations draw the explicit connection between the end points of an interval and the point structure.

**Definition 2** Two functions are defined for a given interval and point structure, as follows:\(^\text{11}\)

- \( \alpha([p_1, p_2]) = \alpha_{stf}, p_1 \)
- \( \omega([p_1, p_2]) = \omega_{stf}, p_2 \)
- \( \alpha([p_1, p_2]) = \alpha_{stf}, p_2 \)
- \( \omega([p_1, p_2]) = \omega_{stf}, p_1 \)
- \( \alpha([p_1, p_2]) = \alpha_{stf}, p_1 \)
- \( \omega([p_1, p_2]) = \omega_{stf}, p_2 \)
- \( \alpha([p_1, p_2]) = \alpha_{stf}, p_2 \)
- \( \omega([p_1, p_2]) = \omega_{stf}, p_1 \)

The end points of an interval become accessible with the functions \( \alpha \) and \( \omega \). This will become important, when a temporal reasoning system based on point relation constraints is defined in section 5.3.1. It is furthermore to be stressed that the end points of an open and a closed interval are the same, although the end points are explicitly excluded for the open one.

In order to use the reasoning mechanism introduced later this is a necessary definition.\(^\text{12}\)

But the distinction between open and closed intervals will have further implications for the conceivable temporal relations, as discussed in section 5.5.1.

In substance, the proposed structure allows us to distinguish three different levels of abstraction:

- A situation structure reflects the knowledge we have about the occurrences in the world we are able to describe linguistically.
- A function \( \text{LOC} \) relates the situations to their temporal extension.
- A point structure builds the basis for the interval structure and depicts the continuous flow of time on the most abstract level.

\(^{11}\)As already informally used in the previous chapter for the revised TDP; \( \alpha_{st} \) is the short form for \( \alpha([s, t]) \), given that \( s \) is an interval.

\(^{12}\)The temporal reasoning system by Allen, which will be introduced in the following section, does not distinguish between open or closed intervals.

In the next section, I will discuss the expressed temporal knowledge with respect to the relevant structure in more detail. I will in particular introduce further constraints, assuming a logical representation in the form of first order predicate logic. However, where further extensions of this formalism have to be made this will be explicitly noted.

5.2.2 Temporal relations

A three-fold system of situations, intervals and points is assumed for the proposed time logic. As already seen, temporal relations can be found on each level. But the question has to be asked whether the proposed relations \(<\) and \(=\) are expressive enough for the temporal relations we encounter in a narrative discourse. Most former approaches to the representation of temporal relations in a narrative discourse limited the set of temporal relations to the two introduced in the previous section. Additionally, the \( \subseteq \) (most) relation was occasionally used within the DRT representation. As Kamp and Reyle (1993) note for their own framework there is nothing sacrosanct about the choice of the set of temporal relations used.\(^\text{13}\) Considering the analysis of narratives in German carried out in the previous chapter it is indeed necessary to explore how we can present a richer system of temporal relations.

Taking this issue as a starting point, this section discusses what kind of information is expressible on which level and which advantages and disadvantages of point, interval and situation (or event) structures have to be taken into account.

5.2.2.1 Situations

Generally speaking, the different levels of situation, interval and point structures coincide with an increasing abstraction of the expressed temporal knowledge. On a situation level predications can be made about the internal structure of the situation. This allows us, for instance, to say something about the felicity of the combination of situation types with certain time adverbials. As discussed earlier in section 2.3, the oddness of the combination of punctual adverbials and accomplishments can be explained on this level (cf. criticism of reference time on page 17):

\[(5.7)\] At 6 pm, John built a house.

None the less, the set of basic temporal relations is quite restricted on this level. Only two relations which hold between situations are normally assumed, namely the precedence relation \(<\) and the general overlap relation \(=\). Additionally, there may be more explicit relations defined on this level. The sub-situation relation \(\subseteq\) is more restrictive than the “overlap” relation \(=\). This relation applies only to situations which can be seen as part of each other (e.g. boiling water is a part of cooking spaghetti). This level therefore describes the inherent dependencies between situations which will get lost as soon as we present the temporal relations by intervals.

In addition, I would like to introduce two relations which refer to the beginnings and endings of situations, namely initial and final. The relations initial and final are used to specify the sub-situations which share the boundaries of a situation.

\(^{13}\)See footnote 76 in Kamp and Reyle (1993, p. 668).
5.2 Time Logic Points, intervals, situations and their temporal relations

Definition 3 Initial and final parts of a situation are defined as follows:

- \( \text{initial}(s, s') =_{df} s \subseteq s' \land \neg \exists s'' (s'' \subseteq s' \land s'' \prec s) \)
- \( \text{final}(s, s') =_{df} s \subseteq s' \land \neg \exists s'' (s'' \subseteq s' \land s \prec s'') \)

To sum up, initial and final are used to describe those sub-situations which share the same beginnings and endings of a situation \( s \), respectively.

In order to get a more detailed set of temporal relations we descend to a more abstract representation, namely an interval structure.

5.2.2.2 Intervals

It is important to stress the observation made in the previous section which draws a line between the realm of situations and the more abstract realm of intervals (and points). We know, for instance, that cooking a meal may involve chopping some onions or boiling water. This knowledge is based on the inherent structure of the domain. If we wanted to organise and to optimise this process, and we would probably refer to the temporal extension of the sub-situations, we would be able to distinguish between punctual events (e.g. opening a bottle) and durative ones (e.g. washing the vegetables). Naturally, a more detailed description on an interval level would lead to more temporal relations. What we gain by this abstraction is hence an elaborate set of temporal relations. It is a matter of fact that 13 temporal relations at an interval level describe an exhaustive set of relations for these two-dimensional objects. Interval calculi have been proposed and investigated to do temporal reasoning with these relations. The most well-known formalism for the representation of temporal knowledge based on intervals was proposed by Allen (1984). He presumes a temporal reasoning system which contains all 13 conceivable relations between intervals: \( b(\text{before}) \), \( m(\text{meets}) \), \( o(\text{overlaps}) \), \( s(\text{starts}) \), \( d(\text{during}) \), \( f(\text{finishes}) \), the 6 reverse relations \( b^{-1} \), \( m^{-1} \), \( o^{-1} \), \( s^{-1} \), \( d^{-1} \) and \( f^{-1} \) and \( eq(\text{equal}) \) (cf. figure 5.1).

Formally, the 13 relations can be defined via the relations between the end points. The two functions \( \alpha \) and \( \nu \) are used to make this connection between the point and the interval structure. Table 5.1 summarises the point relations which hold between the end points of the intervals for all 13 conceivable relations.

<table>
<thead>
<tr>
<th>Relation</th>
<th>Symbol</th>
<th>Inverse</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>x before y</td>
<td>b</td>
<td>b\text{'}</td>
<td>x</td>
</tr>
<tr>
<td>x meets y</td>
<td>m</td>
<td>m\text{'}</td>
<td>x</td>
</tr>
<tr>
<td>x overlaps y</td>
<td>o</td>
<td>o\text{'}</td>
<td>x</td>
</tr>
<tr>
<td>x starts y</td>
<td>s</td>
<td>s\text{'}</td>
<td>y</td>
</tr>
<tr>
<td>x during y</td>
<td>d</td>
<td>d\text{'}</td>
<td>x</td>
</tr>
<tr>
<td>x finishes y</td>
<td>f</td>
<td>f\text{'}</td>
<td>y</td>
</tr>
<tr>
<td>x equal y</td>
<td>eq</td>
<td>eq\text{'}</td>
<td>y</td>
</tr>
</tbody>
</table>

Figure 5.1: The 13 interval relations

Finally, the most abstract level allows the construction of a dense time line of the real (or rational) numbers. Based on the axiom enforcing the density we can conclude that another point between two points can always be found. The set of temporal relations, however, has shrunk to \( \{<, -, >\} \) if we have points only.

An explicit account of how the situation types interact with the interval and point level is still needed. The next section will show how the features of the situation types (i.e. \text{static}, \text{bounded}, \text{punctual}, \text{telic}) may have further influences on the other two levels.
5.2 Time Logic Points, intervals, situations and their temporal relations

<table>
<thead>
<tr>
<th>$0^1(s_1)$</th>
<th>$0^2(s_2)$</th>
<th>$0^1(s_1)$</th>
<th>$0^2(s_2)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s_1$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_2$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_3$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_4$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_5$</td>
<td>$&gt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_6$</td>
<td>$&gt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_7$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_8$</td>
<td>$&gt;$</td>
<td>$&gt;$</td>
<td>$&lt;$</td>
</tr>
<tr>
<td>$s_9$</td>
<td>$&gt;$</td>
<td>$&gt;$</td>
<td>$&gt;$</td>
</tr>
</tbody>
</table>

Table 5.1: The 13 interval relations and its point relations

5.2.3 Situation types and interval constraints

In this section I want to go into greater depth regarding the constraints which are imposed by the different situation types. I will examine how the situation types allow further conclusions with respect to the described situation.

Moreover, I have now reached a point where I have to define more precisely what a situation is and how different situation types can be derived. The idea proposed by Davidson (1967) of having an event argument for each predicate will be developed further for this purpose. This additional event argument, which I would like to call situation argument, contains a situation $s$ defined earlier within the situation structure. In order to distinguish the five situation types the predicates have to fulfill certain properties.

Similar to the Davidsonian approach, the situation theoretic framework developed by Barwise and Perry (1983) assumes a situation as a part of the world that provides certain information. Most interestingly for the phenomena I discuss in this thesis, situations are viewed as spatiotemporally-located entities.

Formally speaking, a situation $s$ supports information we know about the situation (i.e. the so-called asnom $\sigma$) which is expressed in a situation semantic representation as $s \models \sigma$. This is also the way to represent propositions as an object of the situation theoretic universe.14 This kind of proposition is used for describing the meaning of a simple declarative sentence. A sentence like Smith hired Jones specifies a situation $s$ as the described situation. In the following, this will be formally represented as $P(s)$, where $P$ is the predicate $\text{hired}(\text{Jones, Smith})$.

I will define how situations can be categorized according to the properties of the predicates which are assigned to a given situation. Firstly, I will discuss in which way states and the other situation types can be distinguished by stative predicates.

Secondly, a particularly important distinction which was already made between bounded and unbounded situations in the previous chapter will be defined. As a consequence, states and activities are represented as open intervals, whereas accomplishments, achievements and semelfactives are mapped to closed intervals.

Thirdly, the definition of telic is given. This feature is crucial in order to differentiate between achievements and accomplishments and the other three situation types.

Fourthly, the distinction between punctual and durative situation is defined. Generally speaking, in order to define the restrictions which are imposed by the different situation types and the viewpoint, we have to spell out precisely when such a predicate holds. Research carried out by Allen (1984), McDermott (1982) and Shoham (1987) has already discussed the usage of different entities which are associated with the intervals or points. Allen, for instance, introduces a three-folded system of properties, events and processes. McDermott, on the other hand, proposes a dichotomy between facts and events. A more elaborate system was developed by Shoham (1987). Their proposals were mainly intuitively motivated and lack a detailed linguistic motivation. An aim of this section is therefore to combine the findings of linguistic investigation regarding the situations types (e.g. Smith (1991)) with the more logically oriented representation. Bear in mind that the linguistic tests in chapter 2 and 3 were used to determine which predicates should be categorised as state, activity, accomplishment etc. In what follows I will incorporate some of Shoham’s insights into the system of situation types discussed earlier. This can be done fairly straightforwardly, since his time logic is based on intervals definable by points as well. The features stative, bounded, punctual and telic are constraints on the expressed propositions. The term “unbounded situation”, for instance, should be understood as a shorthand for “situation in the extension of an unbounded predicate”.

5.2.3.1 Stative

A feature stative is needed to distinguish states from the other four situation types. A situation $s$ is defined as stative if it is in the extension of a stative predicate. The class of stative predicates was categorized according to the linguistic tests described in chapter 3. Consequently, a predicate $P$ which holds for such a situation is defined as stative iff the $P$ holds for every sub-situation $s'$ of a given situation $s$.

Definition 4 (stative) A predicate $P$ is stative iff $\forall s, s'$ ($P(s) \land s' \subseteq s$) $\rightarrow P(s')$

Consequently, a predicate $P$ (e.g. Peter was happy) which may be true for a situation $s$ holds furthermore for every sub-situation $s'$.

Consider that a stative predicate describes a situation $s$ rather than a time $t$, because an anaphoric reference is possible to this situation.15 Referring back via an anaphoric expression like Mary saw it requires a situation $s$ for Peter being happy, whereas a temporal adverbial

---

14The proposition $s \models \sigma$ is called an Austinian proposition by Barwise and Etchemendy (1987). They contrast this kind of proposition with so-called Russellian propositions which do not describe a particular situation, such as in statements like $2 + 2 = 4$.

15See discussion on events and states on page 115.
5.2 Time Logic

Points, intervals, situations and their temporal relations

Like at 3pm picks out the time point \( p \). Proposals made by Herweg (1991a), for instance, define stative propositions only over times. This approach is problematic, because the anaphoric references cannot be explained. One needs to have a discourse referent \( s \) to refer back to the situation instead of having only a time as antecedent. Moreover, he defines activities as stative as well. But note that an activity like Peter ran is not true for all its time points. Consequently, the criterion has to be treated differently for activities.

We can conclude that for the remaining four situation types there is a certain dynamism involved. That means, the property \( P \) cannot be downwardly inherited to the punctual sub-situations of a situations, but only to a certain limit. On the one hand, we have activities which are valid down to a certain lower bound and, on the other hand, bounded situations hold only over the assigned time interval.\(^{16}\)

Taking the linguistic evidence discussed on page 12 in chapter 2 into account, I will define a further feature bounded which distinguishes states and activities from the other three situation types in the next section.

5.2.3.2 Bounded

I introduce the property bounded here, because it has proven to be crucial regarding the question of whether we perceive a forward movement of narrative time or not.

Definition 5 (bounded)\(^ {17} \) A predicate \( P \) is bounded iff \( \forall s, s' (P(s) \land s' \subseteq s) \rightarrow \neg P(s') \)

A bounded predicate \( P \) consequently holds only for situations with the temporal extension \( \text{LOC}(s) = [p_1, p_2] \) and not for any sub-situation of it. Conversely, unbounded predicates hold over situations and their sub-situations, but only stative predicates hold also for every punctual sub-situation. Note that the function \( \text{LOC} \) assigns an open interval to such situations.

There are a couple more words to say about the construction of intervals. One interesting conclusion we can draw is that an open interval must have a duration. It cannot only consist of one point provided we have a dense point structure.

An unbounded predicate can only describe a situation which has an open time interval as its temporal extension (i.e. \( \text{LOC}(s) = [p_1, p_2] \)). Notice that this combines with our intuition about such situations. They can only be closed by a bounded situation, they do not have any definite boundaries. Although they may have end points, those points are determined by another bounded situation.

Interestingly enough, we can furthermore conclude that two unbounded situations cannot meet. According to the definition of meet the two intervals need to have a common time point. But the end points of the intervals are explicitly excluded per definitionem. That means that two open intervals can come arbitrarily close to each other, but they will never share only one single point in time. This reflects again our intuition that two unbounded situations in a narration are understood as overlapping (i.e. \( s \)). We can only think of two unbounded situations in a sequence (i.e. \( s \) before \( s' \)), when we assume a bounded situation in between them triggering this transition.\(^ {18} \)

These findings are taken up by the discussion of how unbounded situation can be represented within the proposed formal framework in section 5.5.

Having seen that our intuitions about unboundedness are adequately expressed by open and closed time intervals and that a bounded predicate holds only over the whole situation, we can now proceed and define the feature punctuality in the following section.

5.2.3.3 Punctual

The next property I want to discuss is punctuality. A predicate \( P \) describes a punctual situation \( s \) iff all sub-situations \( s' \) are equal to \( s \).

Definition 6 (punctual) A predicate \( P \) is punctual iff \( \forall s (P(s) \rightarrow \forall s' (s' \subseteq s \rightarrow s = s')) \)

Bear in mind that such a situation should not be seen as a point without any duration. Since we want to represent punctual situations as without any further sub-situations has important consequences with respect to temporal reasoning, as was pointed out by Allen and Hayes (1989). However, they make their claims within a purely interval based framework which leads to a couple of complications. Generally speaking, they describe intervals which do not contain any other sub-intervals as moments. Apart from their representation of intervals which always possess a duration they assume time points which only exist as an abstraction of real world events and are associated with them as the beginning and ending, respectively. Unfortunately, it is not clear what they actually refer to by their notion of points, whether this is a point structure as defined earlier or only the boundaries which come with the intervals. It is also questionable why those points are an abstraction of real world events and not the intervals.

I believe that a clearer picture can be given when we assume a three-fold system which also includes the situation structure. Then, we can make a clear-cut distinction of punctual and durative situations on this level which has further implication for the interval structure.

Furthermore, time points are the points in \( P \), the abstract time line invoked by \( R \) (or \( Q \)). We gain a dense time line which serves as an intuitive and abstract representation of time. This kind of representation is not offered by the account due to Allen and Hayes (1989).

Since this whole issue is quite important for the representation of aspectual knowledge, this section will elaborate on their approach and show how further constraints can restrict the interval relations. It should be stressed here that I still assume intervals as the temporal extension of situations and see moments as further restrictions which can be imposed on the temporal relation holding between two intervals, assuming that moments are a special kind of interval derived from a punctual situation.

\(^{16}\) Compare with Shoham (1987) who defines an interval-downward-heritary property which would apply to activities.

\(^{17}\) The strict inclusion relation is defined as \( s \sqsubseteq s' \land \neg s = s' \).

\(^{18}\) Temporal adverbs like four hours later may have a similar effect.
5.2 Time Logic

Points, intervals, situations and their temporal relations

As a consequence, punctual situations are not represented as points without any duration which would contradict our perception of situations which always last a certain period of time.

In their framework, Allen and Hayes (1989) define a moment as an interval with no internal structure. They assume moments to have a duration which can therefore be seen as a presentation of punctual events. While moments can be related to other intervals, time points cannot stand alone and always have to refer to an interval. It is furthermore important to note that these time points define an internal structure especially for overlapping intervals. If two intervals overlap, a third interval can be inferred from this constellation, namely the period of time the two intervals share.

However, note that this definition works only on the basis of intervals and an important feature to distinguish moments from real intervals is the internal structure. How this can be described on an abstract interval level is not clear. I therefore favour the approach presented earlier, where the distinction with respect to punctuality is made on a situation level.

Allen and Hayes (1989) introduce the more abstract notion of a time point in order to include a point structure possibly referring to the rational or real numbers, but they do not mention this explicitly. Instead, a more precise notion of a three-fold system containing situations, intervals and points is given in the proposed system in this thesis instead.

One important finding by Allen and Hayes (1989) should be mentioned here. Within their axiomatic system they can prove the following lemmas:

Lemma 1 (MO1)

\[ \forall m, j \ (\text{moment}(m) \rightarrow m \in \{ b, m, c, s, d, j, f, m, b, s \}) \]

Lemma 2 (MO2)

\[ \forall i, j \ (\text{moment}(i) \land \text{moment}(j) \rightarrow i \in \{ b, m, c, s, d, j, f, m, b, s \}) \]

I will use these constraints for representing punctual situations so as to further restrict the reasoning on the temporal relations. Note that according to the two lemmas only a reduced set of temporal relations is allowed. The next section 5.3 will give an exact account how this can be done in a computationally efficient way, before I can give a more concise reformulation of the lemmas in 5.5.2.

