

Temporal Relations in English and German Narrative Discourse

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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

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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 a contradiction is denoted by a preceding ‘#’.

Feature structures are represented as follows: $\left[\text{FEATURE: value} \right]$

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ONE

Introduction

"Die Insel Anthos ist mit dem besagten Dampfer zu erreichen, der bei Bedarf einmal in der Woche vor der Bucht vor Anker geht. Natürlich hielt ich während der Fahrt fleißig Ausschau."

Nun, dachte ich bei mir während der Erzähler sich neu einschränkte, nun wird gleich das Wort: Reling kommen — denn er erging sich in den ausgefahrenen Gleisen der Sprache. Wirklich, es kam!

"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. 20–22)

"The island of Anthos is reached by the said steamer, which anchors once a week, if required to, 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, *The Dolphin*, 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-

mation to the reader:

(...) Ein Boot mit zwei großen Augen am Bug, wie man sie auf griechischen Augenschalen 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 interpretation 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 movement 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 (...) Mühsam kam er den Dorfweg herauf, 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)

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 second 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 temporal 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 single 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?

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

- (1.1) 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 simple past. That means there are certain context conditions which allow the *Preterite* to describe an uncompleted situation, whereas the English *simple past* (i.e. *Hans crossed the street*) is not capable of expressing such a reading. However, the question remains what exactly these conditions 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 discourse 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 framework 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 relations accurately. Finally, a discourse grammar presents an overarching frame for the several factors which have to be considered while processing a discourse.

¹This example was taken from Eberle (1988, p. 163).

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/ldv/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.

TWO

Former Approaches

The aim of this chapter is to provide the reader with an overview of influential former approaches to the modelling 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.

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.

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 cost*

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 *verbluten, verrostet, 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 *fällen, legen, setzen* ('to fell', '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-*.

aspect "(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 inside. The internal structure is shown (e.g. *Peter was reading a book*).

Although especially the usage of the term *Aktionsart* can cause a lot of confusion, we can observe at least a two-way distinction of the terminology. On the one hand, terms like aspectual class and *Aktionsart* (in the sense of the Germanic tradition) are used to classify the inherent structure of a described situation. Aspect and *Aktionsart* (in the sense of the Slavonic tradition) refer to a view on a situation which is indicated by a derivational morphology. It should not come as a surprise that most Slavists focussed on this phenomenon, since all Slavonic languages possess a rich morphological system. In contrast a language like German does not have such a rich morphological system. It compensates the lack of a derivational system by having a great number of verbs which focus on the start (i.e. inchoative) or the completion (i.e. resultative) of a situation, while in English phrasal verbs and other means are used to express these distinctions. These verbs are quite often marked by a prefix like *ab-*, *ein-* or *ver-*, but these morphemes are not systematically combinable. The meaning expressed by these prefixes is purely lexical. The reader should bear this observation in mind, when the aspectual system of German will be analysed in more detail in section 3.2.

For the time being, I want to focus on the classification of aspectual classes based on linguistic tests which were designed for English by Vendler (1967). His well-known and influential categorisation is based on a philosophical tradition reaching back to Aristotle. Vendler built his work on the linguistic investigations by Ryle (1949) and Kenny (1963). His classification will be described in section 2.2.1.

A more elaborate classification of aspectual classes proposed by Moens (1987) will be given in section 2.2.2.

Later in chapter 3 I will come back to the question of how the term aspect as a view of a situation can be defined. I will use the framework developed by Smith (1991) and distinguish between two levels of aspectual information how this was already suggested by the two different traditions for the term *Aktionsart*.

2.2.1 Vendler (1967)

The classification proposed by Vendler (1967) contains four categories: *state* terms, *activity* terms, *accomplishment* terms and *achievement* terms. 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 Krifka (1992) developed theories which showed the influence of arguments and adjuncts on the aspectual class of the whole sentence.¹

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

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 compability of sentences with a durative adverbial like *for 2 hours* and with time-span adverbials like (*with*)*in 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 *achievements* and *accomplishments*. 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

White (1995), for instance, for a recently developed computational approach to aspect composition.

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.

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).

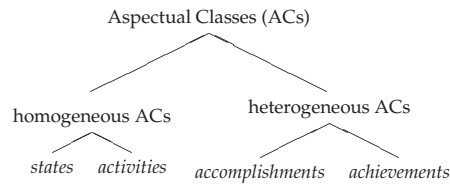


Figure 2.1: Hierarchical structure of aspectual classes according to the mereological tradition

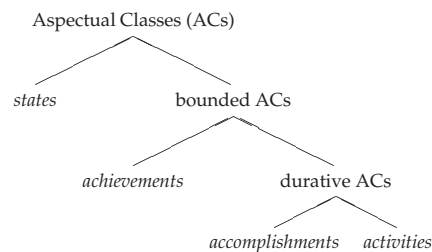


Figure 2.2: Aspectual class hierarchy according to the stative/non-stative distinction

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

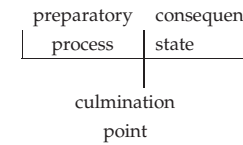


Figure 2.3: The nucleus developed by Moens (1987)

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.

	Events		States
	atomic	extended	
+conseq	Culmination <i>recognise, spot, win the race</i>	Culminated Process <i>build a house, eat a sandwich</i>	<i>understand, love, know resemble</i>
-conseq	Point <i>hiccough, tap, wink</i>	Process <i>run, swim, walk, play the piano</i>	

Table 2.1: Moens' categorisation of aspectual classes

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.

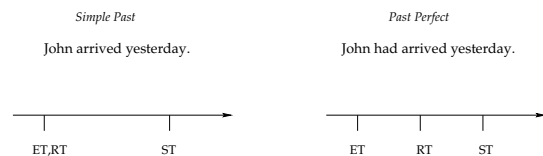


Figure 2.4: Simple Past vs. Past Perfect according to Reichenbach (1947)

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

	Past	Present	Future
Simple	<i>She ate</i>	<i>She eats</i>	<i>She will eat</i>
	ET = RT < ST	ET = RT = ST	ET = RT > ST
Perfect	<i>She had eaten</i>	<i>She has eaten</i>	<i>She will have eaten</i>
	ET < RT < ST	ET < RT = ST	ET < RT > ST

Table 2.2: Reichenbach's constraints on ET, RT and ST

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.

Some of the approaches to discourse processing described in the following sections use this idea that the discourse establishes an *anchor* for the reference time. In that sense, tense is understood as anaphoric, referring back to the *pronominal* RT.

Problems The reference time is presented as a point in time in the original proposal. Reichenbach assumes points for his representation and only for the progressive does he allow an interval. Subsequent research pointed out that the RTs have to be seen as intervals rather than points in time (Hornstein 1977). It is also debatable whether the *progressive form* or the *present perfect* is sufficiently explained by referring merely to time intervals. Such approaches do not capture the fact that for the *present perfect*, for example, a culmination point is required (e.g. *She has arrived at the summit* vs. **He has sneezed*).

Another doubt, which is in the line of the previous criticism, is pointed out by Moens (1987, p. 26) who criticises that a theory based solely on reference times cannot explain why sentences like in (2.10) are ungrammatical:

- (2.10) a. *At 6 pm, John built a house.
b. *The mountaineer reached the top in less than 5 hours.

A theory which relies only on points (or intervals) on a time line cannot explain the phenomena observable in 2.10. It seems to be necessary to assume a more complex notion like the *nucleus* model which relates to the different parts of a situation.

Later in chapter 5, I will come back to this issue and present an approach which combines the different notions of a *nucleus* and a reference time presented as an interval.

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.

2.4.1 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:

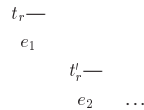
(2.11) Mary walked into the room (e_1). She switched on the light (e_2).

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):



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, \dots, 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

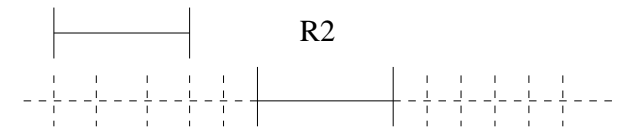


Figure 2.5: Dowty's TDIP

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_1). The report was on her desk (e_2)

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 reference 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):

(2.17) 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 *statives* 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 an 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*.

³There are marginal exceptions like in:

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

- (2.21) a. Jackie sawed off the end of the shelf. It was six inches too long to fit next to her bed.
 b. The magician poured a silver liquid into the bowl. It was in a crystal beaker.
 c. Maria gave a single yell. It was very loud.

In all these example discourses the state ends when the event has come to an end as well.⁴

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 only 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.

⁴Interestingly enough, this observation cannot be made for the German translations as I will discuss in section 3.3.1.