Finally, a feature has to be defined which allows us to distinguish telic and atelic situations.

5.2.3.4 Telic

In order to distinguish semelfactives from achievements and activities from accomplishments we have to define the feature telic. This feature reflects the observation that situations can introduce a consequent state. This situation begins immediately after the end of the bounded event. The temporal extension of this result state is represented as an open interval. Following Egg (1995) I define a telic predicate as follows:

Definition 7 (telic) A predicate \( P \) is telic if there is necessarily another predicate which does not hold for a situation \( s' \) immediately before \( s \), but does hold immediately after \( s \) for situation \( s'' \). The necessity operator rules out the possibility that a predicate \( P' \) may happen to be accidently true after the telic situation \( s \). This ensures that the situation \( s \) has actually evoked the change from a situation \( s' \) where \( \neg P' \) holds to \( s'' \) where \( P' \) is valid.

 Additionally, the formula has to exclude a trivial fulfilment which is surely not intended. The formula in definition 7 can, for example, easily be fulfilled by a predicate \( P' \) of being accidently true after the described situation \( s \). Consequently, a restriction has to be imposed which allows \( P' \) to be true for a situation \( s'' \) even if \( P' \) is not valid for any situation \( s'' \).

This makes sure that the predicate \( P' \) is not trivially fulfilled only because \( P' \) holds. Formally, this can be expressed by the following constraint: \( \text{C} = \neg (P'(s') \land \neg s''(P'(s''))) \).

This additional constraint \( C \) has to exclude predicates which are dependent on the existence of a predicate \( P \). In order to do that, it should be possible that there is a world \( w \) where \( P'(s') \) is true without any situation \( s'' \) which fulfils \( P' \). The predicate to enter a room, for example, requires a result state like \( \text{being in the room} \). Such a predicate is a good candidate for \( P' \), because it fulfils the additional constraints. It is conceivable that somebody is in a room without ever entering it. A predicate like \( \text{just being after y} \) would be filtered by this constraint, because it demands that there is no situation which fulfils \( P \) at all.

Although definition 7 is similar to the definition of TEL by Egg (1995), three differences need to be pointed out. First, I do not assume times but situations, as introduced earlier. Second, the situation \( s \) does not have to be the minimal situation (or time \( t \) for Egg’s definition) with respect to the two situations proceeding and following \( s \). This further constraint can be neglected, since it is only used to show that TEL implies BD (i.e. boundedness as defined on page 116). Third, Egg uses \( \neg P' \) (i.e. the contrary of \( P' \) holds) instead of \( \neg P'' \) (i.e. \( P'' \) does not hold or is undefined). He uses this feature for justifying a new situation type, namely the interregresive. This situation type can be categorised as BD but not TEL. Note that Egg’s definition requires there to be a time where \( \neg P'' \) is valid. Compare (5.8) with (5.9):

(5.8) Fritz entered the pub.
(5.9) Fritz ran a mile.

Only for (5.8) can a predicate \( P' \) be found (i.e. \( \text{being in the pub} \)) which is true after the described situation and where the contrary \( \neg P'' \) is valid immediately before that. This strict version of telicity gives rise therefore to a new situation type. However, I do not want to take this new type into account and so use the definition of telicity which covers the spirit of previous definitions of the feature in the literature. That means that only \( \neg P'' \) is required (cf. \( \text{CHANGE-OF-STATE} \)) by Sandström (1993, p. 113) or Dowty’s BECOME in Dowty (1979, p. 141).\(^{20}\)


\(^{21}\)The temporal relations are captured via the open and closed intervals for my definition, whereas Egg’s proposal uses an adjacency relation between times. The definition of this relation is given in Herweg (1990, p. 98) and requires that two intervals are adjacent if all intervals in between are points of time (cf. definition of punctuality). I believe that my definition is more appropriate, because the result state follows immediately after the telic situation. It seems to be rather odd to allow a temporal gap between them, even if this is only a point.
We now have obtained the formal definitions for all the situation types, but we have not formalised how the viewpoint allows us to make further inferences with this knowledge. I will propose a formalisation in the following section.

5.2.4 Open-perfective viewpoint and temporal constraints

Finally, the contribution of the open-perfective viewpoint has to be described. It will turn out that a default rule can be defined which captures the observation that normally a perfective reading is assumed which, however, can be overridden provided the context allows this.

As already pointed out in chapter 3, the open-perfective viewpoint confirms the initial part of a situation, but refers only to our world knowledge regarding the final part of it. That means, we presume only by default that the whole situation is actually described. Note that every subpart which includes the initial boundary of a situation can be called initial. The whole situation is consequently also an initial part of itself. Consequently, this default assumption works fine for most cases and in particular for a single sentence.

The default rule, however, might get overridden by a specific context. As shown in chapter 3, there are two cases where the open-perfective viewpoint allows a different reading:

a. Another situation is mentioned which overrides the natural end point of the first situation (cf. discourse sequence (3.15) on page 40).

b. A state (or an activity) can focus on the preparatory phase of an accomplishment (cf. discourse sequence (3.31) on page 51).

Both cases have to be formalised by default rules more specific than the general one in order to get the correct temporal reading. The general default rule introduced by the open-perfective viewpoint which is represented as a predicate op holding between a situation and a predicate P is as follows:

- **the open-perfective viewpoint normally has a perfective reading:**

\[ \text{op}(\text{me}(a), P) \Rightarrow P(\text{me}(a)) \]

Since the specific readings a and b only occur within a narrative context, this observation has to be expressed formally as well. I adopt the updating function \( i \) introduced by Lascarides and Asher (1993) to relate a newly processed sentence \( \beta \) to an already existing discourse \( \gamma \) via a sentence \( \alpha \). Two more specific default rules can now be defined as follows:

Firstly, context knowledge which allows us to conclude that the situation described by \( P \) was not complete leads to the conclusion that the described situation \( \text{me}(a) \) is not of type \( P \).

- **the open-perfective viewpoint allows an ingressive reading, where \( P \) is a predicate describing a situation which interrupts the first mentioned situation of type \( P' \):**

\[ [(\gamma, \alpha, \beta) \land \text{op}(\text{me}(a), P) \land \text{op}(\text{me}(\beta), P') \land \text{interrupt}(\text{me}(\alpha), \text{me}(\beta))] \Rightarrow \neg P(\text{me}(\alpha)) \]

Another axiom has to be defined to clarify what predicate actually describes \( \text{me}(\alpha) \):

\[ \text{initial}(\text{me}(\alpha), s) \land P'(s) \land \text{prep}(\text{me}(\alpha), s) \]

These formulae can be applied to the discourse example in (3.15):

\[ [(\gamma, \alpha, \beta) \land \text{op}(\text{me}(\alpha), P) \land \text{op}(\text{me}(\beta), P') \land \text{interrupt}(\text{me}(\alpha), \text{me}(\beta))] \Rightarrow \neg P(\text{me}(\alpha)) \]

This default rule overrides the normal default for the open-perfective viewpoint via the Penguin Principle and the conclusion can be derived that the situation \( \text{me}(a) \) is not described by an accomplishment of type \( \text{drive}(\text{defendant}, \text{home}) \). But it can be concluded that this situation can be seen as a driving process up to the location of the accident:

\[ [(\gamma, \alpha, \beta) \land \text{op}(\text{me}(\alpha), P) \land \text{op}(\text{me}(\beta), P') \land \text{interrupt}(\text{me}(\alpha), \text{me}(\beta))] \Rightarrow \neg \text{drive}(\text{defendant}, \text{home} | \text{me}(\alpha)) \]

This default rule, however, might get overridden by a specific context. As shown in chapter 3, there are two cases where the open-perfective viewpoint normally has a perfective reading.

- **Interrupted situations describe the preparatory phase leading to a situation of type \( P' \), which describes a situation lasting until the interruption:**

\[ [(\gamma, \alpha, \beta) \land \text{op}(\text{me}(\alpha), P) \land \text{op}(\text{me}(\beta), P') \land \text{interrupt}(\text{me}(\alpha), \text{me}(\beta))] \Rightarrow \exists s \text{ initial}(\text{me}(\alpha), s) \land P'(s) \land \text{prep}(\text{me}(\alpha), s) \]

Firstly, context knowledge which allows us to conclude that the situation described by \( P \) was not complete leads to the conclusion that the described situation \( \text{me}(a) \) is not of type \( P \).

- **the open-perfective viewpoint allows an open reading when combined with a static situation described by \( P_a \):**

\[ [(\gamma, \alpha, \beta) \land \text{op}(\text{me}(\alpha), P) \land \text{op}(\text{me}(\beta), P_a)] \Rightarrow \exists s \text{ initial}(\text{me}(\alpha), s) \land P_a(s) \land \text{prep}(\text{me}(\alpha), s) \]

Another situation is introduced by this default rule, namely a situation \( s \) of type \( P_a \). However, we have to make sure that the general default for the open-perfective viewpoint does not fire. In order to block this inference (i.e. \( P(\text{me}(a)) \)), the Complex Penguin Principle has to be applied:

- **Complex Penguin Principle:**

\[ \Box (\phi \rightarrow \psi), \Box ! > ! \psi ! > \chi, \phi > \zeta, \Box (\chi \rightarrow \theta), \Box (\zeta \rightarrow \neg \theta), \phi \equiv \zeta \]

The reason why this Complex Penguin Principle is required is that there are not two defeasible rules which allow us to derive \( \neg \zeta \) and \( \zeta \), respectively. Instead we have to derive the conflict between two axioms which are imposed on the consequences of the default rules (i.e. \( \chi \) and \( \zeta \)). Moreover, another axiom \( \Box (\phi \rightarrow \psi) \) is necessary.

This axiom is easily derived by the laws of logic:

\[ \Box ([(\gamma, \alpha, \beta) \land \text{op}(\text{me}(\alpha), P) \land \text{op}(\text{me}(\beta), P_a)] \Rightarrow \text{op}(\text{me}(\alpha), P)) \]

The two remaining axioms express a certain conflict for the information given by \( \chi \) (i.e. \( P(\text{me}(a)) \)) and \( \zeta \) (i.e. \( \exists s \text{ initial}(\text{me}(a), s) \land P_a(s) \land \text{prep}(\text{me}(a), s) \)), the two consequences of the default rules.

The first axiom is again derived from the laws of logic:

\[ \Box (P(\text{me}(a)) \rightarrow P(\text{me}(a))) \]

\[ \text{Cf. the normal Penguin Principle on page 22.} \]
The second axiom expresses the intuition that preparatory phases of a given situation \( s \) cannot be described by the completed situation \( P \):
\[
\phi \rightarrow \exists i \in I (i \models \text{init}(\text{me}(s),i) \land P(s) \land \text{prep}(i,s)) \rightarrow \neg P \text{me}(s))
\]
Assuming these axioms and the given two default rules, we can now non-monotonically infer that \( \text{me}(s) \) is described by the preparatory process of a situation \( s \), which is of type \( P \). Note that for this constellation the situation \( \text{me}(s) \) is only the preparatory phase of \( P \), assuming that there is still a completed situation.  

Finally, an interesting comparison with approaches to the progressive form in English proposed by Asher (1992) and Glasbey (1996) can be made. Asher uses the default reasoning system introduced earlier in section 2.4.3.1 and Glasbey employs a channel theoretic framework developed by Barwise and Seligman (1994).

Informally, the approach Asher uses demands the definition of a default to capture the meaning of the progressive in the following way:

- Asher’s default definition for the progressive:

\[
\forall s \left[ \text{prog}(\phi)(s) > \exists e (s \subseteq e \land \phi(e)) \right]
\]

This approach of demanding a default for the progressive was criticised by Glasbey (1996). Consider (5.10) which was also mentioned by Asher himself:

\[(5.10) \text{Mary was crossing the mine field.}\]

Glasbey points out that it is only necessary to see the completed situation to be “conceivably possible”. It is therefore not required to assume a general default, as Asher does. She formalises this observation as a channel which has to hold between two situation types.

This approach seems to be more plausible for the English progressive form, but why is the assumption of a default more appropriate for the German open-perfective viewpoint?

Compare the German translation of (5.10) with the prediction Asher’s default makes for the English progressive form:

\[(5.11) \text{Maria durchquerte das Minenfeld.}\]

The normal intuition about this sentence is clearly that Maria has safely reached the other side of the mine field. Recall that this is what is demanded by the default rule proposed for the open-perfective viewpoint which has certain similarities to the Asher’s default for the progressive form. Since the open-perfective viewpoint normally leads to a completed situation, the stipulation of a default rule appears to be appropriate for this viewpoint, whereas the progressive form only demands that the completed situation is possible.

Interestingly enough, this explains, for example, why a discourse like (5.12) sounds rather odd, whereas the English translation is accepted:

\[(5.12) \text{Maria durchquerte das Minenfeld. Sie versuchte sich umzubringen.}\]

Mary was crossing the mine field. She was trying to kill herself.

\[\text{Should the subsequent context override this information, note that a more specific default is required here as well.}\]

\[\text{The operator prog takes an event-predicate } \phi \text{ and returns a state-predicate prog}(\phi).\]

\[\text{Variant of Glasbey (1996).}\]

On the other hand, a continuation which can be seen as elaboration of the first described situation of crossing the mine field is fine:

\[(5.13) \text{Maria durchquerte das Minenfeld. Sie arbeitete sich mühsam voran.}\]

Mary was crossing the mine field. She was arduously working her way forward.

**Concluding Remarks** Summing up, a three-fold theoretical framework has been proposed. It has been pointed out that situation type information constrains all levels of the representation. The open-perfective viewpoint can be seen as the interface between the world knowledge introduced by the situation types and the knowledge presented by an actual sentence.

In order to do some reasoning on the assumed temporal intervals, we want to be able to express coarse and strict knowledge. If a strict temporal relation like meets, for instance, is required, this should be expressible within the formalism, but so also should be a coarse temporal relation which is a set of two or more possible strict relations.

The following section deals with the question of how this can be efficiently expressed, since the full algebra of Allen’s interval calculus has been proven to be computationally intractable.

### 5.3 Coarse and strict temporal knowledge

Within the original interval calculus proposed by Allen (1984), the representation of coarse knowledge was only expressible by the disjunction of the interval relations (e.g. I: [before] ∨ meets] ∨ or overlaps]. Unfortunately the algorithm for testing the consistency of the stored temporal relations is proved to be NP-hard in the full algebra (Vilain and Kautz 1986). Therefore sub-algebras were investigated and more efficient reasoning algorithms were proposed (Vilain, Kautz, and van Beek 1990; van Beek 1992). The findings of these investigations will be discussed in more detail in the following section.

An investigation of the representation of coarse knowledge is necessary, especially considering the reasoning system as an application for a discourse processing system or a machine translation program. As shown in the previous chapter the temporal relations which are expressed in a narrative discourse are mainly underspecified and vague. It is furthermore often the case that further context information provided by temporal conjunctive clauses, world knowledge and the like can narrow down the possible temporal relations between the situations. As shown in the previous chapter states and activities, for instance, allow only the conclusion of a rather vague temporal relation:

\[(5.14) \text{Maria ging den Strand entlang. Die Seemöwen kreischten. Sie war ruhig und ausge-lassen}\]

Mary walked along the beach. The seagulls shrieked. She was quiet and happy.

Several temporal relations can be expressed by this discourse when we try to pinpoint the exact temporal constellation between the described situations. It is conceivable that the walk...
lasted as long as the other two situations, but it is also imaginable that the shrieking of the seagulls lasted longer than the other two. Another scenario which is possible could lead to the assumption that the last situation may have started after the beginning of the two other ones.

If we wanted to spell out every possible combination, we would find 9 relations which hold between each of these two situations. It is easy to see that the complexity explodes, the more situations are described by a discourse.

Approaches to the representation of temporal relations offer either an underspecified temporal relation (i.e. the overlap relation $/$ defined on page 107) or a specific temporal relation, referring to the overlap relation defined by Allen’s interval calculus (cf. Song and Cohen (1988)). The former approach captures the underspecification especially for this constellation of two unbounded situation types, but it is not capable of representing a stricter temporal relation, if this is required, as in the following example where a meta relation is required.

\[(5.15) \text{Peter schaltete das Licht aus. Es war stockfinster im Zimmer.} \]

Peter switched off the light. It was pitch dark in the room.

On the other hand, the latter accounts which choose to use the strict relation run into difficulties when a vaguer temporal relation is needed like in (5.14).

Hence a temporal reasoning system must express the coarse knowledge as well as fine interval relations, when necessary. Such a reasoning system will be presented in the following three sections. First, I will introduce the notion of a point algebra which was used by Vilain, Kautz, and van Beek (1990) to restrict the complexity of the full algebra. Second, a further restriction of convex relations is given which provides us with a small set of conceivable relations which allow temporal reasoning to become very efficient. Finally, the notion of conceptual neighbourhood is discussed and compared with the intuitive analysis of the temporal relations carried out in the previous chapter.

### 5.3.1 Point algebra

The point algebra proposed by Vilain, Kautz, and van Beek (1990) offers a way to restrict the complexity of the full algebra. Sets of interval relations are described by the point relations (i.e. $<, -, >$) between the beginning and end points of the intervals (i.e. $\alpha$ and $\omega$). A further subset of the full algebra, the convex interval relation algebra, for example, fulfills the desired properties with respect to computational tractability. The definition of this algebra requires an even more restrictive set of point relations (van Beek 1992).

The following sections describe how the 82 convex relations are defined via the point relations and discuss how a more intuitively adequate explanation can be provided by the concept of conceptual neighbourhood following Freksa (1992).

I will furthermore point out that the conceptual neighbourhood relation algebra is a proper superset of the convex relation algebra.

### 5.3.2 Convex relations

The point algebra is defined by the four relations $R_1$ to $R_4$ between the beginning and ending points of the two intervals $I_1$ and $I_2$ in question (i.e. $\alpha I_1 \alpha, \omega I_2 \omega, \alpha I_2 \omega$ and $\omega I_1 \alpha$). See figure 5.2 for a graphical representation of the required relations for this algebra.

\[
\begin{align*}
R_1 &< R_2 \\
R_3 &< R_4
\end{align*}
\]

Figure 5.2: The four point relations, which hold between the end points of the two intervals

In order to describe a convex relation the following relation-sets are allowed: $<, -, >, \neq, =, \ldots$. A convex relation evolves when the four relations $R_1$ to $R_4$ are assigned to 1 of these 6 point relations. An interesting structure can be found if we order the 13 strict relations according to the possible point relations; see table 5.2. This ordering can be put into a diagram which reflects the ordering in a graphical way (see figure 5.3). The term convex can now be explained with the help of this diagram. A convex relation $Rel$ has to have a top (i.e. $r_2$) and a bottom element (i.e. $r_1$) such that $Rel = \{ r_1, \ldots, r_2 \}$. Note that therefore the disjunction of the two Interval relations before and after (i.e. $\{ \text{before} \lor \text{after} \}$) cannot be represented by this algebra. The point-relation set $<, >$ would be required to describe this interval relations set.