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 (\models is the entailment relation for the monotonic predicate logic):

Tweety is a bird.
 All birds fly.
 Penguins do not fly.
 \models 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 $>$ is introduced to represent defaults of the form $\phi > \psi$ (i.e. ϕ then ψ , 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 (\approx is the non-monotonic entailment relation):

- **Defeasible Modus Ponens:**

$\phi > \psi, \phi \approx \psi$

(e.g. if birds fly and Tweety is a bird, then Tweety flies)

- **Penguin Principle:**

$\phi > \psi, \psi > \zeta, \phi > \neg\zeta, \phi \approx \neg\zeta,$

but not: ζ

(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:**

$\text{not}(\phi > \psi, \zeta > \neg\psi, \phi, \zeta \approx \psi \text{ (or } \neg\psi))$

(e.g. there is an irresolvable conflict in the following: Quakers are pacifists, republicans are non-pacifists, Nixon is a quaker and republican)

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” ($\Box(A \rightarrow B)$).

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 $\langle \rangle$ to relate a newly processed sentence — represented as a Segmented DRS (SDRS) — to an already existing discourse γ via a sentence β .⁵ A rhetorical relation has to be derived for an SDRS α in order to establish a coherent discourse:

- **Narration:**

$\langle \gamma, \alpha, \beta \rangle > \text{narration}(\alpha, \beta)$

If this discourse relation can be derived, the following axiom applies. ($me(\alpha)$ refers to the main eventuality described by α and \prec is the temporal precedence relation).⁶

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

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

⁵The sentence β does not have to precede sentence α immediately. See section 6.2.2 for the definition of *open* sentences which are determined by the discourse structure.

⁶See Lascarides and Asher (1993) for a formal definition.

(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 situation:

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

This can be formalised by the following default:

- **States overlap:**

$$\langle \alpha, \beta \rangle \wedge \text{state}(me(\beta)) > \text{overlap}(me(\alpha), me(\beta))$$

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

- **Background Relation:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{overlap}(me(\alpha), me(\beta)) > \text{background}(\alpha, \beta)$$

And finally, the following axiom confirms the temporal relation:

- **Axiom on Background:**

$$\Box(\text{background}(\alpha, \beta) \rightarrow \text{overlap}(me(\alpha), me(\beta)))$$

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:**

$$\langle \alpha, \beta \rangle \wedge \text{switch_off}(x, \text{light}, me(\alpha)) \wedge \text{be_dark}(\text{room}, me(\beta)) > \text{cause}(me(\alpha), me(\beta))$$

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:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{cause}(\alpha, \beta) > \text{result}(\alpha, \beta)$$

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:**

$$\langle \alpha, \beta \rangle \wedge \text{prep}(me(\alpha), me(\beta)) > \text{elaboration}(\alpha, \beta)$$

- **Axiom on Elaboration:** $\Box(\text{elaboration}(\alpha, \beta) \rightarrow \neg(me(\alpha) \prec me(\beta)))$

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 *event* via a *state*. An overlapping relation according to *background* or a precedence relation according to *result* can be derived, provided the appropriate information is given by the context and the world knowledge. However, the example sentences in (2.21a) to (2.21c) all involve an anaphoric expression which enables the reader to draw the conclusion that the *state* is part of the preceding *event*. I will therefore call this discourse relation *anaphoric elaboration*.

Another problem may be caused by the choice of the underlying temporal logic. The only temporal relations they assume are the precedence relation and the overlapping relation. For the latter, it is unclear whether this is a strict overlapping or whether the two situations have to share only one common subpart. Moreover, they model the subset relation via an additional predicate, using the preparatory phase (i.e. *prep*) of an event by following the *nucleus* model (Moens 1987). The axiom on *Elaboration* only requires that the situations are not sequentially ordered (i.e. $\neg(me(\alpha) \prec me(\beta))$). The *prep* relation has to introduce the subset relation. Bear in mind that therefore this temporal relation is rather implicit within this framework. It remains unclear which inferences can be drawn with respect to the other temporal relations.