The formal definition of a convex relation is as follows:

**Definition 8 (Convex Relation)** A temporal relation $Rel$ between two intervals $I_1$ and $I_2$ can be described by the four point-relations $R(\cdot, \cdot)$, where $R_1$ is one of $\{ <, -, >, \neq, =, \ldots \}$. The representation is used by (Freksa 1992) for an iconic representation of the neighbourhood relations \( \circ \) reflects the structure of the ordering in table 5.2. The dots represent the possible interval relations. For example, \( \circ \) describes the two interval relations before and meets.

\[\begin{align*}
\text{In the following I will use the abbreviations } &<, -, >, \neq, =, \ldots \text{ for the point-relations } \{ <, -, >, \neq, =, \ldots \}.
\end{align*}\]
However, the choice of the point relation for $R_i$ is not totally arbitrary, since the relations $R_1$ to $R_4$ can also be derived via composition of the remaining relations and the preset < relation between the end points of the two intervals $I_1$ and $I_2$ (cf. figure 5.2). It is therefore necessary to ensure that only well-formed relations are constructed. The following definition shows how well-formedness of all the 82 convex relations can be achieved.

**Definition 9 (Well-Formedness)** A temporal relation between two intervals $I_1$ and $I_2$ is *well-formed* if every point-relation between $\alpha_i$ and $\omega_i$ (for $i = 1, 2$) is the same or more definite as every other composed relation with respect to transitivity.

This well-formedness of the convex relations can be computed as follows. First of all the definite relation ($\preceq_{det}$) between point relations has to be defined, which can easily be done using the subset relation for the point relation sets. The < relation, for instance, is more definite than the $\preceq$ relation, because $\{<\} \subseteq \{<, \leq, =\}$.

Secondly, the compose operation for the point relations ($\circ$), which is necessary for determining the transitive closure, can be looked up in table 5.3 (e.g. $(p_1 \leq p_2 \land p_2 = p_3) \rightarrow p_1 \leq p_3$).

The following equations constrain the 4-tuples, so that ill-formed relations can be ruled out (see example 1).

\[
\begin{align*}
R_3 & \preceq_{det} < \circ R_4 \\
& \preceq_{det} R_3 \circ > \\
R_2 & \preceq_{det} > \circ R_3 \\
& \preceq_{det} R_4 \circ <
\end{align*}
\]
5.3 Time Logic

### Table 5.3: The compose operation for point relations

<table>
<thead>
<tr>
<th>≤</th>
<th>=</th>
<th>≥</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>&lt;</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>?</td>
<td>?</td>
<td>&lt;</td>
<td>?</td>
</tr>
<tr>
<td>&lt;</td>
<td>?</td>
<td>?</td>
<td>≥</td>
</tr>
<tr>
<td>≥</td>
<td>≥</td>
<td>≥</td>
<td>≥</td>
</tr>
</tbody>
</table>

5.3.3 Conceptual neighbourhood

Freksa (1992) introduces a new subset of Allen’s interval calculus, which relies on the notion of conceptual neighbourhood. He points out that Allen’s approach possesses a crucial shortcoming, when incomplete knowledge is to be represented. In this case, a disjunction between

5.3 Time Logic

all possible relations is necessary, which leads to an undesired situation, because the less that is known, the more complex the representation becomes.

Freksa therefore proposes a intuitively more adequate representation of conceptually ordered neighbourhood relations. A conceptual neighbour can be defined via transforming the intervals into another by continuously deforming them (i.e. shortening, lengthening). Figure 5.4 shows such a transformation from before, meets to overlaps.

We can now determine all 82 convex relations if we check the transitive closure for all 4-tuples which can be generated according to definitions 8 and 9. See appendix A for a listing of all convex relations and the attendant constraints.

The following section describes a different subset of the full algebra which is restricted by the concept of a conceptual neighbourhood of Allen’s interval relations. The procedure of transforming one relation into another one will be used in the subsequent section which presents the results of the previous chapter within the formal framework.

#### Example 1

\[ [\leq, =, <, ?] \text{ is not well-formed!} \]

The constraints for \( R_2 \) are not fulfilled, because a different relation can be derived for this relation (i.e. \(<\)):

\[
\begin{align*}
\preceq_{bt} & > \preceq \\
\preceq_{bt} & < \preceq
\end{align*}
\]

We can now determine all 82 convex relations if we check the transitive closure for all 4-tuples which can be generated according to definitions 8 and 9. See appendix A for a listing of all convex relations and the attendant constraints.\(^{29}\)

### Figure 5.4: Conceptual Neighbours

A neighbourhood can now be defined as a set of path-connected relations through conceptual neighbour relations. Note that the transitions between these neighbours can also be found in figure 5.2.

Referring back to the investigation of which temporal relations are expressed by different discourse sequences in the previous chapter, we can now use this procedure to determine the particular relation. The relation set can be found in a systematic way by shortening or lengthening the described time intervals. Take for example (5.20):

(5.20) Maria starre Peter an. Er gab ihre Pizza zurück.

Mary stared at Peter. He gave her pizza back.

One has to imagine which temporal relations are conceivable. Starting from a before relation the interval of the first mentioned situation can be lengthened until the end point meets with the beginning point of the interval of the second situation. We can lengthen the interval even more and obtain successively all possible relations in the end.

However, it should be stressed that the conceptual neighbourhood relations are not as restrictive as the convex relations. A coarse relation which fulfills the neighbourhood definition without being a convex relation is, for example, \([s, s, t] \) (i.e. proper subset). The three interval relations are connected via the neighbourhood relations, but this set cannot be described by the point relations allowed.\(^{30}\)

\(^{29}\)This list is taken from Schilder (1993).

\(^{30}\)The convex relation algebra can only capture the \( \subseteq \) relation.
Nevertheless, the concept of neighbourhood relations proved to be a more adequate description for temporal knowledge and should be taken into account when designing a temporal reasoning system. The choice to use only the restricted set of convex relations, which fulfills the requirement for the conceptual neighbourhood, can be justified, since this subset of the full interval calculus has not only been proven to be computationally tractable, but also very efficient algorithms have been proposed (van Beek and Manchak 1996). Future research should show whether a more complex time logic is necessary and desirable for the representation of temporal information in a narrative discourse.

Having defined the convex relation set and introduced the concept of neighbourhood relations, the following section provides a new form of representing the 82 relation set. It will turn out that only a few point relations are necessary to describe a particular convex relation set. Later, the most prominent point restrictions occur again, when the results of the previous chapter are described within the formal framework developed in this chapter.

## 5.4 A hierarchy of convex relations

To find out which point-relations constrain which convex relations, I put the 82 convex relations in a hierarchical order. By doing this, I was able to show that only 20 relations introduce one point relation constraint. The relation *older* \( (>) \), for example, is sufficiently described by only one point relation, namely \( a_1 < a_2 \). Taking the symmetry of the hierarchy into account and the fact that \( \sim \) can be derived by combining \( \leq \) and \( \geq \), only 9 distinct relations need to be considered.

The following section 5.4.1 explains the way I ordered the 82 convex relations and why particular relations stand out, because they introduce new point constraints. Section 5.4.2 discusses the findings with respect to the minimal point relation sets, which can now easily be derived from the hierarchy.

### 5.4.1 The hierarchy

The hierarchy’s top element is the fully unspecified temporal relation, since this relation subsumes all other convex relations. On the following level the two relations which allow 12 different interval relations can be found (cf. figure 5.6). The construction of the hierarchy proceeds in the same way until the bottom elements are reached (i.e. the 13 fine interval relations).

Figure 5.5 shows a part of the hierarchy. As can be seen in this figure, certain relations have only one immediate ancestor in the hierarchy and are encircled in the figure. These relations introduce new constraints with respect to the point relations, whereas the other relations are defined via a combination of two (or three) relations. Consequently, these relations are sufficiently described by two point (or three) point relation constraints.

There is only one exception, as the full hierarchy presented in figure 5.6 shows: the – relation for \( R_1 \) and \( R_3 \) is introduced via a combination of the \( \geq \) and \( \leq \) constraints.

To sum up, the hierarchy reflects the fact that particular relations can be derived from others. If the relation \( R_2 \), for example, is given as \( \leq \), the relation \( R_1 \) has to be \( < \). This can be proved via the transitive constraints which hold for the convex relations or via the hierarchical structure presented here.

The following section shows how the minimal point constraints can be determined by the hierarchy.

### 5.4.2 Minimal point relation sets

As was just shown, sometimes only one point relation is sufficient to determine the complete 4-tuple of the convex relation (e.g. \( R_4 \equiv \leq \)). Interestingly enough, the 13 fine Allen relations cannot always be derived in such a concise way.\(^{31}\) Only before, after, meets and meets inverse can be determined via only one point relation constraint. Freksa (1992, p. 202) claims that “in no case, more than two relations between beginnings and endings of events must be known for uniquely identifying the relation between the corresponding events.”\(^{32}\) Although this is true for most of the fine relations, it has to be stressed that for the interval relation overlaps three point relations are required (cf. table 5.4). The fact that the required relation \( R_4 \equiv > \) for overlaps, for instance, cannot be inferred from the relations \( R_3 \) and \( R_2 \) is reflected by the full hierarchy in figure 5.6. The relation constraint \( R_4 \equiv > \) does not stand above one of the other three convex relations subsuming overlaps (\( >1 \)), while the finish inverse relation (\( >1 \)), for

\(^{31}\)This problem of finding the minimal set of point relations is closely related to the *deductive closure* problem by Vilain and Kautz (1986) and the minimal labelling problem by van Beek (1989).

\(^{32}\)My emphasis.
5.5 Applied temporal knowledge

The discussion of short discourse sequences in chapter 4 has shown that strict as well as coarse temporal knowledge is required to express the temporal relations expressed by a narrative discourse. This section investigates how this knowledge can be represented in an efficient and exhaustive way. As noted earlier, the set of convex relations described by point relation constraints seems to be a good candidate for the desired temporal reasoning system. This system offers a computationally efficient way for drawing inferences regarding the expressed temporal relations. But it is still flexible enough to cover a set of 82 coarse and fine temporal relations.

The following section discusses the question of which set of relations is the most appropriate one for describing the expressed temporal constellation. In this section this will be done in a rather descriptive way as this was already undertaken in chapter 4 in a semi-formal way. We have now the formal tool to portray the set of relations in toto.

Section 5.5.5 compiles all convex relations which are derivable for all the combinations of situation types described in the previous chapter.

Before presenting this compilation of relation sets, note that the convex relations are used for representing the temporal relations which hold between intervals. But because of the tripartite representation system, we are able to reduce the set of possible relations even further if we take world knowledge about the situations into account. Some of these restrictions are already shown on an interval level, namely the open intervals. The following section is concerned with the inferences which can be drawn from this restriction.

Next, I will investigate how the feature of punctuality may have an influence on the relation sets. We can infer such restrictions as already noted in section 5.2.3.3.

I will furthermore discuss the possibilities which arise for closed and durative intervals in section 5.5.3. I will show, in particular, how these relations can further be restricted by world knowledge inference.

Finally, I will present the coarse relations which can be assumed for a sequence of two sentences in the Preterite. I will compare my findings with the results presented by Eberle (1988).

### 5.5.1 Open intervals

There are three important observations to make with respect to the open intervals:

- Two open intervals cannot meet.
5.5 Time Logic

Applied temporal knowledge

- An open interval can “approach” a closed interval from two sides. Consequently two
  coarse relations are obtainable.
- Two open intervals can only precede or succeed each other if the existence of at least
  one closed interval connecting both is inerface. This bounded situation may trigger or
  terminate the unbounded situation, if this inference is sustained by our world knowledge.

The first observation reflects the fact that two unbounded situations overlap each other and
hence meets our intuition in this respect. However, what kind of “overlapping” is expressed
is mostly underspecified. Therefore the temporal relation set which is assigned to such a
sequence in a narrative discourse is called contemporary. This set covers 9 possible relations
and is constrained in the following way:

<table>
<thead>
<tr>
<th>Name</th>
<th>Point Relations</th>
<th>Interval Relations</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>ct</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
</tr>
</tbody>
</table>

An example discourse discussed earlier which yields this coarse temporal relation can be
found in (5.21).

(5.21) (. . .) Die Delphine stimmen jedenfalls, die sich aus den Meereswogen, so schien
es, in Tiere verwandelt haben (sta). Sie begleiteten unser Schiff (act). (Penzoldt, Der
Delphin, p. 22)

( . . .). It was true about the dolphins at least — waves of the sea, one might think,
that have turned into creatures. They were accompanying our ship. (Penzoldt, The
Dolphin, p. 23)

Another interesting observation we can make with respect to the open intervals shows two
different kinds of background information. Since the open boundary can be expanded into the
direction of a closed interval from two different angles, we obtain two different backgrounding
relations:

<table>
<thead>
<tr>
<th>Name</th>
<th>Point Relations</th>
<th>Interval Relations</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>ol</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
</tr>
<tr>
<td>sb</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
<td>![Relation Icon]</td>
</tr>
</tbody>
</table>

5.5 Time Logic

The relation older is applied when the unbounded situation is uttered first as in (5.22), whereas
survived by is used when the unbounded situation comes second as in (5.23). In these cases
two even more restricted relations can be derived, since our world knowledge supports the
background relation. Hence the two relations before and meets are excluded.

(5.22) Maria starre Peter an (act). Er gab ihr das Stück Pizza zurück (acc).
Mary stared at Peter. He gave back her piece of pizza.

(5.23) Als ihr Vater hereinkam, hatte ich mich gerade gesetzt, ich stand sofort auf (act).
Er war so verlegen wie ich, auch so schüchtern (sta) ( . . . ) (Böll, Ansichten eines Clowns,
p. 78)
When her father came in I had just sat down, I stood up at once. He was as embar-
rassed as I was, and just as shy ( . . . ) (Böll, The Clown, p. 57)

The last observation made has further implications, when a sequence of a bounded and
unbounded situation is encountered. An unbounded situation can forward narrative time as
discussed in section 4.3.2 provided this is supported by the world knowledge. What happens
in such a case on the interval level? We can assume that the boundary of the bounded situation
coincides with the beginning (or ending) of the hitherto unbounded situation. We are allowed
to infer a definite bound for this situation via context or world knowledge and can assume a
meets relation between them as in example (4.20) on page 81 which I repeat here as (5.24):

(5.24) Peter schaltete das Licht aus. Es war stockfinster im Zimmer.
Peter switched off the light. It was pitch dark in the room.

Discourse sequences where stative situations were conceptualised as events as in DRT
(cf. example discourse (5.6) on page 106) can now be explained by the inference we can draw
regarding our context (e.g. then) or world knowledge which leads to this temporal constraint.

Note for (4.20) that in order to derive this fine temporal relation certain world knowledge
has to be taken into account (e.g. practical knowledge about switching off a light). On the other
hand, if we did not have this information available, only a coarse relation would be assumed.
If we did not know about the connection of switching off the light and the subsequent darkness
in a room, we could not infer the meets relation holding between the two situations described
in (4.20).

The reader may have noticed that an even more restricted set of relations can be inferred
for the example discourses presented in this section, when the bounded situation was punct-
ual. Section 5.2.3.3 already discussed further constraints introduced by punctual situation.
The constraints are repeated in the following section, but with respect to the convex relation
algebra (i.e. constraints on the point relations are given).

Keep in mind that the restrictions made in this section are made purely on the basis of the
two types of intervals (i.e. open and closed), apart from sequences like (5.24), whereas the fol-
lowing constraint can only be imposed when information from a situation type is considered.

33See also appendix B.2.
34This discourse sequence was numbered (4.5) on page 75.
35These two alternatives for backgrounding are also compiled in appendix B.
36Compare with (4.34) on page 93 and (4.25) on page 82.
37See section 6.2.1.3 on page 148 for the exact definition of the two required relations.
5.5 Time Logic

Applied temporal knowledge

5.5.2 Punctual intervals

Punctual situations do not look different when they are represented on an interval level, and can indeed overlap. But on a more complex situation level, further restrictions can be imposed. The following figure shows how the set of interval relations is further limited.

![Figure 5.7: The relations between instances and intervals](image)

The iconic representation of the possible relations for instances reveals that actually only four coarse relations are needed, namely precedes, subset, superset and equals in order to represent the constraints.\(^{38}\)

<table>
<thead>
<tr>
<th>Name</th>
<th>Point Relations</th>
<th>Interval Relations</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>pr</td>
<td>(&lt;, &lt;, \leq)</td>
<td>([0, \infty])</td>
<td>![icon]</td>
</tr>
<tr>
<td>eq</td>
<td>([\leq, =, \leq, &gt;])</td>
<td>([0, \infty])</td>
<td>![icon]</td>
</tr>
<tr>
<td>superset</td>
<td>(\leq, \leq, &gt;)</td>
<td>([1, \infty, \infty], [1, \infty, 1])</td>
<td>![icon]</td>
</tr>
<tr>
<td>subset</td>
<td>(\geq, \leq, &gt;)</td>
<td>([1, \infty, \infty], [1, \infty, 1])</td>
<td>![icon]</td>
</tr>
</tbody>
</table>

The lemmas introduced by Allen and Hayes (1989) enumerate the set of possible relations explicitly, as noted earlier.\(^{39}\) We are now able to rewrite these lemmas by using the more concise notion of convex relations. Furthermore by using the minimal point relation sets which

\(^{38}\)Note that \(\leq, =, \geq\) is needed as well, but it is omitted in the following table, because this temporal relation cannot occur in the discourses investigated, discussed in section 4.4.4.

\(^{39}\)See section 5.2.3.3 on page 117 and also the appendix B.
5.5 Time Logic  

5.5.3 Closed and durative intervals

This section is concerned with durative situations which are bounded. There are two possibilities: the situations can either precede each other or the second situation can be a subpart of the first one. As for the punctual intervals there are two possible convex relations, namely precesses and superset. These two relations conjoined do not describe a convex relation, but for the time being we can assume the relation set which also includes the two borderline cases starts and overlap. I will call this relation initial later, since the restriction imposed by this relation is that beginning points of the two intervals have to precede each other and this relation includes superset as well.

<table>
<thead>
<tr>
<th>Name</th>
<th>Point Relations</th>
<th>Interval Relations</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>is</td>
<td>[≤, &gt;, ≤]</td>
<td>[b, m, o, f, i, d, i, s, ∗, s]</td>
<td></td>
</tr>
</tbody>
</table>

This decision can be justified, because a rhetorical relation is derived in any case which would lead to the precesses (i.e. narration in (5.28) or superset (i.e. elaboration in (5.29)).

(5.28) Wir gingen zu einer der Buden auf der Venloer Straße (acc), allen zwei Portionen Gulasch (acc), kaufte uns eine Flasche Rotwein (acc) und gingen nach Hause (acc). (Böll, Anichten eines Clouens, p. 196)

(5.29) Mitten in jenem Winter kam er mit Fahrrad und Auftrag hierher (acc) (...) Müttern kam er den Dorfweg herauf (acc), der an der Schule vorbei führte (...) Durch die Fenster der Schulklasse sahen wir ihn nähern kommen (...) (Lenz, Der Verzicht, p. 110)

5.5.4 Forward movement

As discussed in section 4.4.4.4, I stipulated a revised TDIP originally proposed by Dowty. My claim was that there is no backward movement of narrative time for two sentences in the Preterite. The temporal constraints imposed by this principle were expressed by the precedence relation which holds between the beginning point of the first described situation and the end point of the second one (i.e. \( \alpha_i < \omega_{i+1} \)). Having introduced the convex relation algebra in the previous section, we are now able to show what this constraint means, that is, which Allen relations are actually covered by this point constraint. Table 5.2 can be used to extract this information. The convex relation restricted by this constraint contains 11 interval relations: [b, m, o, f, i, d, i, s, ∗, s].