Furthermore, they confuse what actually is related via the temporal precedence or overlapping relations. The representation of the sentence *Max stood up* can be paraphrased within their DRT-type framework as follows:

$$(2.26) \quad [e_1, t_1] [t_1 \prec \text{now}, \text{hold}(e_1, t), \text{stand up}(m, e_1)]$$

This representation contains two discourse referents e_1 and t_1 , where e_1 refers to an event of Max standing up and t_1 is a point of time. The precedence relation (\prec) apparently holds between time points rather than events. However, as it was introduced earlier, the temporal relations imposed by the rhetorical relations are defined for the *main eventuality* of events (i.e. $me(e)$), which are again discourse referents referring to events. This shortcoming can be amended by introducing the *hold* predicate in the earlier mentioned definitions. However, we run into problems again, when defining the overlapping of two events. Assuming time points for the underlying time logic, this is impossible to express, since between time points only the three relations $<$, $>$ and $=$ can hold.

It may be concluded from this that the time logic used by Lascarides and Asher (1993) needs to be elaborated in order to express the required relations holding between the described situations in a narrative discourse. In particular a logic which clarifies the dependencies between events, intervals and points is required.

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).

THREE

Aspectual Information Encoded in German

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 lexeme¹ 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 Bäuerle (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).

¹Besides 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).

3.2.1 Situation types

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

situation types	static	durative	telic	temporal schema
state	[+]	[+]	[-]	(I)—(F)
activity	[-]	[+]	[-]	I...F _{arbitrary}
accomplishment	[-]	[+]	[+]	I...F _{natural} (R)
semelfactive	[-]	[-]	[-]	I F
achievement	[-]	[-]	[+]	...I(R)... F

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):

²In the following I will use *stative* instead of *static* in order to use confusion with the use of the term *static* in chapter 6.

- (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 tests \pm stative. 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* \Rightarrow *-stative*)
 c. Tom eats a sandwich. (*habitual* \Rightarrow *-stative*)
 d. Della taps on the desk. (*habitual* \Rightarrow *-stative*)
 e. Tony shatters the glass. (*habitual* \Rightarrow *-stative*)

Expressions of Duration The following two tests distinguish between durative and punctual situation types (\pm durative). According to these tests instantaneous (i.e. *achievements* and *semelfactives*) fulfil 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. (\Rightarrow *-durative*)
 b. *I knocked for an hour. (\Rightarrow *-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. (\Rightarrow *-durative*)
 b. I knocked at midnight. (\Rightarrow *-durative*)
 c. ?Mary ran at 11 am. (\Rightarrow *+durative*)
 d. *Tom built a house at midday. (\Rightarrow *+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. (\Rightarrow *+telic*)
 b. *I knocked in two hours. (\Rightarrow *-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. (\Rightarrow *-telic*)
 b. *Tom ate a sandwich for three hours. (\Rightarrow *+telic*)
 c. *Mary climbed the mountain for three minutes. (\Rightarrow *+telic*)
 d. Mary climbed the mountain for years. (*iteration* \Rightarrow *-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:

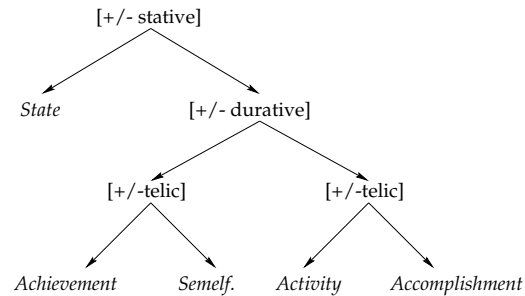


Figure 3.1: The decision tree for the German situation types

- (3.7) a. ?? Das Fahrrad war gerade blau. (*state*)
 The bike was just blue.
 ?? The bike was being blue.
- b. ?? Peter wußte gerade die Antwort. (*state*)
 Peter knew just the answer.
 *Peter was knowing the answer.
- c. Johann ging gerade zur Schule. (*accomplishment*)
 John went just to-the school.
 John was going to school.
- d. Peter arbeitete gerade im Garten. (*activity*)
 Peter worked just in-the garden.
 Peter was working in the garden
- e. Maria erreichte gerade den Gipfel. (*achievement*)
 Mary reached just the summit.
 Mary was just reaching the summit.
- f. Paul hustete gerade. (*semelfactive*)
 Paul coughed just.
 Paul was coughing.

The only reinterpretation conceivable for (3.7a) and (3.7b) involves a change of state. Assuming a situation where somebody repaints his/her bike regularly, this sentence (3.7a) would be acceptable. Furthermore, (3.7b) can have a reading where this sentence refers to the result state of an *achievement* like *Peter got the answer*. Again, a change of state can be inferred for this reading.³

³The usage of the *progressive form* in English can highlight this effect as in *Peter is being silly*. However, a context which allows the reader/hearer to infer a change of state is required as well.