5.5 Time Logic  

A proposal made by Eberle (1988) describes a similar scheme. He proposes a relation not-before which expresses the same intuition that there is no backward movement perceived. The relation is formally defined within a standard DRT framework as follows:

\[
\forall c_1, c_2 \left( c_2 \text{ not-before } c_1 \equiv c_2 < c_1 \lor (c_1 = c_2 \land \forall c_3 (c_3 < c_1 \rightarrow c_3 < c_2)) \right)
\]

However, note that this definition excludes the overlap relation on an interval level. But this relation should be included, because unbounded situations allow this kind of overlap (i.e. the second situation might have started before the first one).

Interestingly enough, Eberle also sees the advantage of using point constraint representation for its notational efficiency. Consequently, he shows that the event structure can be translated to a point structure fitted with the point algebra for the Allen relations. As already mentioned in 4.4.4, he gives such a formalisation with the help of point constraints for a sequence of two accomplishments, namely \( \alpha_i < \alpha_{i+1} \). Note that this is not the point constraint introduced for this situation type in section 5.5.3. In order to describe the following set of interval relations [b, m, o, f, i, d, i, s, ∗, s], the point constraint \( \alpha_i \leq \alpha_j \) is required.

Having shown how an efficient description for temporal relations can be given by the convex relation algebra, some critical questions have to be raised. This will be done in the following section.

5.5.5 Some critical remarks on convex relations

I would like to evaluate the choice of the convex relation set for the proposed time logic in this section. As discussed in the preceding section, there are a few critical cases, where the convex relations are not capable of expressing the exact temporal relation.

- Information about punctual situations cannot be expressed within the convex relation algebra. In particular a proper subset relation is sometimes required.
- A generalisation for durative and closed intervals (i.e. accomplishments) on the situation level regarding the conveyed temporal relation is only possible if a relation set is used which is too coarse. Taking world knowledge into account, the appropriate relation will subsequently be derived.

These limitations of the proposed formalism could be amended, if a more expressive sub-algebra were specified which allows us to represent the required relations. The maximal tractable sub-algebra of the full Allen algebra was found by Nebel and Bürgert (1993).

Summarising, the following table 5.5 reflects the possible combinations which have already been described informally in the previous chapter. I compiled in this table all convex relations which cover all conceivable temporal relations for the respective combination. Due to the definition of the convex relations there are some relations included which did not occur for a given example. The representation is therefore too coarse for the following cases:

- It obviously uses the point algebra, but he does not make clear whether this is restricted to the convex relations algebra.
- Note that he forgets to mention the not-before relation which has to be included as well.
5.5 Time Logic

- The relation `<` is a superposition of the relations `b`, `m`, `o`, `f1`, `d1`, `s`, `=`, `si`. The relations `o` and `s` do not occur for punctual situations. If the two situations are both punctual, also `f1`, `d1` and `si` should be omitted. The proposed lemmas exclude these relations, but the convex relation algebra alone cannot satisfy this constraint.

- The same relation `s` contains two superfluous relations for durative and closed intervals which are used for representing accomplishments.

To sum up, although some of the convex relations are too coarse for an exact description of the temporal relations, note that this shortcoming will be remedied as soon as the rhetorical relations come into play. The analysis of the influence situation types have on their own has again been proven not to be fine enough.\(^4\)

But the following interesting discoveries were made:

- Two unbounded situations which are represented as open intervals allow only the coarse relation `contemporary`. This convex relations includes 9 fine Allen relations and can be grasped by two point relations (i.e. `R_1 = `). More restrictions can be imposed, but this can only be justified if world or context knowledge can license this inference.

- If an unbounded situation is combined with a bounded one, the sequence of the two sentences is of great importance.
  - If the sentence describing the unbounded situation precedes the sentence which refers to a bounded situation, the derived relation is `older`.
  - For the reverse sequence, the relation `arrived` by is inferred.

- Unbounded situations may be equal to the result state of a bounded situation.\(^5\) Moreover, not much attention has been given to the constellation where an unbounded situation is terminated by a bounded one. Note that the fine `met` relation is contained in the set of relations described by `older` as well as `survived` by.

- Punctual situations can only precede each other or be equals if world knowledge supports this conclusion.

- Durative situations can either precede each other or the second situation can be a subpart of the first situation. This can be expressed by a relation called `initial`, `super` if these two possibilities are represented together. Note that for a sequence of a punctual and a durative situation, the inverse relation has to be assumed (i.e. `initial_subset`).

\(^4\)Compare the approaches proposed by Herrich and Partee which rely only on the information given by the situation type, with non-monotonic frameworks which take rhetorical relations into account (Lascarides and Asher 1993).

\(^5\)Unfortunately, it is not always clear what the exact result state is. More world and context knowledge probably has to be taken into account when we derive the `met` relation in (4.20), for instance.

5.6 Conclusions

This chapter introduced a tripartite structure for representing temporal knowledge:

- A situation structure contains the restrictions given by the situation types. This can narrow down the set of possible temporal relations. For instance, punctual events cannot overlap.

- The elaborate interval calculus proposed by Allen was used to represent the temporal relations. In order to reduce the complexity of a temporal reasoning system, a well-investigated sub-algebra was chosen to represent the coarse and fine relations in a narrative discourse. Such a system is needed to formalise the expressed relations as the analysis of German discourse sequences in the previous chapter has shown. The algebra of convex relations in most cases allowed an adequate representation. But it also turned out that it is not expressive enough for some constellations involving in particular punctual situations.

- A well known approach was adopted for defining the algebra of convex relations, namely via point relation constraints. I have shown how the 82 convex relations can be put into a hierarchical ordering. It turned out that only 20 relations impose new constraints with respect to the point relations. A minimal point relation set could also be determined for the 13 fine interval relations. Interestingly enough, not all of the fine relations are only derivable by 2 point relations, as the `overlaps` relation requires at least 3 point relations. These results can be used for the specification of an interface which defines the interaction between the rhetorical relations and the temporal information. This approach therefore allows a more fine-grained description of the constraints than former approaches which used only a few temporal relations (e.g. `<` and `=`).\(^6\)

\(^6\)Only Song and Cohen (1988) provide a more detailed set of temporal relations. But their system is still not as expressive as the one used in this thesis.
5.6 Time Logic Conclusions

The interaction between the three levels was defined as follows: The point relations were used to define the convex relations. The situation type information can be used to restrict the relations even further. In particular, I introduced open intervals which reflect the feature of unboundedness on the situation level. The behaviour of these intervals was needed to represent states and activities. Moreover, the change from an open to an unbounded interval explains the phenomenon observable in a narration where a bounded situation may supply the beginning or end point of a state or activity.

A further addition to the calculus was given by the introduction of new constraints, which have to be taken into account for punctual situations. Since the original calculus was defined with intervals as primitives, there was a demand to incorporate a representation for instantaneous events as well. However, these situations are defined as intervals with a duration, but without any further sub-situations.

The following chapter provides a framework which is required to combine the different knowledge sources discussed so far:

- Temporal information represented as point constraints.
- Situation type presents information about the situation.
- Viewpoint filters the situation type information.
- Rhetorical information binds the previous sources together and establishes a coherent discourse.

In particular the last source has been mentioned throughout the preceding part of this thesis, but how this information can be used in a systematic way will be investigated in more detail in the following chapter. So far only a rather descriptive analysis of temporal relations for a narrative discourse has been provided. Instead I will focus on the derivation of the rhetorical relations in the following chapter. The established discourse structure allows us to add the appropriate constraints on the temporal relations.

SIX The Rhetorical Structure of a Narrative

In chapter 5 it was shown how a temporal relation can be determined between the described situations, but a formal account of how the exact rhetorical structure can be inferred and represented is still missing. In this chapter, I will propose a hierarchical tree structure in order to establish the coherence of a text. This structure is formally expressed by a Tree Description Grammar (TDG) which provides a computationally oriented description of discourse processing. A clear interface between the expressed semantic structure and the required pragmatic constraints is given. I will furthermore discuss how the derived hierarchical structure of the discourse can be used to explain phenomena like discourse attachment. A small fragment of German will be represented by the proposed formalism and described in the following chapter.

6.1 Introduction

This chapter deals with an approach to discourse processing via a modified Feature-based Tree Adjoining Grammar (FTAG) (Vijay-Shanker and Joshi 1988) based on a new more general interpretation of TAG proposed by Vijay-Shanker (1992). The formalism is called Tree Description Grammar (TDG) and defined in Kallmeyer (1996).

In particular, I will discuss a discourse example presented by Lascarides and Asher (1991b) which is concerned with the question of how the continuation of a story can be explained by referring back to a situation mentioned earlier in the text. They propose a formalism based on a non-monotonic reasoning system Common sense Entailment (CE) as described in section 2.4.3.1, which offers an explanation of attachment in a narrative discourse.

My approach, on the other hand, is based on a TDG using tree description for the rhetorical relations which hold between the discourse segments. This TDG allows us to model a flexible discourse structure which can account for a wide range of difficult to explain discourse effects like flashback sequences or the repair of an already processed discourse in a monotonic way.
6.2 The Rhetorical Structure of a Narrative

Discourse structure

(i.e. adding further information which refines the temporal structure).

Within this formalism it is not necessary to define all structural dependencies holding between particular subtrees. It is rather the case that a forest of trees is given where certain, but not all, subtrees may be fully specified with respect to the parents relation. For some only a dominance relation is known so that further text segments can be inserted between them.

Not much attention has been paid to the discourse principles which actually guide the processing of a text. I will make a clear distinction between the discourse structure and the discourse principles which guide the processing of the text. Those principles can be used to predict attachment points in a hierarchically ordered text.

In addition, this new tree grammar based on a TDG offers a precise notion of openness which may be used for linguistic data for which no theory has yet provided a suitable explanation. Flashback sequences, definite description or repair sentences which allow us to refer back to deeply embedded segments of the discourse require such an open discourse structure.

The formalisation provided allows a monotonic description of the discourse processing and can furthermore be seen as a computational-oriented account which can easily be implemented into a feature-based grammar framework (e.g. Head-driven Phrase Structure Grammar). The non-monotonic component of the formalism is restricted to the world and context knowledge which is crucial for the derivation of the rhetorical relations.

The remaining part of the chapter is organised as follows:

- Section 6.2 summarises the rhetorical relations used for the formalisation and which have already been mentioned in previous chapters. It also describes how former approaches dealt with the modelling of the discourse structure and how discourse attachment was derived.
- Section 6.3 contains the formal definition of the TDG. It shows how a discourse structure can be constructed and how the term openness is defined within this formalism. The temporal constraints are incorporated in the derived tree structure as well.
- Section 6.4 shows how further constraints are imposed on the given discourse tree structure while parsing a discourse. The difference between discourse principles and discourse structure is stressed. The former are governed by the parsing technique employed for discourse processing, the latter is restricted by the tree structure.
- The final section contains some conclusions.

6.2 Discourse structure

The structure of a discourse is organised by rhetorical relations which are grounded in context and world knowledge. Former theories of discourse processing by Hobbs (1985) and Polanyi (1988) have already pointed this out. The analysis of German discourses with respect to the temporal relations carried out in chapter 4 also showed the need for these discourse relations.

Unfortunately, it is still unclear which and how many relations should be used. In this thesis, I therefore have to restrict the set of relations to the ones which have an obvious influence on the temporal relations. Following Lascarides and Asher (1993) I assume narration, elaboration, background and result. Another relation called explanation will not be included within the system I propose, because such a relation does not occur in the German discourse examples investigated.1 Additionally I see the need for another relation which is the mirror expression of result which I will call termination. A reverse background (i.e. an unbounded situation followed by a bounded one) and a more general background relation called scenesetting (i.e. two unbounded situations) will be assumed in addition to the background relation which can be derived for a bounded situation followed by an unbounded one.

The following section introduces in more detail the definitions of the respective relations. I will in particular stress the differences between my definition of narration and Lascarides’ and Asher’s. This relation is seen as a general default in their system. I will argue against this and show that this relation requires certain conditions to be fulfilled as the other relations do.

6.2.1 Rhetorical relations

6.2.1.1 Narration

Two situations are connected by the narration relation if a sequence is described as in (6.1):

(6.1) Peter stand auf. Maria grüßte ihn.

Peter stood up. Mary greeted him.

According to the contingency model by Caenepeel (1989) the situation described by the second situation has to be contingently connected with the first situation. However, as we have already seen in section 4.2.1.1 this definition is too restrictive since it only takes the different situation types into account and neglects the discourse effects caused by world knowledge.

Instead I want to postulate a notion of contingency which emphasises only the plausibility of the sequence which is described. This knowledge that certain situations occur in a sequence can, for example, be obtained from our script knowledge about typical sequences. The understanding of a discourse consequently hinges on our world knowledge of the domain the text is about.

One understandable objection to this view is how we are able to understand a text describing a sequence of situations about which we possess no or insufficient knowledge. The answer is that we are probably incapable of inferring the correct temporal relations if this described sequence of situations is unfamiliar to us, unless temporal connectives like before, after or then show us the temporal constraints explicitly.

A recent proposal by Asher (1996) does not solve this problematic issue of how much we have to take into account for deriving a narration relation between two situations. He introduces a constraint on narration (i.e. occasion), which can be inferred if the knowledge base of

---

1 It is furthermore debatable whether the claim made by Lascarides and Asher (1993) that the explanation relation can hold between two sentences in the single past expressing a reverse temporal order can be upheld. Compare with Eberle (1991, p. 381) and see section 4.4.4 on the temporal relations expressible by a German discourse.
the non-monotonic reasoning system allows an overlapping of the post-state of the first situation with the pre-state of the second one. But he unfortunately fails to give a clear definition of these states and, in particular, does not clarify when the post-state ends. Assuming that the post-state is unlimited, all pre-states of subsequent situations would overlap. Consequently, the occasion is not restrictive enough.

But the spirit of this definition is quite similar to the proposal made in this thesis. The post-state of the first situation must be a prerequisite for the second situation. Or to put it in another way: the second situation can be seen as a plausible continuation of the first situation. Our world knowledge tells us that the world changes only in a continuous way. There are no unexplainable jumps from one situation to another one. Therefore I assume that the way we organise our knowledge about the sequence of situations is organised as a transition net definable by the connections between situations. This means we possess a general knowledge about how one situation can lead to another one. A discourse sequence like (6.2) does not allow such an inference and can only be processed with a great deal of puzzlement.  

(6.2) "Ich stehe auf, ziehe mein Kleid aus, lege es aufs Kissen, ziehe meinen Pyjama an, gehe in die Küche (…).

(I get up, take off my dress, put it on the pillow, put on my pajamas, go to the kitchen (…).)

In order to understand a sequence, we rely heavily on our world knowledge. I call the relation which licenses a narration relation enablement, following Sandström (1995, p. 63). She defines this relation as a relation holding between two events \( e_1 \) and \( e_2 \) by virtue of the state of \( e_2 \), which is such as to make \( e_2 \) possible. ‘Making possible’ includes cases of physical enablement, but also cases of providing ‘appropriate conditions’ for \( e_2 \) to happen (…). The relation of enablement comprises all planned sequences of actions, for instance all actions undertaken with a specific goal in sight."

Hence this relation may be sustained by script information about the typical sequences (e.g. getting up in the morning). If such a relation can be established, two sentences are seen as a sequence. This is not the case for (6.2), where our world knowledge clashes with the information coming from the tense. Recall that the revised TDSP on page 99 predicts that a sequence of two sentences with the Preterite allow at least the conclusion that the first described situation does not succeed the second one (i.e. \( \text{after}, \text{most} \text{inverse} \)). This is the only assumption we can make within a two sentence discourse without knowing anything else. This contradicts with our world knowledge about getting up in (6.2).

A coherent narrative can consequently only be derived if an enablement relation holds between the two situations. This can be supported by evidence coming from our script knowledge or simply by the inference that the second situation can be a plausible continuation of the first one.  

- **Narration**:  

3See page 95 for the full text.

The Greek symbols \( \alpha, \beta \) etc. refer to the clause in the discourse and the function \( me \) assigns the main eventuality (i.e. the situation described by the sentence). See Lascarides and Asher (1993, p. 477) for more details.

The axiom with respect to the temporal constraint can be defined within the framework developed in the previous section. Note that the intervals of the situations assigned to the relation \( \text{LOC} \) are used in the axiom.

- **Axiom on Narration:**  

\[ (\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \]

Translating this relation into the point relation constraint representation and considering the minimal point relations, only one constraint has to be introduced: \( R_k \equiv <.4.6.2.1.2\) Elaboration

Following Lascarides and Asher (1993), an elaboration of a situation \( \alpha \) is given if \( \beta \) is part of the preparatory phase of it. This specific knowledge about parts of a situation is analogous to the script knowledge which can trigger the narration relation. Similar to the enablement relation which has to be derived for narration, evidence coming from our world knowledge is required to infer elaboration. This rhetorical relation is given if it is defeasible to assume that the second described situation is part of the first one. The prep relation which describes the preparatory process of a situation refers to such a constellation. However, explicit reference to part of the first situation allows us to derive an elaboration relation as well:

(6.3) Peter bestieg den Berg. Er verstauchte sich das Fußgelenk beim Aufstieg.

(Peter climbed the mountain. He sprained his ankle on his way up.)

Note that in such a case often a definite description referring back to the first situation is required (i.e. beim Aufstieg (‘on his way up’)). It may be furthermore concluded from this example discourse that a slightly more complex reasoning process precedes the derivation of elaboration. It does not seem to be enough to look up whether the situation of \( \beta \) is in the preparatory phase of the situation in \( \alpha \). More defeasible knowledge about being part of a situation and references by definite description have to be considered as well. Nevertheless, I will assume Lascarides’ and Asher’s premise for elaboration (i.e. \( \text{prep}(\text{me}(\alpha), \text{me}(\beta)) \)) and future research will show how a more precise account to this issue can be offered.

The axiom on the temporal relation I stipulate for this relation, however, differs from Lascarides’ and Asher’s system. According to the more elaborate temporal reasoning system, the \( \text{super} \) relation can be postulated for this rhetorical relation:

- **Elaboration:**  

\[ (\gamma, \alpha, \beta) \wedge \text{prep}(\text{me}(\alpha), \text{me}(\beta)) \rightarrow \text{elaboration}(\alpha, \beta) \]

- **Axioms on Elaboration:**  

1. \( (\text{elaboration}(\alpha, \beta) \rightarrow \text{super}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)

Compare with the previous chapter and see also appendix B.

3See appendix B.
### 6.2 The Rhetorical Structure of a Narrative

#### Discourse structure

<table>
<thead>
<tr>
<th></th>
<th>Two unbounded situations share a common time interval:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\gamma, \alpha, \beta \land \text{bounded}(me(x)) \land \text{bounded}(me(y)) \land \text{contemporary of}(LOC(me(x)), LOC(me(y)))$</td>
</tr>
</tbody>
</table>

The default rule which licenses the scene-setting relation is actually more general than the one for background. This rule would therefore be fired also for a *unbounded* and *bounded* (or the reverse) sequence. But because of the Penguin Principle, the more specific default (i.e. background) would win.\(^7\)

- **Scene Setting Relation:**
  - $\text{contemporary of}(LOC(me(x)), LOC(me(y))) > \text{scene-setting}(a, \beta)$

  This relation allows only a very coarse temporal relation, as the analysis of discourse sequences in chapter 4 has shown.