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 inceptive 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* ('at 4 pm') 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 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 in(nerhalb von) zwei Stunden.
 John reached the summit (with)in two hours.

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 Busstation.
*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 be 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-stative 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.

⁴But 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.

I will summarise Smith's definitions of three different viewpoints, focusing especially on the *neutral* viewpoint. She introduces this concept in order to apply a viewpoint to aspectually ambiguous sentences and, in particular, to languages which do not possess a grammaticalised aspectual system (e.g. Finnish). However, none of the five languages she investigates is such a language. It seems therefore to be quite interesting to use her theoretical framework to apply this concept to German — a language without any overt aspectual markers.

Smith's justification of this new theoretical concept is only backed up by aspectually ambiguous sentences in French, Chinese and Navajo. As she points out herself, the *neutral* viewpoint might differ with respect to other languages. Hence future research is needed here to clarify, in particular, the following objection. It is conceivable that one might claim that languages which do not possess explicit viewpoint morphemes are more appropriately described with an underspecified aspectual system. That is, the *imperfective/perfective* distinction is upheld and for aspectually ambiguous sentences an underspecified superclass is simply assumed. Such an approach was presented by Bäuerle (1988) for the German Preterite. He observed two readings for the sentence *der Angeklagte fuhr nach Hause* ('the defendant drove home'): one reading refers to an extended reading the other one to a single event. Comparing this outcome with the English aspect system, he concluded that the German Preterite is ambiguous with respect to the *imperfective* (i.e. *progressive form*) and the *perfective* (i.e. *simple aspect*) viewpoint. But I will show that his assumption is based on an over-generalisation and that the discourse example he gives can be better explained when the rhetorical structure (i.e. elaboration of an event) is taken into account. It will be furthermore proved that the discourse function of *backgrounding* is not obtainable for German, which makes it questionable why the Preterite should be ambiguous with respect to the English *progressive form* and the *simple aspect*, since this is an important discourse function of the *imperfective* viewpoint. This discussion will, in particular, prove the importance of a more detailed analysis of the expressed discourse structure (see section 3.3.1).

I will hence point out that a new concept for the German aspect system is needed and apply Smith's notion of a *neutral* viewpoint to German data. It will turn out that Smith's definition has to be clarified. My investigation of German discourse sequences will consequently lead to a slightly altered definition of a third viewpoint, which I will call *open-perfective* viewpoint, in order to avoid confusion.

This section is organised as follows: In section 3.2.2.1 I will present Smith's notion of a viewpoint, in particular reviewing her justification of the *neutral* viewpoint. Section 3.2.2.2 contains Bäuerle's approach (and a similar account given by Eberle (1988)) and a discussion of his claim and my alternative explanation of his discourse example. The concluding section 3.2.2.3 presents the new notion of a *neutral* viewpoint I propose for German: the *open-perfective* viewpoint.

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

the end points, whereas the *imperfective* omits the endpoints of the situation. Note that this is only the case if the situation type provides definite end points. In English, for example, a *state* has no intrinsic endpoints, so this situation type seen by a *perfective* view cannot offer such points.

Generally speaking, the viewpoint is understood in this representation as a focus on parts or on the whole situation (///) (see table 3.2). An analogy can be drawn with a camera which shows only parts of an object or allows the view of the whole. Presenting, for example, only the main entrance door of a house, we normally assume that this is the part of a complete building. However, this inference based on our world knowledge can simply be overridden, when the focus opens and we become aware that the door was the only part still standing after the rest of the building was destroyed by a bomb.

Viewpoint	Schema	Explanation
Imperfective	I.//////////..F	shows no end points spans an internal interval
Perfective	I F //////////	includes end points presents the whole situation
Neutral	I. ///	includes initial point and first internal stage

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

The imperfective view 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.⁵

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.

⁵In 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.

In the following I will repeat her French data.⁶ Firstly, Smith investigates *when*-sentences 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* view 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 #.

- (3.14) # Le cheval gagnera la course mais il ne gagnera pas.
The horse will win the race but he not will 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

⁶See 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 1988, 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

⁷Some of my informants accepted the simple aspect, however. This may be explainable because of the special *accomplishment* which is a movement verb indicating a path with a goal. It seems to be easier to intercept this path by additional information. However, in another example given in (3.24) the simple aspect cannot be used.