- **Axiom on Scene Setting:**
  - $\Box (\text{scene-setting}(a, \beta) \rightarrow \text{contemporary of}(LOC(me(x)), LOC(me(y))))$

  The point relation constraints are $R_3 \equiv <$ and $R_4 \equiv >$.\(^8\)

#### Result

This relation is defined as in Lascarides and Asher (1993):

- **Result:**
  - $\gamma, \alpha, \beta \land \text{cause}(me(x), me(y)) \rightarrow \text{result}(a, \beta)$

  The temporal relation evoked by this rhetorical relation is $\text{meets}$ a;

- **Axiom on Result:**
  - $\Box (\text{result}(a, \beta) \rightarrow \text{meets}(LOC(me(x)), LOC(me(y))))$

#### 6.2.1.5 Termination

The inverse relation is called termination:

- **Termination:**
  - $\gamma, \alpha, \beta \land \text{stop}(me(x), me(y)) > \text{termination}(a, \beta)$

  The stop relation is actually a specific cause relation and should be read as situation $me(x)$

1. **Two unbounded situations share a common time interval:**

   $\gamma, \alpha, \beta \land \text{bounded}(me(x)) \land \text{bounded}(me(y)) \land \text{contemporary of}(LOC(me(x)), LOC(me(y)))$

   The default rule which licenses the scene-setting relation is actually more general than the one for background. This rule would therefore be fired also for a *unbounded* and *bounded* (or the reverse) sequence. But because of the Penguin Principle, the more specific default (i.e. background) would win.\(^7\)

2. **Scene Setting Relation:**

   $\gamma, \alpha, \beta \land \text{bounded}(me(x)) \land \text{bounded}(me(y)) \land \text{contemporary of}(LOC(me(x)), LOC(me(y)))$

   This relation allows only a very coarse temporal relation, as the analysis of discourse sequences in chapter 4 has shown.

3. **Axiom on Scene Setting:**

   $\Box (\text{scene-setting}(a, \beta) \rightarrow \text{contemporary of}(LOC(me(x)), LOC(me(y))))$

   The point relation constraints are $R_3 \equiv <$ and $R_4 \equiv >$.\(^8\)

---

\(^7\)See appendix B.2.1.

\(^8\)Consider that there are also inverse temporal relations. The reverse background relation, for instance, indicates such an inverse temporal relation, whereas the inverse termination relation is actually a reverted causal relation.

---

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2 The Rhetorical Structure of a Narrative

Discourse structure

6.2.2 Hierarchical discourses

This section gives an overview of the phenomena we can observe in a more detailed discourse of more than two sentences. It has been pointed out that a narrative discourse is structured in a hierarchical way. Two constellations are mainly distinguished: coordination and subordination. Polanyi (1988), for instance, proposes a discourse grammar which reflects this observation and develops a notion of openness for a discourse. Only some situations are open for further attachment while processing the following discourse. Subsequent research has elaborated this insight. Webber (1991) claims that attachment is only possible on the right edge of a discourse parse tree. The idea of allowing attachment only on the right frontier has been adopted by many subsequent proposals on discourse processing. However, there is no common agreement on what the right frontier is, exactly. Moreover, some discourse phenomena seem to contradict the thesis of the right frontier attachment. An observation which can be, for example, made for spoken language is that we are tolerant of so-called repair sequences. A speaker may have forgotten something, notices that and goes back in her narration and adds something to it. Note that the providing of additional information can be easily incorporated into the hearer’s mental model of the discourse.

In the following, I will briefly summarise the main results with respect to discourse attachment in the literature, focusing on the term openness. An example discourse presented by Lascarides and Asher (1993) will be discussed and finally some problematic cases for this approach will be presented.

In section 6.3 I will describe a formalism which is flexible enough to allow a representation for the problematic cases discussed.

6.2.2.1 Openness and subordination

Former research has already acknowledged that the attachment of a new clause to an already processed discourse follows certain principles. A notion of openness has been developed and the constraints on possible attachment sites has been proposed. Polanyi (1988) and Webber (1991) propose such a notion which can be paraphrased as the right frontier hypothesis. Both approaches assume a tree structure for the parsed discourse and restrict further attachment to the right frontier of the discourse structure. This assumption arises from the observation that a new clause cannot be related to every preceding sentence but only to a restricted subset.

Lascarides and Asher (1993) give such a definition for what they call discourse dominance which is along the lines of this hypothesis. In their theory the notion of openness is restricted by rhetorical relations. The last added clause is clearly open and also all the clauses which this clause elaborates or explains (see figure 6.1).

The formal definition of subordination and openness is given in Lascarides and Asher (1993, p. 458) ($\tau$ is a Discourse Representation Pair (DRP) containing the DRSs $\alpha$ and $\beta$):

**Definition 10 (Subordination)** $\alpha$ is subordinate to $\beta$ if:

(i) explanation $\beta, \alpha$ or elaboration $\beta; \alpha$ holds; or

(ii) $\gamma$ is a DRS in $\tau$ such that explanation $\gamma, \alpha$ or elaboration $\gamma; \alpha$ holds, and $\gamma$ is subordinate to $\beta$.

**Definition 11 (Openness)** A DRS $\alpha$ is open in the DRP $\tau$ if $\alpha$ is the DRS representing the previous clause in the text, or this DRS is subordinate to $\alpha$.

Discourse examples such as (6.4) show the effect one can get if a sentence contains a situation which refers to an already ‘closed off’ discourse segment.

(6.4) (a) Guy experienced a lovely evening last night. (b) He had a fantastic meal. (c) He ate salmon. (d) He devoured lots of cheese. (e) He won a dancing competition. (f) He boned the salmon with great expertise.
6.2 The Rhetorical Structure of a Narrative

Discourse structure

Sentence (6.4f) cannot be related to (6.4c), since this clause is closed. The discourse up to (6.4e), however, can be described as a coherent discourse sequence. It furthermore exemplifies an interesting phenomenon, which was baptised ‘discourse popping’ by Lascarides and Asher (1993) and will be explained in the following section in more detail.\(^{11}\)

But note that they cannot give an explanation of why the whole discourse is still understandable. In spoken language, this discourse sequence may not be too unusual, since people are not always well structured with their narrations. A formal model is therefore needed which is flexible enough to allow this kind of repair sentence.

6.2.2.2 Discourse popping

Lascarides and Asher (1993) use a discourse interpretation system called DICE, which is based on a non-monotonic reasoning system called Common sense Entailment (CE), in order to show how the discourse in (6.4) can be explained. In particular, it can be shown that (6.4e) cannot be related to (6.4d). Instead the clause in (6.4e) has to be ‘popped up’ to the preceding open clauses (6.4a+b).

Assuming a set of rhetorical relations mentioned earlier, a coherent discourse can be established up to sentence (6.4e) in the following way:

According to our world knowledge we can conclude that the situation described by sentence (6.4b) elaborates the one in (6.4a). A further elaboration of (6.4b) is given by (6.4c). Note that for the following sentence (6.4d) two relations can be inferred: Firstly, it can be seen as a narrative continuation of (6.4c) and, secondly, as an elaboration of (6.4b).

Sentence (6.4e), however, cannot be attached to the last sentence (6.4d). In order to ‘pop up’ (6.4e) to the two remaining open sentences, the attachment of (6.4e) to (6.4d) via narration has to be blocked. The DICE system will derive an irresolvable conflict between narration and the constraints on narration, which result in a ‘Nixon Polygon’.\(^{12}\) The deduction which leads to this conflict can informally be described as follows (Lascarides and Asher 1991b, p. 61)

- (6.4d) and (6.4e) cannot be combined via narration, because
  - Winning a dancing competition (i.e. (6.4e)) is normally not a part of a having a meal (i.e. (6.4b)).
  - Consequently, (6.4e) cannot elaborate (6.4b).
  - But (6.4d) is an elaboration of (6.4b) and (6.4e) can only be seen as an narrative continuation of (6.4d) if it elaborates (6.4b) as well.

Formally, this observation can be captured by the following rules and the information obtained so far. The following information is available: (6.4a-d), (6.4a, 6.4e), (6.4a-d, 6.4b, 6.4e), (6.4a-d, 6.4d, 6.4e). First, we need a rule which allows us to derive ¬elaboration:

**Rule 1** \((∀, 3, 4) > ¬elaboration (3, 4)\)

\(^{12}\)This phenomenon was noted earlier by Grosz and Sidner (1985).

Moreover, ¬narration has to be derived in order to obtain the irresolvable conflict:

**Rule 2** elaboration\((3, 4) ∧ ¬elaboration (3, 4) > ¬narration (5, 6)\)

Since narration for clause (6.4d) and (6.4e) can be derived by ((6.4a-d), 6.4d, 6.4e) as well as ¬narration via the rule 1 and 2, a ‘Nixon Polygon’ arises. As a consequence, clause (6.4e) cannot be attached to (6.4d) and has to look for another sentence (cf. figure 6.3).

Assuming the concept of openness introduced earlier, the following sentences are still available for attachment: (6.4b) and (6.4e). According to our world knowledge the two following relations can be derived: elaboration(6.4a, 6.4e) and narration(6.4b, 6.4e).\(^{13}\)

Figures 6.2: The hierarchical structure according to Lascarides and Asher (1993)

We have seen how discourse popping can be described via the non-monotonic reasoning system by Lascarides and Asher (1993). Non-attachment was modelled via an irresolvable conflict of the given default rules. However, it seems intuitively more attractive to describe this phenomenon by the constraints of the hierarchical tree structure imposed by the discourse (cf. figure 6.1).

Furthermore the following discourse causes a problem for the given definition of openness where it is assumed that a narration ‘closes off’ a discourse segment.\(^{14}\)

\(^{13}\)These relations can be inferred by using Cascaded Penguin Principle and Defeasible Modus Ponens. Note that the former principle is not valid in general — however, if it can be shown that the defaults in question are independent, CE validates this principle. See Lascarides and Asher (1993) for more details.

\(^{14}\)This example discourse is taken from Cooreman and Sanford (1996).
6.2 The Rhetorical Structure of a Narrative

The rhetorical structure of a narrative discourse is built on rules that govern the flow of information. Rules 2 and 3 are particularly important:

- **Rule 2**: The narrative unfolds through elaboration on earlier events.
- **Rule 3**: Narration connects earlier and later events.

Figure 6.3: The Nixon Polygon which arises

![The Nixon Polygon](image)

### Examples

#### Sentence (6.5)
(a) The porter phoned the building’s owner before (b) the woman detective investigated the scene of crime. (c) He hung up when he heard the line was busy.

*Notice also that sentence (6.4f) may be ill-placed, but the whole sequence is by no means incomprehensible. A general theory of discourse processing should be able to accommodate such a repair utterance which is furthermore quite common in spoken language.*

#### Sentence (6.6)
“You have it pretty good, don’t you?” Ruth asks him. They have gone on the afternoon of this Memorial Day to the public swimming pool in West Brewer. She was self-conscious about getting into a bathing suit but in fact when she came out of the bath-house she looked great (...) Words came from this monumental Ruth in the same scale, as massive wheels rolling to the porches of his ears, as mute coins spinning in the light. “You have it pretty good.” (John Updike, *Rabbit, Run*, p.142-143)

The flashback sequence is initiated by the *present perfect tense* in the third sentence. The narration continues from there on and comes quite naturally back to the utterance described by the first sentence. This kind of of flashback sequence comes quite naturally and the text flows without an interruption.

On the other hand, there are examples where the reader gets stalled and has to establish a link between the sentence introducing a flashback and the preceding text. The following two paragraphs exemplify such a type of text. The reader cannot continue from the end of the first paragraph which describes the protagonist’s arriving in Glasgow, when the train got stuck just before entering the terminus (i.e. Queen Street Station):

#### Sentence (6.7)
‘Ladies and gentleman …’ crackled a gruff Glaswegian voice from the carriage loudspeakers. My heart sank. The perfect end to a perfect holiday. ‘Due to a signalling failure …’ (...) I thought of Uncle Rory, then remembered that I had some more of his papers with me, and a load of his poems. Mum had found them for me in the house at Lochgair. I got my bag down from the rack. Uncle Rory could not be more depressing than reality was, just now.

*Any hope I might have entertained that Lewis and Verity’s little Hogmanay hug had been an aberration, (...) was comprehensively quashed the next evening, when they turned up together at Uncle Hamish and Aunt Tone’s (…). (Iain Banks, *The Crow Road*, p. 216–218)*

Without knowing that the first paragraph describes the protagonist’s trip to Glasgow a couple of days *after* Hogmanay, the whole discourse sounds quite strange. The situations described in the second paragraph happened on New Year’s Eve before he went home to Glasgow.

The only clue that such an extreme flashback is given is indicated by the asterisk (*). This punctuation mark can be interpreted as a warning to the reader that the following text segment does not necessarily continue the preceding one.

Another issue regarding the definition of openness is worth mentioning. According to Lascarides’ and Asher’s definition of *subordination* we should assume that sequences involving a background are closed as well. Consider (6.8):

#### Sentence (6.8)
(a) Um drei Uhr verließ Peter die Bergstation. (b) Es schneite furchterlich. (c) Trotzdem fuhr er recht flott hinunter zum Kästlehütli.

Note that there is also a short flashback in (6.7) indicated by *past perfect tense*.
At 3pm, Peter left the summit station. It was snowing terribly. Nevertheless, he skied quite quickly down to the Kasihüttli.

In this sequence, sentence (6.8a) is backgrounded by an activity in (6.8b). The subsequent sentence (6.8c), however, allows two rhetorical relations: background (6.8b, 6.8c) and background (6.8c, 6.8a).

To sum up, it seems to be desirable that the discourse structure and the constraints on attachment sites should be described via monotonic constraints imposed by the discourse tree structure. Moreover, the definition of openness given by Lascarides and Asher (1993) has certain shortcomings and should be amended in order to cover the data I have examined.

In the following section I would like to propose a new formalism which establishes a monotonic derivation framework for discourse attachment. It furthermore is flexible enough to incorporate findings of future research with respect to flashback and repair of a given discourse.

6.3 Tree descriptions

The definition of a so-called Tree Description Grammar (TDG) evolved from work on Tree Adjoining Grammars (TAGs) which have been mainly used for the analysis of syntactic phenomena like long-distance scrambling and unbounded dependencies. The newly developed formalism of TDGs possesses certain advantages. Firstly, it allows a uniform definition of an operation which combines the formally used adjunction and substitution operation for TAGs. Secondly, the formalism is capable of giving underspecified descriptions similar to representations proposed by Muskens (1995) for quantifier scope ambiguities.

It has to be noted that this formalism has not been used for a discourse grammar so far. Nevertheless, the reasons in favour of using this formalism are transferable. For a discourse grammar, we need a uniform operation which allows us to combine two sentences as well as two discourse sequences with each other via a rhetorical relation. We assume furthermore that quite distant text segments can be connected as well (e.g. discourse popping). Although the problem of connecting complex discourse segments is beyond the scope of this thesis, the chosen formalism allows the possibility of incorporating such discourse phenomena in further research.

In the following I will present a short introduction to TDGs in section 6.3.1, before I propose in section 6.3.2 two tree descriptions which reflect the discourse structure established by subordinating and coordinating rhetorical relations.

6.3.1 Formal forests

Following the definition of TDG by Kallmeyer (1996) a tree description consists of constraints for finite labelled trees.17

Related to this constraint based logic is the definition of D-trees by Rambow, Vijay-Shanker, and Weir (1995): a D-tree is defined as a tree with two types of edges: domination edges (d-edges) and immediate domination edges (i-edges). These edges reflect the two different sorts of dominance relation we can get in a D-tree. On the one hand, the familiar immediate dominance relation between the mother and daughter nodes are defined by the i-edges. Graphically this is expressed either by a triangle representing a normal tree or a straight line in contrast to a broken (or dotted) one which symbolises the d-edges.

Within TDG, these two kinds of edges are described by the dominance relation holding between the node labels. Since all nodes are labelled, two dominance relations hold between these labels: dominance and immediate dominance relation.

A dominance relation between node labels indicates that these two labels can be equated or have a path of arbitrary length inserted between them. An immediate dominance, however, disallows such an equation of labels and establishes a strict parent relation between the two nodes.

The tree’s root node $S$ in figure 6.4, for example, immediately dominates the two daughter’s which are NP and VP. The rightmost daughter, however, only dominates the other VP node. That means that these two nodes could either be identical or an undetermined long path of other nodes could be between them.

In order to define these dominance relations formally, the node labels are used within TDG. Two relation symbols expressing the dominance (i.e. $<$) and immediate dominance (i.e. $\prec$) relation are introduced.18 The tree in figure 6.4 can be described by the following set of constraints which hold between the labels: $\{k_1 \prec k_2, k_1 < k_3, k_1 < k_4, k_4 < k_5, k_4 < k_6\}$.

![Figure 6.4: A labelled tree description](image-url)

One more word has to be said about the description of trees constraints by the given labels.19

---

156

---

16 In English, the same effect is obtained by the usage of the progressive form.

17 The logic used is a quantifier-free first order logic which bears certain similarities to the logic proposed by Rogers (1994) for feature structure based TAGs. See Vijay-Shanker (1987), Vijay-Shanker (1992) or Vijay-Shanker and Joshi (1988) for a definition of FTAGs.

18 Compare with Backofen, Rogers, and Vijay-Shanker (1985) regarding the usage of these symbols.
The dominance relation allows us to denote an equivalence class of tree formulae which fulfill the given constraints. Hence tree descriptions actually describe sets of trees or to put it in another way, a forest. The underspecification of the dominance relations furthermore allows us to leave open which subset of a forest actually applies to a given syntactic structure. But this set can become more and more restricted when further constraints are added.

Formally speaking a TDG is a tuple \( \{N, T, \prec, \prec^*, \prec, S\} \) where \( N \) and \( T \) are disjoint finite sets for the nonterminal and terminal symbols.

**Definition 12 (Tree Description Grammar)** A Tree Description Grammar (TDG) is a tuple \( G = \{N, T, \prec, \prec^*, \prec, S\} \), such that:

- \( N \) and \( T \) are disjoint finite sets for the nonterminal and terminal symbols.
- \( \prec \) is the parent relation (i.e. immediate dominance) which is irreflexive, asymmetric and intransitive.
- \( \prec^* \) is the dominance relation which is the transitive closure of \( \prec \).
- \( \prec \) is the linear precedence relation which is irreflexive, asymmetric and transitive.
- \( S \) is the start description.

In order to enrich the grammar with respect to the rhetorical relations and some other discourse information, feature value structures are added as well. This information occurs at the assigned node. Hence a set of attributes \( A \) and values \( V \) are added to the definition of a TDG similar to feature based TAGs. These feature structures can impose further constraints on the discourse structure and restrict the possible attachment points.

**Definition 13 (Finite Atomic Feature Structure)** A set of finite atomic feature structures \( N_{A, V} \) consists of sets \( N, A \) (i.e. attributes) and \( V \) (i.e. values), such that

1. \( N \) and \( V \) are finite sets, \( N \cap V = \emptyset \)
2. \( A \) is a finite set of pairs \( \{a_i|a|\} \), where \( a_i \) is a partial function from \( N \) to \( V \) and \( a \) is the unique name of \( a_i \).

For the application of the TDG as a discourse grammar only two categories are necessary, namely \( D \) (discourse) and \( S \) (sentence). In this grammar the set of non-terminal symbols consists of \( D \), whereas the terminals are the sentences. In traditional TAGs the terminals are quite often lexicalised. The actual elementary trees are marked where a lexical entry has to be inserted from the lexicon. For a discourse grammar, the lexical entry for a syntactic analysis of a single sentence corresponds to the semantic content of a sentence within the discourse sequence. We can therefore assume that \( S \) gets associated with the meaning of a sentence containing all discourse referents and the conditions imposed on them.