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.

⁸Final events are categorised as *stop* or *culmination*, following the intuition in the nucleus model by Moens (1987).

⁹Note that the PP *at this time* is not required for the English discourse to be fully understood.

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 (3.15 b) 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:

- (3.23) Der Angeklagte konsumierte einige Gläser Bier in einer Kneipe. Dann fuhr er nach Hause. Am Lustnauer Tor hatte einen Unfall und beging Fahrerflucht. Die Polizei konnte ihn jedoch an seinem Haus verhaften, da ein Zeuge seine Autonummer notiert hatte.
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*.

The crucial difference with German, however, is that the natural end point can be overridden by further context information. In English, a different viewpoint or situation type had to be chosen to reflect this correct temporal relation. This can either be the *progressive form* or a stative expression (e.g. *On his way home he had an accident*).

One objection, however, can still be made: movement-verbs like *drive* plus a PP denoting a goal express a rather special *accomplishment*. Some native speakers of English even claimed that (3.15b) 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 schiefe 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.

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).

3.2.2.3 German and the *open-perfective* viewpoint

In this section I will 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:¹⁰

(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.

¹⁰In German *wenn* also possesses a conditional meaning (i.e. *if*), which I will ignore here.

Hans will cough/be coughing.

- e. wird Hans seinen Fehler einsehen. (*achievement*)
will Hans his mistake recognise.
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.¹¹ *Semelfactives* allow a simultaneous reading,¹² 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.

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.

¹¹The preferred interpretation may differ depending on the native speaker's intuition.

¹²To 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.

- 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 *als*-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 *stative* 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 *semelfactive* 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 form*, 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 choose between the *progressive form* and the simple aspect. The former one is allowed, whereas the latter 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 endpoint 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.

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. (3.28 b)).

Moreover, the data presented disproves Bäuerle'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 point¹³ and no cancellation is

¹³Provided that the situation type provides an inherent end point which is not the case for *states*.

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.
 - *Stative* sentences may trigger an open reading of an *accomplishment*.
- The distinction between world knowledge (i.e. situation type) and the information given by the speaker's view (i.e. viewpoint).

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.

Viewpoint	Schema	Explanation
Open-perfective	I...F ///???	includes initial point and first internal stages information about final point is world knowledge

Table 3.3: The *open-perfective* viewpoint revised

¹⁴A formal definition which fulfils these requirement can be found in Schilder (1995b).

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

The magician was pouring 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 Spejewski (1994, p. 12). Note that her example contains the *simple aspect* as discussed on page 20.

(3.32) '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.

(3.33) ...Plötzlich hörte er auf, mehr von der Flüssigkeit in das Gefäß zu gießen und verwandelte den Becher in eine Taube.
... 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:

(3.34) Der Zauberer goß eine silberne Flüssigkeit in das Gefäß. (#)Er hörte auf, mehr in das Gefäß zu gießen.
The magician poured a silver liquid into the container. (#)He stopped pouring the liquid.

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 *pluperfect* would have to be used.

(3.35) 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):

(3.36) 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 for the *Preterite* 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.

3.3.2 *Du hast keine Wahl, aber nutze sie...*

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.

I will carry out a cross-linguistic investigation of English, French and Russian in the three following sections, before I present a compilation and comparison of the data with German in section 3.3.2.4.

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 (3.37 a). However, a sequential reading is also possible as example (3.37 b) shows.

Interestingly enough, *states* can only be combined with the *simple aspect*.¹⁶ 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 (pc)*:¹⁷

- (3.38) # Jean a été malade ce matin et il est malade maintenant.
Jean was ill_{pc} 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:¹⁸

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

¹⁶There are some exceptions like *Fred is being silly*. See Comrie (1976, p. 36) for discussion.

¹⁷The # indicates that one cannot refer to the same illness.

¹⁸Note 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-fashioned 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)).

To obtain an overlapping reading like in (3.37a) the *Imparfait* has to be chosen to express this temporal relation between the two situations:

- (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.

3.3.2.3 Russian

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

- (3.41) Piotr znaet otvet.
Peter knows_{imperf} the answer.

According to the schema of the *imperfective* viewpoint, no end points are made available to the reader. The preferred reading for (3.42b) is therefore an overlapping one, whereas the English translation suggests a sequential reading according to our world knowledge.

- (3.42) a. Piotr voshol v komnatu. Marina byla serdita.
Peter entered the room. Mary was angry.
b. Piotr razbil vazhu. Marina byla serdita.
Peter broke the vase. Mary was angry.

Note that the sequential reading is available in Russian as well, but in order to make the point the result state should be expressed with an *achievement* verb (i.e. *to get angry*):

- (3.43) Piotr razbil vazhu. Marina rasserdilas'.
Peter broke the vase. Mary got angry.

To sum up, although Russian allows the two readings, the clue coming from the *imperfective* viewpoint indicates a preferred overlapping reading.

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.

Choice?	View on <i>states</i>	Language	Temporal Relations
YES	///	French	overlap
	////////		sequential
NO	////////	English	ambiguous
	////????	German	ambiguous
	///	Russian	(ambiguous)
	(I)—(F)		

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 *waiting*-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.

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.

situation type	stative	durative	telic	temporal schema
activity	[-]	[+]	[-]	(I)...(F)

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.
 John was going to school for two hours.
- b. ??Peter arbeitete gerade zwei Stunden lang im Garten.
Peter worked just two hours long in-the garden.
 Peter was working in the garden for two hours.
- c. *Maria erreichte gerade zwei Stunden lang den Gipfel.
Mary reached just two hours long the summit.
 *Mary was reaching the summit for two hours.
- d. ??Paul hustete gerade zwei Stunden lang.
Paul coughed just two hours long.
 Paul was coughing for two hours.

¹⁹Note that the translation of the *for*-adverbial into German is not *für* + *duration*, but *duration* + *lang*.

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

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 klopfe 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 fulfil 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 mahlte*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'):

- (3.56) a. Peter fuhr nach Hamburg.
Peter drove to Hamburg.
- b. Peter fuhr in Richtung Hamburg.
Peter drove towards Hamburg/was driving to Hamburg.

This construction very much resembles the *nominal progressive*, since the *in Richtung*-construction contains the inherent end point of the situation. Also (3.56b) can be combined with a durational adverbial:

- (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 Bäuerle (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 *states* (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.

FOUR

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 tempo-

ral 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.

¹See section 2.4.3.2.

²But the two tenses are not interchangeable as Ehrlich (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*.

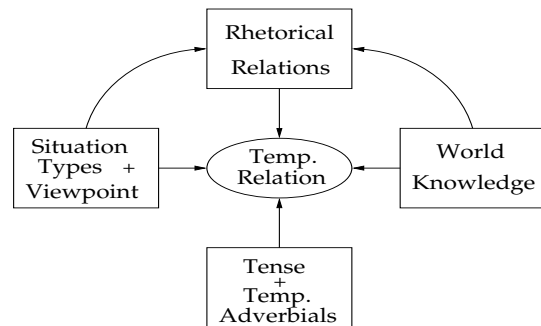


Figure 4.1: The temporal relation influenced by four different sources

The rest of this chapter is organised as follows:

- The next section 4.2 is concerned with the question of how the situation type and the viewpoint information has to be represented. A more precise representation as open and closed intervals will be given. It will turn out that the viewpoint can be seen as a function between the knowledge about the situation type and the actual described situation. The contingency structure applied to German is discussed by this section and two forms are presented.
- Section 4.3 provides a detailed investigation of how the different situation types seen from one viewpoint contribute to the inferences one can draw about the temporal rela-

tion. In particular the analysis of *activities* adds more evidence to the concept of an *open-perfective* viewpoint for German. Moreover, pragmatic knowledge (i.e. world/context knowledge), which imposes further constraints on the temporal relation and establishes a coherent discourse, is investigated as well.

- Section 4.4 discusses the forward movement of narrative time and how this is perceived by a reader. The requirements which lead to a forward movement are listed and compared with the constellations which imply an overlapping or subset relation between the described situations. The minimal constraint which is imposed by a sequence of two sentences in the *Preterite* is given as well.
- A summary of the results of this chapter are presented in the conclusion in section 4.5. As a result, the cases are summarised when a forward movement of narrative time is expressed or when an overlapping (or sometimes a subset relation) holds between the situations. The situation type requirements as well as the pragmatic constraints are compiled for German narratives.

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.³ 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.⁴

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

³Additionally to the description of aspectual types introduced by Moens (1987), Caenepeel (1989) also focuses on the use of two different reference times. Referring back to Dowty (1986) she develops the idea of an *asserted* and *assumed* reference time further. The asserted reference time r is the time at which the situation mentioned in the narrative takes place. The *assumed* reference time r' , on the other hand, denotes the time interval the whole situation is assumed to take place. However, for a critical review of this double reference approach see Sandström (1993, p. 35–39).