For the time being, I will assume that this content is represented by a discourse representation structure (DRS) as standard DRT would predict. This DRS would be the value of a feature \( \textit{CONTENT} \) as in the following feature structure:

```plaintext
\begin{align*}
\text{CONTENT} & \quad \text{DR: } \{x\} \\
& \quad \text{COND: } \text{prote} \{x\}, \text{achieved} \{x\}
\end{align*}
```

However, in what follows I will quite often neglect the exact content of the DRS.

Basically, if we insert a new sentence into a given discourse, we obtain a tree description representation as in figure 6.5. A second situation whose semantic content is labelled by \( \square \) is related to another one labelled by \( \square \) via a discourse relation \( \text{Rel} \). The broken line reflects the fact that the first situation is embedded in a discourse. There may possibly be a discourse inserted later which dominates the situation, but this is underspecified by the representation. Moreover the content of sentence \( \square \) may also be embedded deeper into the discourse structure provided the ensuing discourse can provide such information (e.g. flashback).

![Figure 6.5: A tree description for a sentence embedded in a discourse](image)

In order to start a parse of a discourse a start tree \( S \) is needed as well which is illustrated in figure 6.6. This tree can be glossed as a single sentence discourse whose rhetorical relation which connects it to another sentence is undetermined. Consequently, there is no \( \text{RHET} \) feature in the \( D \) node.

The two operations substitution and adjunction which are needed to combine two trees within TAGs can be simulated in TDG:

**Substitution** Substitution can take place at a frontier nonterminal node (i.e. leaf) of a tree. Take for example the tree representing a single sentence discourse as in figure 6.6. This tree

Note that these labels belong to the feature structure and should not be mistaken for tree node labels.
6.3 The Rhetorical Structure of a Narrative

Figure 6.6: A tree description representing the minimal discourse of one sentence

called α in figure 6.7 is added at the frontier node D of a second tree description β. Formally, the combined tree description can be derived by the following label equivalence:

\[ k_1 \equiv k_2 \]

For the purpose of the discourse grammar, this operation is used to insert the start tree derived from the first sentence of the sequence into the tree description established together with the second sentence via a rhetorical relation.

**Adjunction** This operation combines one tree description with another one at a broken line which indicates that only a dominance relation holds between the two node labels. See figure 6.7 where tree description γ is added into tree description β. Generally speaking, the labels of the four D nodes used for this operation are merged, so that the two upper nodes as well as the two lower nodes now share the same information.

The derivation step which enables this operation can be concisely described by the two label equivalences:

\[ k_3 \equiv k_4 \wedge k_5 \equiv k_6 \]

6.3.2 Two tree descriptions

I will define a discourse grammar according to the definition of the TDG in the previous section. Additionally, I will add some features and describe an interface to the non-monotonic reasoning system which I assume to be the same as in Lascarides and Asher (1993).

Firstly, I will add a feature PROMI(NENT) which will be used to define the notion of openness more precisely. The feature PROMI reflects the fact that one situation is subordinated by another one when combined via a rhetorical relation.\(^{22}\)

It has to be stressed that the PROMI feature only reflects the subordination and openness in a discourse. The term **topic** has partly been used for the same purpose in the literature, but also for different discourse phenomena. I refrain therefore from using this term. The value of the PROMI feature is the main situation described by this sentence (i.e., \( s = \text{root}(a) \)).

Secondly, I will introduce a feature containing the temporal information which can be derived. The feature TEMP has as its value a temporal relation which is as follows:

\[ \text{conrel} \]

The value of CONREL will be quite often abbreviated with the name of the convex relation (e.g., **cont** for **contemporary of**).

Thirdly, I will argue against accounts developed by Polanyi (1988), Gardent (1994) and

---

\(^{21}\)See Kallmeyer (1996, p. 4) for the definition of intuitively clear equivalence relation between labels.

\(^{22}\)The way this prominent information is understood within the described framework is similar to the account proposed by Polanyi (1988, p. 607). She uses the term **topic** instead, but in order to avoid confusion with the standard usage of this term, I chose the more neutral feature PROMI(NENT). Polanyi uses a rather informal notion of ‘topic’ “which refers to a semantic entity which the sentence or clause is to be taken to be ‘about’.” Her definition also differs substantially from the usage of **topic** by Asher (1996).
van den Berg (1996a) which use only a context free grammar in order to implement a linguistic model which allows discourse parsing and the building up of a tree structure. The mere stipulation of so-called discourse constituent units and discourse operators does not explain how rhetorical relations (e.g. narration, explanation) can be derived. No explicit link to our world knowledge is offered by such approaches. But the derivation of the appropriate rhetorical relation which provides a connection between the situations can be described by a non-monotonic reasoning system as used for the definition of the relation in the previous section.

In order to conjoin these two approaches a precisely defined semantics-pragmatics interface is needed. This interface permits the definition of how semantic information about the discourse tree structure and pragmatic information about the world/context knowledge can interact.

In the following section two types of tree description are defined. The first tree is used for narration, result, and termination which move forward narrative time and furthermore close off preceding text segments. The second one is used for background, scenesetting and elaboration which convey different sorts of overlapping relations (e.g. superset) and constructs a subordinate discourse segment which leaves the situation mentioned earlier open for subsequent attachment.

### 6.3.2.1 Subordinating tree

As mentioned earlier, I introduce a feature PROMI, in order to emphasise the situation, which is the actual subordinating situation of the discourse segment. The structure sharing mechanism between the PROMI values allows only the prominent situation to be percolated up to the node which also contains the feature assigning the rhetorical relation.

A rhetorical relation which requires such a discourse structure is narration, for instance. According to Lascarides’ and Asher’s definition of subordination and openness this rhetorical relation describes a closed discourse segment (see definition 10 and 11 on 151). The PROMI feature serves the purpose to contain the situation which subordinates another one within the tree structure.

For the tree description evoked by the narration relation the second situation therefore "occupies" the right frontier of the parse tree. This leads to the following two consequences. First, a newly processed sentence can only be attached with respect to this situation. Second, the discourse segment on the left hand daughter’s side is ‘closed off’.23

Additionally to the tree description, further constraints have to be added. It has to be ensured that the situations fulfill the requirements imposed by the rhetorical relation. That is, the enablement relation, for instance, requires that the second situation can be seen as a narrative continuation of the first one.

The same subordinating tree structure is used for the following three rhetorical relations: narration, result and termination. Note that the tree description structure can only be licensed by the result of the non-monotonic reasoning system.24

---

23See section 6.4.1 for a precise definition of openness which make use of the dominance relation established by the tree description.

24This constraint is comparable to the relational constraints imposed on feature structures in HPSG (e.g. sub-

---

### Table 6.1: The rhetorical relations and the temporal constraints for a subordinating tree

<table>
<thead>
<tr>
<th>relation</th>
<th>temporal constraint</th>
<th>instance</th>
</tr>
</thead>
<tbody>
<tr>
<td>narration</td>
<td>before (b)</td>
<td>1</td>
</tr>
<tr>
<td>result</td>
<td>meets (m)</td>
<td>5</td>
</tr>
<tr>
<td>termination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

The derived rhetorical relation also determines the content of the temporal relation. See table 6.1 for an overview of the possible rhetorical relations and the respective temporal constraints.

---
Subordinated tree

A subordinated tree adds another situation to the discourse tree, but this situation is subordinated to another situation higher in the tree. Again, the PROMI feature plays an important role in how the situations are related to the contexts they are embedded in. Both situations occur at the right edge of the tree and they are therefore available for attachment of subsequent situations.

The exact attachment site is furthermore specified by the d-edge. This tree contains two open nodes, whereas the subordinating tree possesses only one node which is open to further attachment.25

The rhetorical relations which license this tree and the respective temporal relations can be found in table 6.2.

Subordinated Tree

<table>
<thead>
<tr>
<th>Subordinated Tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROM</td>
</tr>
<tr>
<td>D</td>
</tr>
</tbody>
</table>

However, as already mentioned in section 6.2.1.3 there are two possibilities for the background relation. Either an unbounded situation is described by the second sentence or the sentence expressing such a situation precedes the sentence with bounded situation in the text.

25Compare this intuitive definition with the discussion on expandable and open tree nodes in section 6.4.2.

The reverse case — sentence $\alpha$ describing the unbounded situation precedes sentence $\beta$ describing the bounded situation — is transformed into a background relation by reversing the order of $\alpha$ and $\beta$ (i.e. background($\beta, \alpha$)). This allows us to treat this rhetorical relation in a uniform way, especially when a tree structure has to be chosen to represent it. The disadvantage of this is, however, that the order of the leaves in the discourse tree is not homomorphic to the sequential structure of the text anymore.

If you traverse the tree and obtain an ordered list, the sentences are ordered as they are sequenced in the actual text. But this is not the case for the reversed background relation. As far as I can see, this does not have any further implications regarding the derivation of the temporal relation or the possible attachment sites, I assume that this way of representing a reverse background is justified.

The ordered list for the subordinated tree looks like follows:

The question this section is mainly concerned with is how the online process of building up a discourse structure can be constrained by certain principles. So far research has been mainly focusing on the discourse structure which constitutes the coherence of a text. The only principle which has been proposed for how a text is actually processed as an online process is the right frontier hypothesis (Webber 1991).

Generally, I will follow this hypothesis, but I will also ask the question of how this frontier is defined and how attachment is possible behind this frontier. Recall that a sentence like (6.4f)
6.4 The Rhetorical Structure of a Narrative

Planting a forest

on page 151 can be understood and incorporated into the preceding discourse structure. We can conclude from this observation that the right frontier hypothesis is a principle for discourse parsing which can be violated to a certain extent.\footnote{See Asher (1993) for other counter examples.}

The following sections explain in more detail how I describe the discourse processing with the help of the earlier defined tree description. Section 6.4.1 establishes the right frontier of the discourse tree as the preferred place for attachment sites. However, the proposed discourse structure is flexible enough to allow also so-called repair sentences. How this type of sentence can be incorporated in the discourse tree is explained in section 6.4.2. Finally, the question will be asked of how more than two situations can be combined and formally represented by the tree description in section 6.4.3. This investigation is indispensable for the representation of three or more sentences, as this will be done in the next chapter of this thesis with respect to a small fragment of German.

6.4.1 Right frontier

As already mentioned in the introduction of section 6.4, the right frontier hypothesis can only be seen as a discourse principle which we follow while producing or understanding a text. Consequently, we are inclined to attach new sentences only at this edge of the discourse tree. The definition of openness as defined in former approaches relied mainly on this criterion given by the discourse tree.

The formalism proposed in the previous section, however, allows to define a more precise notion of openness which matches with the restrictions of the tree description. Basically, all d-edges on the right edge of the discourse tree describe open nodes. Note that the rhetorical relations background, scene-setting and elaboration introduce subordinated tree descriptions which possess two d-edges on the right frontier. Consequently, we have two possible attachment sites for the subsequent discourse. On the other hand, tree descriptions which only have one d-edge on the right side allow the continuation only at this node.

If there is more than one attachment site, the question arises whether there is a choice or a preference between the different sites. Discourse examples like (6.4) showed that an attachment is preferred at a deeper level, the current elaboration level. Only if a conflict can be derived (i.e. 'Nixon Polygon') the processing is popped up the tree according to Lascarides' and Asher’s approach.

In contrast to this, I intend to derive a monotonic description of discourse attachment. I furthermore specify which node has to be seen as current. The situation of this node is preferred for further attachment. The definition of current is quite straightforward: the last processed sentence establishes the current node. A pointer to this node in the discourse tree is used to indicate this.

One last remark has to be made on the open nodes in the tree, before I discuss repair sentences which can be seen as a problematic case for the right frontier hypothesis. The d-edges which do not lie at the right edge of the discourse tree are theoretically speaking open for further attachment as well. However, the discourse processing does normally not consider these nodes which are closed off from the right edge of the discourse tree. As it will be discussed in the following section, so-called repair sentences are capable of reaching behind the right frontier and force an attachment even at these nodes. It will therefore turn out that these so-called expandable nodes can be used to repair a discourse segment in a monotonic way.

6.4.2 Repair

If a discourse structure violates the right frontier principle, this aberration comes with a certain cost. The whole discourse becomes hard to process, the reader has to pause a moment and repair the structure derived up to a repair sentence like (6.9d).\footnote{This example discourse is taken from van den Berg (1996b, p. 116) who offers an explanation within the Linguistic Discourse Model. This explanation, however, requires a non-monotonic discourse semantics in order to override the discourse structure obtained up until the reader encounters a repairing segment.}

\begin{equation}
(6.9) \quad (a) \text{John came home and (b) left the groceries in the pantry. Then (c) he wrapped the present for his grandmother. No. (d) He called Mary. And then (e) he wrapped the present for his grandmother.}
\end{equation}

Reading or hearing this discourse, we are forced to go back in our representation and insert sentence (6.9d) before (6.9c). However, the whole discourse is still understandable and a general theory to discourse processing should cover this observation.

I propose an approach to explain the data presented in (6.9) by the proposed TDG. The definition of tree descriptions and the idea of attaching new sentences at the right frontier will prove to be crucial for this explanation.

Assuming that a stylistically normal discourse is processed as a tree structure where only the right frontier allows further attachment, a repair signal like the exclamation no indicates a relaxation of the processing principle. The reader or hearer is forced to go back to the last attachment point and probably has to add some more information there.

Since the given data structure of d-edges enables us to add an attachment monotonically to the already derived discourse structure, this usage of tree description can be seen as advantageous over previous formalisms.

Tree description $\alpha$ in figure 6.8 reflects the discourse structure up to (6.9c). The next utterance signals a repair of the discourse structure. The following sentence (6.9c) has to be embedded behind the right frontier of the discourse tree. Although this violates the principle for attachment of newly processed sentences, the discourse structure is flexible enough to allow such a sequence. The sentence (6.9b) which is actually already ‘closed off’ is connected with a d-edge to the subordinated sentence (6.9c). Hence the subversion operation can take place at this part of the discourse structure.

Interestingly enough, sentence (6.9c) is repeated after this repair segment has been inserted. It seems to be likely that this is a common strategy to orientate the reader towards the right frontier again.

Additionally, we can now explain a huge amount of repair utterances which are quite common in spoken language. Consequently, the whole discourse in (6.4) could be amended by ...
adding a sentence before (6.4f), saying that the speaker forgot to mention something with respect to the meal. In fact, this more explicit definite description seems to be necessary in this discourse, because the place where sentence (6.4f) has to be inserted is even more deeply embedded in the tree structure than in example discourse (6.9).

To sum up, the proposed discourse grammar is flexible enough to incorporate repair utterances which add further information to the discourse structure. Strictly speaking, this is not a repair (i.e. overriding of information), but adding more information. That is why I think a monotonic representation is more appropriate for this phenomenon.

However, the question of how definite descriptions or other repair command have an influence on the generated discourse structure cannot be elaborated here. But it has to be stressed that the proposed formalism appears to be flexible enough to account for this kind of discourse phenomenon.

The next section discusses the problems one encounters when more than one rhetorical relation can be derived. So far, we have only assumed that there is a single rhetorical relation which holds between two discourse segments. However, as noted by Moore and Pollack (1992), this is not always the case.

6.4.3 Multiple rhetorical relations

It is still an open question whether a discourse structure should allow one or more rhetorical relations between discourse segments. Theories like Rhetorical Structure Theory (RST) (Mann and Thompson 1987) generally assume that there can only be one relation derived connecting two discourse elements. Moore and Pollack (1992) criticise this assumption and argue for a two-fold representation which distinguishes between an informational and an intentional level.

Since I focus in this thesis on the temporal relations between the situations, this problem can be omitted. Nevertheless, a similar problem emerges when we consider longer discourse sequences which allow rhetorical relations not only between the last two sentences but also between preceding segments. Lascarides and Asher (1993) allow the derivation of all possible relations which can be presented in a hierarchical structure as in figure 6.2. However, this is not a tree structure. It is therefore not quite clear how they want to capture the observation of a hierarchical discourse structure formally. The further development by Asher (1993) gives a graph structure which is not as restrictive as a tree structure. Although he also introduces "embedding trees", the proposed formalism by Asher does not restrict the discourse structure to be a tree.

On the other hand, approaches based on context-free grammars like the Linguistic Discourse Model run into problems representing multiple discourse relations (cf. van den Berg (1996a)). Gardent (1994) therefore introduces a more flexible Tree Insertion Grammar (TIG) which is a special form of a TAG to account for multiple dependencies in a discourse. The TDG used in this chapter can be seen in the spirit of this formalism, but it uses a monotonic derivation system for the generation of the discourse tree structure, whereas a TIG has to employ a non-monotonic insertion operation.

In the discourse grammar presented in this chapter two cases come to mind where more than one rhetorical relation hold. Firstly, a narration continues on an embedded level of the discourse tree as in (6.4). The discourse grammar has to ensure that not only the narration relation is derived, but also the elaboration relation is imposed for all dominated situations. Secondly, a piece of background information normally holds not only for the first subsequent sentence. An unbounded situation tends to provide a background for the whole subsequent consecutive discourse segment which follows the sentence describing it.

6.4.3.1 Elaboration and narration

As described earlier in (6.4) an elaboration of a situation can be elaborated again. Moreover, the thread starting with the second elaboration can be continued via a narration. I repeat here a part of sequence (6.4) as (6.10):

(6.10)  (a) Guy experienced a lovely evening last night. (b) He had a fantastic meal. (c) He ate salmon. (d) He devoured lots of cheese. (e) He won a dancing competition.

Sentence (6.10a) is elaborated by (6.10b) and a further elaboration is given in (6.10c). Then a narration is derived which holds between (6.10c) and (6.10d) due to our script knowledge. However, this situation of devouring lots of cheese has also to be an elaboration of (6.10b).

In order to ensure this rhetorical relation for all deeper embedded sentences as well, this rhetorical relation has to be propagated down the right frontier. Reconsider the discourse tree for subordinated trees on page 164. The constraint which has to be fulfilled with respect to the non-monotonic reasoning system is rel(\(\exists\)) \(\Rightarrow\) elaboration. The label \(\exists\) refers to the situation described by the second sentence if we consider only two sentences. But since we now take more than two sentences into perspective, we have to add the following constraint:

\[
\begin{align*}
D_1 \left[ \text{praise} \right] & \prec D_1 \left[ \text{praise} \right] \Rightarrow \text{rel(\(\exists\)) \Rightarrow elaboration.29}
\end{align*}
\]

Note that this constraint has to be imposed on the discourse segment which is embedded under the situation and subsequently elaborated, because otherwise we might get a contradictory discourse. If we change, for example, the discourse slightly like in (6.11):

(6.11)  (a) Guy experienced a lovely evening last night. (b) He had a meal at his favourite restaurant. (c) He ate salmon. (d) He devoured lots of cheese. (e) He had a bad dessert.

The content of sentence (6.11e) clashes with the statement of a lovely evening in the first sentence. The subtopic of having a fantastic meal has been changed to having a meal at his favourite restaurant, because otherwise (6.11e) would already be contradictory to (6.11b).

It may be concluded from this discourse example that there is a need for a further constraint on the discourse structure which is imposed by a elaboration relation. Note that other theories on discourse processing cannot predict this contradiction, because they only allow the derivation of conceivable relations, as for (6.4) by Lascarides and Asher (1995).

29The relations \(\prec\) and \(\preceq\) actually hold between labels, but for the sake of clarity I refrain here from the formally correct specification.
6.4 The Rhetorical Structure of a Narrative

The next section is concerned with background sequences which require a similar constraint on embedded situations. Additionally, two constellations can be observed for these rhetorical relations which may have different consequences for the continuation of the narrative.

6.4.3.2 Background and narration

The background relation also introduces a subordinating tree which allows the continuation of the subsequent discourse at two open situations. However, there are two constellations possible. As pointed out earlier in section 6.2.1.3, a reverse background is given, when the unbounded situation is described before the bounded one by the text.

\[(6.12)\] Maria war wütend (sta). Peter gab ihr das Stück Pizza zurück (acc).

Mary was angry. Peter gave back her piece of pizza.

In this case it seems to be difficult to continue with a scenesetting relation between the first described situation and a third one as in \((6.13)\):³⁰

\[(6.13)\] Sie stampte mit den Füßen.

She stamped her feet.

The described situation is most likely to be interpreted with respect to the last sentence instead. I assume therefore a subordinated tree as for narration for a reverse background. On the other hand, a discourse like \((6.14)\) gives rise to a subordinating tree structure, since \((6.14a)\) and \((6.14b)\) are natural continuations for this sequence.

\[(6.14)\] Peter gab Maria das Stück Pizza zurück (acc). Sie war wütend (sta).

Peter gave Mary back her piece of pizza. She was angry.

a. Sie stampte mit den Füßen.

She stamped her feet.

b. Sie nahm das Stück.

She took the piece.

Similar to the elaboration constraint on subordinated discourse structure, I assume a constraint triggered by a reverse background relation. This constraint furthermore determines the temporal relation which can be derived by this rhetorical relation (i.e. b.c). However, the inference that the unbounded situation may have ceased before the end of the bounded situation is due to our world knowledge. Consider:

\[(6.15)\] (a) Es schneite furchtberlich. (b) Trotzdem fuhr Peter recht flott hinaunter zum Käslihüttli.

It was snowing terribly. Nevertheless, Peter skied quite quickly down to the Käslihüttli.

The acceptability judgement \((77)\) applies only if \((6.13)\) is seen as adding more information to the general scene description (i.e. scenesetting relation).

6.5 The Rhetorical Structure of a Narrative

We normally assume that an unbounded situation persists until we get information about the end of the situation or we can infer a natural end of the situation, since we know how long situations typically last for.³¹

6.5 Conclusions

In this chapter I have introduced a new formalism for representing the discourse structure. TDG has been used to model two crucial features of discourse processing:

- The hierarchical structure of a discourse can be described via a well-defined tree generation grammar. The minimal trees constitute subordinated and subordinating dependencies between the discourse segments.

- The discourse attachment is possible at the right frontier of the discourse tree as former approaches stipulated it. Furthermore I was able to show how the discourse structure proposed allows repair sentences to be monotonically embedded into discourse segments which are ‘closed off’ the right frontier.

The temporal relations are derived from the rhetorical relations. With respect to the analysis of German narratives carried out in the previous chapters, I defined the temporal constraints imposed by the discourse relations more precisely than former approaches did. I furthermore stressed the need for two new rhetorical relations, namely scenesetting and termination. The former one is a more general background relation which comes with a rather coarse temporal relation in contrast to the stricter background relation. The latter one is the mirror relation of result and describes the causation of the end of an unbounded situation.

Finally, I discussed the interactions which arise when more than two sentences are processed and it is possible to infer multiple rhetorical relations. The following chapter contains a short discourse sequence which will be varied three times. It will be shown how the rhetorical relations influence the temporal relation, how the discourse structure restricts the possible attachment sites and how the interaction between the aspectual knowledge (i.e. situation type and viewpoint) and the discourse structure can be explained.

³⁰The following chapter shows in more detail how the tree discourse structure can be constructed for a reverse background.
This chapter contains a fragment of German, which covers some of the example sequences discussed in the previous chapters. The set of default rules imposed by the open-perfective viewpoint is discussed with respect to different example texts. The mechanisms which are needed to derive a coherent discourse and which are given by the proposed TDG are applied to them and consequently a temporal relation holding between the described situations is derived. Although the coverage of this fragment is very small, it shows how different knowledge sources can be used to constrain the temporal structure of a discourse sequence for the crucial discourse phenomena investigated.

7.1 Example texts

The following example text contains three different continuations of the first two sentences:

(7.1) (a) Um drei Uhr verließ Peter die Bergstation. (b) Es schneite furchtbar. (c) Trotzdem fuhr er recht flott hinunter zum Kaslihüttli. (d) Er klopfte sich den Schnee aus den Kleidern. (e) Dann trat er ein und (f) bestellte sich einen Glühwein. Nevertheless, he skied quite quickly down to the Kaslihüttli. He brushed the snow off his clothes. Then he entered and ordered a Glühwein (mulled wine).

1The first two alternations of the text are taken from Eberle (1991, p. 383).
The Fragment Example derivations

7.2 The Fragment Example derivations

The first discourse in (7.1nar) describes a sequence of sentences which are mainly connected via narration. Two interesting phenomena are discussed in more detail in section 7.2.1:

- **How does an unbounded situation interact with a preceding and a subsequent bounded one (i.e. (7.1a-c))?** A discourse structure is given which reflects the ambiguous tree structure for a background and narration relation which holds between an earlier sentence and the last sentence added to the discourse.

- **How does the open-perfective viewpoint present the situation in (7.1c)?** A bounded reading is obviously needed in order to continue with (7.1d) via a narration relation.

The second discourse in (7.1a-h’) introduces an elaboration relation for German with (7.1d’).

Three issues are raised and discussed for this discourse sequence in section 7.2.2:

- **How can an elaboration between (7.1c’) and (7.1d’) be derived?** Knowledge about the alpine world is required here.

- **Why do we need a different translation for English and what effects does this have on the rhetorical structure?** Note that the German text contains the same sentence for all three possible continuations (7.1c+c’+c”).

- **How does the state in (7.1h’) move forward narrative time?**

Finally, the third possible continuation describes a rather disastrous ending for the accomplishment in (7.1c”). Two questions are asked in section 7.2.3:

- **What is the crucial difference from the previous discourse where Peter nevertheless made it to the Kaslihütl?**

- **Where do we continue after the end of situation (7.1c”) in the discourse structure?**
7.2 The Fragment  

Example derivations

<table>
<thead>
<tr>
<th>x y s₁ i₁ t n</th>
</tr>
</thead>
<tbody>
<tr>
<td>named (Peter)</td>
</tr>
<tr>
<td>Bergstation ()</td>
</tr>
<tr>
<td>op (not verlassen (x, y), s₁)</td>
</tr>
<tr>
<td>3 Uhr (t)</td>
</tr>
<tr>
<td>LOC (e₁) = i₁</td>
</tr>
<tr>
<td>i₁ during t</td>
</tr>
<tr>
<td>i₁ before s</td>
</tr>
</tbody>
</table>

We can already learn certain things from this semantic analysis about the temporal constraints which are introduced by this sentence.

- The described situation s₁ has a temporal extension i₁ which is assigned to it by the function LOC.
- The situation type of verlassen (‘to leave’) is punctual, therefore the described situation s₁ is punctual as well. Note that for punctual situations there are no sub-situations. Representing this information within a situation theoretical framework, we could assume a situation type here S : verlassen(s₁, y).
- The situation occurred at a time t, which refers to 3 Uhr (‘3 pm’).
- The situation happened before the utterance time t₁.

I will omit the value of the content feature in the following, but it should be borne in mind that this constitutes the semantic content to which ensuing situations can be related.

(7.2b) This sentence contains a state which is an unbounded situation type. Following the default on background this leads to a temporal overlapping of the two situations. More precisely a coarse temporal relation survived by contemporaneous of (bc) can be derived at first. This relation which includes three interval relations (i.e. over-laps, starts, during) can be narrowed down. According to our knowledge about punctual situations, we can conclude that the snowing situation cannot overlap with the preceding leaving situation. A starts relation seems to be unlikely, since Peter’s leaving probably did not start the snow to fall. Nevertheless this relation can still be included, assuming that the reader probably does not resolve this inference. However, if she is asked for the exact temporal relation, she would assume a during relation, because no indication is given in this text that Peter might have caused the heavy snow fall. It has to be stressed that the given coarse relation reflects this unresolved knowledge. It is a matter of fact that not every inference is drawn by readers while processing a text. The formalism presented succeeds in of expressing this observation.

7.2c Trotzdem fuhr er recht flott hinaunter zum Käslihütli. The next sentence (7.2c) contains a bounded situation which can be either seen as a continuation of (7.2a) licensed by our script knowledge or as the foreground situation which is backgrounded by (7.2b). The value of the RHET and TEMP feature are therefore sets of rhetorical and temporal relations, respectively. The input of the non-monotonic derivation process is the set of all open attachment sites (i.e. D PROM  D) and the last processed sentence. For (7.2c) we obtain two possible trees. The first one describes a narrative continuation from (7.2a) to (7.2c):

---

4Compare with the definition of punctual on page 117.
5See section 5.5.1 on the interaction between open and closed intervals.
6The convex relation is presented as icon for the sake of brevity.
7In order to get to the semantic content of the sentence describing these situations, one simply has to follow the path down to the leaf of the discourse tree.
The second tree structure which can be obtained by the background relation captures the fact that the third situation is also backgrounded by the second situation. Note that this sequence of an unbounded situation followed by a bounded one represents reverse backgrounding. The feature structure therefore contains the reversed ordering of the related sentences and intervals.

However, the DTG gives us a tree description which covers both discourse tree structures:
7.2 The Fragment Example derivations

(7.2a) Er klopfte sich den Schnee aus den Kleidern. The situation described by this sentence can now be linked to (7.2c) by narration. The open-perfective viewpoint predicts a completed situation, so that a contingency structure can be established:

\[
\begin{align*}
&x_1, x_2, i_3 \downarrow n, n \\
&x_1 = x \\
&\text{Käslihütte} \\
&\text{op}(\text{hinunterfahren(e)}, x_1, z), s_0) \\
&\text{LOC}(s_1) = i_3 \\
&\text{before n}
\end{align*}
\]

The open-perfective viewpoint allows us to infer per default that the situation \(s_2\) is of a situation type hinunterfahren zur Käslihütte:

\[\text{op}(\text{hinunterfahren}(e), x_1, z), s_2) > \text{lo}(\text{hinunterfahren}(e), x_1, z), s_3)\]

Note also that anaphoric resolution is needed for \(x_1\) (i.e. \(\text{er}\) (‘he’)). Since I do not intend to give a theory for anaphora resolution here, I will only point out that the accessibility of discourse referents has to be redefined for the hierarchical discourse structure along the lines of the standard DRT definition. It is well known that the discourse structure influences the inferences we can draw with respect to anaphoric resolution (cf. Asher (1993) and Roldeutscher (1994)), but further research is definitely needed here.

Now, the following situation of brushing off snow seems to be a plausible continuation:

(7.2b) Dann trat er ein und bestellte sich einen Glühwein. The following two sentences are added to the discourse tree as the previous one via narration. Interestingly enough, the connective dann (‘then’) is needed for (7.2e) to strengthen the narration relation. Otherwise the background relation would be derived for this sequence (7.1d+f) (i.e. Peter would still be brushing off the snow, while entering the Käslihütte). This more specific context knowledge is therefore added to the non-monotonic knowledge base in order to derive narration.

7.2.2 Elaboration

(7.3) (a’) Um drei Uhr verließ Peter die Bergstation. (b’) Es schneite furchtbar. (c’) Trotzdem fuhr er recht flott hinunter zum Käslihütte. (d’) Bei der Mittelstation legte er einen ordentlichen Sturz hin. (e’) rappelte sich aber schnell wieder auf. (f’) Er klopfte sich den Schnee aus den Kleidern. (g’) wedelte weiter. (h’) und war gegen halb vier Uhr unten.
(a') At 3pm, Peter left the summit station. (b') It was snowing terribly. (c') Nevertheless, he skied quite quickly towards the Kaslihütli. (d') At the middle station he had a real fall, (e') but he picked himself up quickly again. (f') He brushed the snow off his clothes, (g') continued wedelling, and (h') was at the bottom at around half past four.

(7.3a’-d’ The discourse sequence up to (7.3c') is the same as in the previous section. However, the following sentence triggers an elaboration which is supported by the PP an der Mitte istation which refers to a part of the accomplishment described by (7.3c'). The prep-relation is given between $s_3$ and $s_4$, because of a part_of relation which can be inferred from the PP at the middle station. In order to formalise this one needs knowledge about movement verbs and the path they can describe. Furthermore specific alpine knowledge of what a Bergstation and a Mittelstation which may establish a path is required.

But the inference that the situation in (7.3d’) is part of the preparatory phase of $s_3$ seems only to be possible for the German text. It is important to stress that Peter’s fall allows the inference that the situation $s_3$ has stopped at the middle station. Hence in English, a slightly different translation is needed. A towards-PP captures the fact that only the initial part of the accomplishment is described, while the open-perfective viewpoint in German quite easily allows this part to be inferred for the described situation $s_3$.

Formally speaking, a more specific default overrides the general default imposed by the open-perfective viewpoint:

\[(7.3a’-d’), (7.3c’), (7.3d’): \text{op}(s_3, x_1^m \text{ hinunterfahren}(s, x_1, z)) \land \text{op}(s_4, x_1^m \text{ stürzen}(s_1, x_1, m)) \land \text{interrupt}(s_3, s_4) \Rightarrow \neg \text{hinunterfahren}(s_3, x_1, z)\]

We can conclude that the situation $s_3$ is described as the initial part of a situation of skiing downhill to the middle station (i.e. m): $\text{initial}(s_3) \land \text{hinunterfahren}(s, x_1, m) \land \text{prep}(s_3, s)$

Note that two different rhetorical relations are given for the two languages. In German, the elaboration relation can be obtained, whereas in English a background relation is derived, because of the unboundedness of the described situation in (7.3c’).

The tree representation for the German discourse follows:

\[(7.3c’): \text{rappelte sich aber schnell wieder auf}. \quad \text{A narration relation can now be derived between (7.3d’) and (7.3e’). The further constraint of (7.3e’) being an elaboration of (7.3c’) is sustained by the inference that the situation took place at the middle station as well (cf. section 6.4.3 on multiple rhetorical relations). In this case the tree structure predetermines which rhetorical relation has to be derived between (7.3c’) and (7.3e’), namely elaboration:} \]
7.2 The Fragment Example derivations

(7.3f‘+g‘) Er klopfte sich den Schnee aus den Kleidern, wedelte weiter. The situation in (7.3c‘) is resumed by (7.3f‘+g‘) which is again established by the further constraint on elaboration and a narration relation is derived which holds between (7.3e‘) and (7.3f‘).

(7.3h‘) und war gegen halb vier Uhr unten. The situation described by (7.3h‘) is a state which can be seen as caused by the situation in (7.3c‘). This is reflected by the discourse tree structure in that the inferred rhetorical relation is inserted at the open node of (7.3c‘) instead of attaching this situation to (7.3g‘). This discourse segment has to be ‘popped up’, because the constraint that (7.3h‘) has to be an elaboration of (7.3c‘) cannot be fulfilled.
7.2 The Fragment Example derivations

7.2.3 Interruption

(7.4)  
(a") Um drei Uhr verließ Peter die Bergstation. (b") Es schneite furchterlich. (c") Trotzdem fuhr er recht flott hinunter zum Käslihütli. (d") Bei der Mittelstation erfasste ihn eine Lawine. (e") Ein freundlicher Bernhardiner grub ihn aus und (f") versorgte ihn mit Kräuterschnaps, bis (g") der Rettungshubschrauber eintraf.  
(a") At 3pm, Peter left the summit station. (b") It was snowing terribly. (c") Nevertheless, he skied quite quickly towards the Käslihütli. (d") At the middle station an avalanche caught him. (e") A friendly Saint Bernard dug him up and (f") provided him with herbal schnapps until (g") the rescue helicopter arrived.

(7.4a"-d") This sequence is very much like the previous version of the example text. However, the main difference is that the situation described in (7.4c") is never completed. The default assumption that the situation $s_4$ is captured by a predicate hinunterfahren($s_4$, $x$, $z$) is overridden by the information about the avalanche. In contrast to the previous text, this information does not get overridden again by a more specific default of continuing the accomplishment situation, as in sentence (7.3g').

Although sentence (7.4d") can be seen as an elaboration of the accomplishment in (7.4c"), it has to be stressed that the situation described clearly sets a premature end to it. The normal expectation of a reader is therefore that the narrative is continued from this end onwards. Interestingly enough, the elaboration as in the previous text which is subordinated to (7.3c'), can only be justified because an aber ("but") is added in (7.3e'). This discourse marker indicates that the subsequent discourse continues with the situation in (7.3c') despite our first expectation that the situation must have ended at the middle station.

Although the discourse structure of (7.4) does not look different from (7.3) after the third situation, the only attachment site for this constellation is the node containing $s_4$ as PROMI value because no information is provided that this situation continues, and more details on it are given in the subsequent discourse.
(7.4e"-f") Ein freundlicher Bernhardiner grub ihn aus und versorgte ihn mit Kräuterschnaps.
Sentence (7.4e") is a continuation of (7.4d"), because of our script knowledge about mountain accidents. Moreover, we can accommodate the next situation described by (7.4f") as temporally preceding as well, due to our world knowledge.

(7.4g") bis der Rettungshubschrauber eintraf. The final sentence of this discourse continues with the connective bis (‘until’). This is necessary, because our world knowledge does not support the sequence of providing somebody with herbal schnaps and the arrival of the rescue helicopter. It may also be the case that we could conclude several likely continuations; for this reason we have to make the link between the situations explicit.

The connective adds the enablement information to the non-monotonic reasoning base and a narration relation can be concluded.
8.1 Summary

In this thesis I have shown how temporal structure is conveyed in narratives, especially focusing on German narratives and comparing their analysis with the analysis of English narratives. This investigation was carried out as follows:

- In chapter 3, a detailed analysis of the aspectual information in a German sentence and a comparison with other languages proved that in German “a different story has to be told.” A new concept was proposed in order to describe the aspectual and temporal properties of the German Preterite, viz. open-perfective viewpoint. The analysis showed that a definite end point of an accomplishment can easily be overridden provided such a reading can be derived from the context. Consequently, a strict distinction between world knowledge coming from the situation type and the knowledge given by the viewpoint was stipulated.

- The interaction between several knowledge sources on a more complex discourse level was investigated in chapter 4. The requirements for a formal semantics were formulated. In particular, the need for a time logic to express underspecified temporal relations arose and the influence of the rhetorical structure on the temporal relation were discussed.

- A model for the representation of the temporal relations was proposed in chapter 5. I demonstrated how a tripartite structure can be used to conjoin all three levels of temporal knowledge:
  - A situation structure contains the restrictions given by the situation types. Further constraints coming from this knowledge source can further narrow down the set of possible temporal relations.
  - Allen’s interval calculus was used to represent the temporal relations in a concise and efficient way. The sub-algebra of convex relations allowed in most cases an adequate representation of the expressed temporal relations.

- Point relation constraints were employed to model the convex relation algebra. The hierarchy of the 82 convex relations I developed was used to obtain the minimal set of point relation constraints which ensures a concise representation for every relation of this sub-algebra. This sub-set of the full algebra is a computationally tractable sub-set, as shown by previous research.

The approach presented allows a more fine-grained description of the temporal constraints than former approaches.

- Finally, in chapter 6 and 7 I developed a discourse grammar which models the representation of discourse structure not only as a static process, but takes also certain discourse principles into account. I was therefore able to show how open attachment sites can be derived from the generated tree structure and how a flexible discourse structure allows us to incorporate so-called repair sentences into the structure in a monotonic way. Example discourses discussed in chapter 7 demonstrated how the presented theory of discourse processing combines all knowledge sources required for a narrative to be fully understood.

8.2 Discussion

There are three main issues explored and discussed in this thesis. The outcome of the analysis regarding these issues is reviewed in the following sections. Firstly, the aspectual properties expressible by German were investigated. Secondly, the question of how the temporal relation can efficiently and accurately be represented was asked. Finally, a formal model was needed on the level of discourse processing to combine different knowledge sources together.

8.2.1 The aspectual properties of German

In chapter 3 and 4 the concept of the open-perfective viewpoint was used to explain some phenomena which were found in German narratives:

- Activities are perceived as unbounded and consequently provide quite often a background for bounded situations.

- Accomplishments seen from an open-perfective viewpoint may not have a natural end point. In such a case, the most natural translation into English is by an ingressive construction (e.g. to start to compose a sonata or to drive towards).

- Although accomplishments and achievements both introduce a contingency structure as in English, two forms have to be distinguished in German:
  - The weak form is introduced by accomplishments. The open-perfective viewpoint does not necessarily include the end point. The internal structure is easily accessible, as shown in chapter 4.
8.2 Conclusion Discussion

The strong form can be established by an achievement as in English.

This newly developed concept was shown to capture the data discussed. It was shown that the temporal properties of the situation seen from the open-perfective viewpoint differ substantially from a situation presented by the simple aspect in English, for instance. However, since the analysis of discourse sequences almost exclusively focussed on the Preterite, it is difficult to make any prediction about how temporal information is conveyed by other tenses. In particular, the present perfect tense which is widely used in spoken language was neglected. Also dialectical forms of the progressive form like the Rheinische Verlaufsf orm did not get much attention. But the restriction to the Preterite can be justified, because this thesis was concerned with narratives where this tense is the predominate tense form in German.

8.2.2 The representation of temporal information

One of my main concerns was to represent the temporal information expressible by a narrative discourse as accurately as possible. But, on the other hand, the chosen temporal reasoning system has to fulfill certain computational properties. It is a well known fact that the full Allen algebra is not computationally tractable, therefore using a sub-algebra seemed to be a natural choice.

Moreover, it proved to be an interesting extension of a pure time logic to embed the reasoning system into a more complex three-fold system, as was similarly proposed by Kamp and Reyle (1993). Further constraints were derived to constrain the set of possible relations.

Applying this model for representing temporal information to the analysis of temporal relations in German narrative discourse obtained in chapter 4, it turned out that in most cases an exact description of the conceivable relation can be given. But unfortunately not all constellations were expressible within the chosen sub-algebra. In particular, punctual situations which allowed us to conclude a strict subset relation (C) of the temporal extension are not fully covered by the formalism.

Nevertheless, most other constellations were described within the sub-algebra of the convex relations and the obtained results of the investigation of discourse sequences present a more detailed description than former approaches can offer.

8.2.3 Discourse processing

The last part of this thesis was concerned with a discourse grammar which combined all the different knowledge sources. A recently developed formalism (Tree Description Grammar) was employed to model the discourse structure established by the derived rhetorical relations. Moreover, I pointed out that a theory on discourse processing is needed as well, in order to explain how a discourse sequence can be understood as an online process.

In conclusion, two terms can be distinguished. On the one hand, the discourse structure represents a static model of the dependencies between the discourse segments linked by rhetorical relations. On the other hand, the construction of such a discourse tree follows certain principles like the right frontier hypothesis. Using this idea of how the last processed sentences should be attached together with the notion of d-edges (i.e. dominance relation between nodes) the concept of open attachment sites was defined more precisely.

The phenomenon of repair sentences was reflected by the fact that d-edges can be expanded even within deeply embedded discourse segments behind the right frontier. But the proposed discourse grammar can only be seen as an initial framework where future research is needed. I did not consider questions regarding anaphora resolution or the composition of aspectual classes in more detail. These are likely areas of future research which should lead to an overall theory on discourse processing.

8.3 Conclusion

Future research should focus on two areas. First, a formalism which can fulfill all the requirements regarding the representation of temporal knowledge has still not been proposed. Second, the interaction between the sentence semantics and the discourse pragmatics has to be examined in more detail.

8.3.1 Temporal reasoning

As mentioned earlier, the chosen sub-algebra was not able to cover all expressed temporal relations sufficiently. Future research should investigate other sub-algebras and especially focus on the interaction between the different knowledge sources. The is still a need to identify all factors which influence the derivation of the temporal relations and to present a time logic which can grasp all the inferences we quite naturally draw while reading a text.

8.3.2 Sentence semantics and discourse processing

For the definition of the discourse grammar a common simplification was assumed: the input for the discourse processing was described “sentence by sentence”. The actual chunks of the discourse structure were defined by the main eventuality of one sentence, although there might have been complex constructions of subordinated sentences containing (at least) two situations (e.g. before/after sentences).

A discourse grammar which claims to give a theory of real text should not be restricted to a sequence of main sentences with the full stop as the only punctuation mark. It is therefore important to analyze how the interface between sentence semantics and discourse pragmatics can be described formally. Unfortunately this is quite difficult to achieve since these two areas are interlinked in a very unfathomable way. But, on the other hand, we cannot assume that discourse processing is only explainable by world knowledge and the aspectual information we get from the text.

In recent research, the investigation of discourse markers like after, but, while etc. has been shown to be very fruitful (cf. Knott (1996)) and I believe that a theory of discourse processing can only be obtained when these findings enrich a formal theory of discourse representation.
## All 82 Convex Relations

<table>
<thead>
<tr>
<th>name</th>
<th>constraints</th>
<th>Allen relations</th>
<th>icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>m</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>o</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>pr</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>mn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>ob</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>ri</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>di</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>mn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>nn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>nn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>nn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>oc</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>nn</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>ol</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>s</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>s</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>si</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
<tr>
<td>b</td>
<td>$[&lt;,</td>
<td>&lt;,</td>
<td>&lt;,</td>
</tr>
</tbody>
</table>

### Examples

- **bi**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **hh**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **d**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **f**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **oi**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **mi**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle m.\rangle]$ | ![Icon](<>) |
- **>**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle m.o.\rangle]$ | ![Icon](<>) |
- **ys**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **rr**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
- **nn**: $[\langle <,|<,|<,|<;> \rangle] \rightarrow [\langle s.\rangle]$ | ![Icon](<>) |
<table>
<thead>
<tr>
<th>name</th>
<th>constraints</th>
<th>Allen relations</th>
<th>icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>am</td>
<td>[(=,&gt;,),[(=,),[(&gt;,)]]</td>
<td>[(=,),f]</td>
<td>[(=,)]</td>
</tr>
<tr>
<td>cm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(si,),o,i,]</td>
<td>[(si,)]</td>
</tr>
<tr>
<td>sm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(si,),o,i,m]</td>
<td>[(si,)]</td>
</tr>
<tr>
<td>cm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(si,),o,i,m]</td>
<td>[(si,)]</td>
</tr>
<tr>
<td>ss</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>mm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>mm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>mm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>bct</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),o,s,d]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>cht</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(c,),m,o,s,d]</td>
<td>[(c,)]</td>
</tr>
<tr>
<td>utc</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(t,),f]</td>
<td>[(t,)]</td>
</tr>
<tr>
<td>sc</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>rv</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(r,),s,i,o,i,m]</td>
<td>[(r,)]</td>
</tr>
<tr>
<td>sm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,s,d,f]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>mm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,s,d,f]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>sm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,s,d,f]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>cm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>sm</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(s,),i,d,f,o,i]</td>
<td>[(s,)]</td>
</tr>
<tr>
<td>ct</td>
<td>[(=,&gt;,),[(&gt;,),[(&gt;,)]]</td>
<td>[(c,),f,i,s,d,f,o,i]</td>
<td>[(c,)]</td>
</tr>
</tbody>
</table>
B

Convex Relations and Intervals

B.1 All possible temporal relations

B.2 Convex Relations and Intervals

Open intervals

B.2 Open intervals

B.2.1 Two open intervals

- Two open intervals cannot meet, because the boundary is explicitly excluded per definitionem. A scenesetting relation is established by this constellation which comes with the following point constraints:

contemporary of $<$ LOC me($\alpha$), LOC me($\beta$)$>$

Note that the top interval corresponds to the situation described by the first sentence.
B.2 Convex Relations and Intervals

Open intervals

B.2.2 One open interval encounters a border

B.2.2.1 background

This constellation appears if the script knowledge supports a sequence:
\( \text{narration}(a, \beta) \rightarrow \text{before}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{before} = [<, <, <, [>] \}

World knowledge with respect to causation or termination of the unbounded situation is required here:
\( \text{result}(a, \beta) \rightarrow \text{meets}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{meets} = [<, <, <, [>] \}

Second situation backgrounds the first one:
\( \text{background}(a, \beta) \rightarrow \text{survived by & contemporary of}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{survived by & contemporary of} = [>, <, <, [>] \}

B.2.2.2 Reverse background

This constellation appears if the script knowledge supports a sequence:
\( \text{narration}(a, \beta) \rightarrow \text{before}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{before} = [<, <, <, [>] \}

World knowledge with respect to causation or termination of the unbounded situation is required here:
\( \text{result}(a, \beta) \rightarrow \text{meets}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{meets} = [<, <, <, [>] \}

First situation backgrounds the second one (i.e. reverse background):
\( \text{background}(a, \beta) \rightarrow \text{older & contemporary of}(\text{LOC}(me(a)), \text{LOC}(me(\beta))) \)
\( \text{older & contemporary of} = [>, <, <, [>] \}
B.3 Punctual intervals

B.3.1 Two punctual situations

* This constellation appears if the script knowledge supports a sequence:
  \( \preceq(narration(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{before} = [\prec, \prec, \prec, \preceq] \)

† When a situation is caused or terminated by the other one, the following constraints are valid, respectively:
  \( \preceq(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{meets} = [\prec, \prec, \prec, \preceq] \)

* The second situation has to elaborate the first one and considering that these two relations are punctual, the equals relation can be derived:
  \( \preceq(\text{elaboration}(\alpha, \beta) \rightarrow \text{superset}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{superset} = [\preceq, \preceq, \prec, \succ] \)

\( \forall s, s' (\text{punctual}(s) \land \text{punctual}(s') \rightarrow \text{LOC}(s) [\omega_1 \leq \alpha_2 \lor (\alpha_1 = \alpha_2 \land \omega_1 = \omega_2)] \land \omega_1 \geq \omega_2 \land \text{LOC}(s')) \)

(Lemma PU2) \( \Rightarrow R_{11} = = , R_{22} = = \)

B.3.2 A punctual situation followed by a durative one

* This constellation appears if the script knowledge can be derived:
  \( \preceq(narration(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{before} = [\prec, \prec, \prec, \preceq] \)

† When a situation is caused or terminated by the other one, the following constraint is valid:
  \( \preceq(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{meets} = [\prec, \prec, \prec, \preceq] \)

* The convex relation is triggered by the background relation, where the second situation surrounds the first one. The fact that the first situation is punctual allows us to draw the inference that the overlaps relation is excluded:
  \( \preceq(\text{background}(\alpha, \beta) \rightarrow \text{survived by a contemporary of}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))) \)
  \( \text{survived by a contemporary of} = [\preceq, \preceq, \prec, \succ] \)

\( \forall s, s' (\text{punctual}(s) \rightarrow \text{LOC}(s) [\omega_1 \leq \alpha_2 \lor (\alpha_1 = \alpha_2 \land \omega_1 = \omega_2)] \land \omega_1 \geq \omega_2 \land \text{LOC}(s')) \)

(Lemma PU1b) \( \Rightarrow R_{11} = \geq \)

† Borderline cases which are only required if a coarse convex relation is needed for representing all given possibilities.
B.4 Closed and durative intervals

• This constellation appears if the script knowledge supports a sequence:
  \[\text{before}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))\]

• Appropriate world knowledge for triggering (or terminating) the following situation is required here:
  \[\text{meets}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))\]

• Second situation elaborates the first one which establishes a superset relation:
  \[\text{super}(\alpha, \beta) \rightarrow \text{super}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta)))\]

• Borderline cases which are only required if a coarse convex relation is needed for representing.

Glossary

accomplishment (p. 10, 32) An \rightarrow aspectual class \rightarrow situation type. This type is durative and telic (e.g. to destroy, to create).

achievement (p. 10, 32) An \rightarrow aspectual class \rightarrow situation type. This type is punctual and telic (e.g. to notice, to win).

activity (p. 10, 32) An \rightarrow aspectual class \rightarrow situation type. This type is durative and not telic (e.g. to run, to walk, to laugh).

Aktionsart (p. 10) There are two traditions which make use of this term:

Germanic tradition A lexicalisation of the classification of situations according to their temporal properties. The distinction is solely based on the inherent meaning of the situation (e.g. Steinitz 1981):

iterative flattern, grübeln, plätschern (‘to flutter/to flap its wings’, ‘to brood’, ‘to babble/to patter’)
inchoative abfliegen, einschlafen, losfahren (‘to take off’, ‘to fall asleep’, ‘to set/move/drive off’)
resultative verbluten, verrostern, zerschlagen (‘to bleed to death’, ‘to get rusty’, ‘to smash to pieces’)
punctual angreifen, finden, treffen (‘to attack’, ‘to find’, ‘to meet’)
mutative sich erkälten, gesund werden, umleiten (‘to get a cold’, ‘to recover’, ‘to divert’)
factive blondieren, reinigen, treckenn (‘to bleach’, ‘to clean’, ‘to dry’)
causative fallen, legen, setzen (‘to fall’, ‘to lay down’, ‘to put/place’)

Slavonic tradition A semantic distinction of situations which is lexicalised according to a derivational morphology (e.g. Isačenko 1968). E.g. the Russian verb igrat’ (‘to play’) can be changed to the ingressive form zaigrat’ (‘to start playing’) via the prefix -za.

⇒ aspectual class, situation type

aspect (p. 10) “(The) different ways of viewing the internal temporal constituency of a situation” (Comrie 1976, p. 3). There are two ways of viewing a situation:
perfective The situation is presented from the outside. An external perspective on the situation is chosen (e.g., Peter read a book yesterday).

imperfective The situation is presented from the inside. The internal structure is shown (e.g., Peter was reading a book).

⇒ viewpoint

aspeсtual class (p. 10) The classification of a situation according to its intrinsic temporal properties. These properties can be tested by linguistic tests as, for instance, proposed by Vendler (1967). (e.g., Peter was happy for 3 hours vs. *Peter was happy in 3 hours). Vendler proposed four types: ⇒ accomplishment, ⇒ achievement, ⇒ activity and ⇒ state. Note that he assigned this classification to verbs rather than whole sentences describing a situation. ⇒ situation type, Aktionsart

background (p. 24, 148) A rhetorical relation triggered by a ⇒ situation type which is unbounded. This feature allows the situation to temporally overlap another situation which is bounded.

bounded (p. 14, 116) Bounded ⇒ situation types are accomplishments, achievements and semelfactives.

closed interval (p. 109) A closed interval contains its end points, whereas for an open interval these points are explicitly excluded.

consequence (p. 79) A consequence relation can be established between two situations if the second one is a consequence of the first one. ⇒ enablement, result.

consequentiality (p. 94) "The reader’s attention in the processing of a narrative will be geared towards detecting consequentiality relations between the states of affairs described." Caenepeel (1989, p. 77). These relations provide the links between the situations, they are "contingently related to each other" and consequently impose a temporal precedence relation. ⇒ contingency structure, enablement, result.

contingency structure (p. 94) This structure is triggered by accomplishments and achievements (⇒ situation type). A change of state is evoked by the structure and "creates the appropriate conditions for a new state of affairs (which comes after it)." Caenepeel (1989, p. 70).

⇒ nucleus

convex relation (p. 124) A set of Allen interval relations can be described as convex due to certain criteria. There are 82 convex relations which define a subset of the full interval algebra.

culmination (p. 15) An aspeсtual class according to the nucleus model by Moens (1987). ⇒ achievement.

durative (p. 31) A feature a ⇒ situation type can possess. The opposite of punctual.

elaboration (p. 147) A rhetorical relation where the second sentence describes a situation of the first mentioned situation.

enablement (p. 94, 146) Sandstrom (1993, p. 63) defines this relation as a relation holding between two events e₁ and e₂ "by virtue of the state of e₁, which is such as to make e₂ possible."

event (p. 18) An event is a bounded situation type. ⇒ achievement, accomplishment, semelfactive

eventuality (p. 106) An overarching category for discourse referents according to (Kamp and Reyle 1993).

imperfective (p. 38) Smith (1991) defines an imperfective ⇒ viewpoint as showing no end points of the situation and spanning an interval. ⇒ aspect

neutral (p. 38) Smith (1991) defines a neutral ⇒ viewpoint presenting the initial point first internal stages of the situation. ⇒ aspect

nucleus (p. 15) The nucleus model by Moens (1987) describes the internal structure of an situation which can consist of a preparatory process (⇒ activity), a culmination (⇒ achievement), culminated process (⇒ accomplishment), a point (⇒ semelfactive) and a state. ⇒ contingency structure

open interval (p. 109) An open interval does not contain its end points, whereas for a closed interval these points are included.

open-perfective viewpoint (p. 30, 119) A further development of Smith’s ⇒ neutral viewpoint. The default reading is perfective, but context may override the end point of the situation.

perfective viewpoint (p. 38) Smith (1991) defines a perfective ⇒ viewpoint presenting the whole situation and consequently including the end points. ⇒ aspect

Preterite (p. 29, 40) The German past tense, frequently used in a narrative.

punctual (p. 117) Punctual ⇒ situation types are achievements and semelfactives. ⇒ durative.

reference time (p. 16) The reference time introduced by Reichenbach (1947) was used to describe complex tenses like past perfect. The temporal interpretation of narrative discourse sequences is understood as a sequence of reference times.

rhetorical relation (p. 21) The rhetorical structure of a discourse establishes the coherence of the text. Relations like background, narration have to be derived between the text segments in order to obtain also the temporal structure of the described situations.

semelfactive (p. 32) An ⇒ aspeсtual class or ⇒ situation type. This type is punctual and not telic (e.g., to knock, to cough).
situation (p. 114) A situation (or eventuality) has a temporal and spatial extension and occurs in the world. Propositions can be assigned to situations and categorised according to their temporal features. ⇒ situation type, aspect

situation type (p. 30, 31) Aspectedual information expressed by the temporal features of a situation. According to Smith (1991) five different types can be distinguished, viz. state, activity, accomplishment, semelfactive, and achievement. ⇒ aspectedual class, Aktionsart (Germanic tradition)

state (p. 10, 32) An ⇒ aspectedual class or ⇒ situation type. This type is durative and stative (e.g. to love, to hate).

stative (p. 31, 115) A proposition P which holds for a situation is defined as stative, when the P holds at every single point of the assigned time interval. ⇒ state

telic (p. 31, 118) This feature reflects the observation that a telic situation introduces a consequent state. ⇒ achievement, accomplishment, culmination

viewpoint (p. 30, 36) Aspectedual information understood as a view on a situation. Smith (1991) distinguishes three different viewpoints: imperfective, perfective and neutral (cf. ⇒ open-perfective viewpoint) ⇒ aspect, Aktionsart (Slavonic tradition)

Bibliography


Works of Fiction