⁴I will use Moens’ classification in the section following Caenepeel’s explanation. For a description of the *nucleus* structure, see section 2.2.2.

definite, but we cannot say that the *state* contains a culmination. I therefore do not consider this constellation as a special type of *state*, but I will come back to the discussion how end points can be derived for unbounded situation types from the context, when I investigate *activities* in section 4.3.2.1.

As already mentioned, the *contingency structure* is used by Caenepeel to explain a *change of state* introduced by a culmination. Based on the *nucleus* structure developed by Moens (1987), she uses this term to make the point that this structure is evoked by the given context (i.e. by a *culmination*, *culminated process* or a contingent *state*) and the described situation has to be contingently connected to this structure. See figure 4.2 for an example of an *culmination* followed by an *culminated process*.

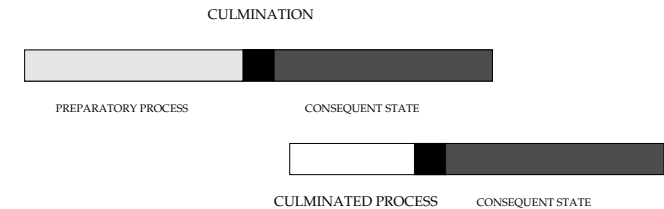


Figure 4.2: The contingency structure by Caenepeel (1989) allows the second situation to be embedded into the consequent state of the first one

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 coerces 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

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 it 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.⁵ The *nucleus* model conjoined with the Smithian features *stative*, *durative* and *telic* is represented by the following interval structure:

	stative	durative	telic	interval schema
nucleus	[±]	[±]	[±]]...[[-]

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

⁵Compare with the discussion on the different levels of temporal knowledge in the following chapter.

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 3.3.3 where I introduce and discuss a different representation for *activities* to the one originally proposed by Smith.

situation type	stative	durative	telic	interval schema
activities	[-]	[+]	[-]]...[

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.

situation type	stative	durative	telic	interval schema
accomplishments	[-]	[+]	[+]]...[]-[-]

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*.⁶ *Semelfactives* are therefore represented as closed and atomic intervals without any internal structure.

situation type	stative	durative	telic	interval schema
semelfactives	[-]	[-]	[-]	[]

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:

situation type	stative	durative	telic	interval schema
achievements	[-]	[-]	[+]]...[]-[-]

⁶See section 5.2.3.3 for a more detailed formal discussion on this topic.

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.

situation type	stative	durative	telic	interval schema
states	[+]	[+]	[-]]I

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.

activity]...I
<i>open-perfective view</i>	///??

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* view 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.

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.

accomplishment]...I -I
<i>open-perfective view</i>	///??

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.

semelfactive]I
<i>open-perfective view</i>	///?

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*.

achievement]...I -I
<i>open-perfective view</i>	///?

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

state]I
<i>open-perfective view</i>	///??

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 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

out in this section. The outcome of this investigation will be that we can already exclude some temporal relations if we have certain combinations of situation types.⁷

Table 4.1 describes how the following sections are structured:

		unbounded		bounded <i>event</i>		
		durative		punctual	durative	
		<i>sta</i>	<i>act</i>	<i>sem</i>	<i>ach</i>	<i>acc</i>
unbounded	durative	<i>sta</i>	Section 4.3.1	Section 4.3.5		
		<i>act</i>				
bounded	punctual	<i>sem</i>	Section 4.3.2	Section 4.3.4		
		<i>ach</i>				
<i>event</i>	durative	<i>acc</i>	Section 4.3.3			

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

4.3.1 *state/activity, state/activity*.

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

- (4.3) Es war Januar, die Straße naß, gelb die Lichter über dem Asphalt, grün die Reklame über dem Gemüseladen drüben: Emil Schmitz. Ich kannte Schmitz, (...) (Böll, *Ansichten eines Clowns*, p. 55)
 (I)t was January, the street was wet, the lights over the asphalt were yellow, the sign over the grocery opposite green: Emil Schmitz. I knew Schmitz, (...) (Böll, *The Clown*, p. 38)

A sequence of *states* like in (4.3) indicates an overlapping or simultaneous occurrence of the described situations. The information when the street was dry again, or since when the lights have been yellow in this street cannot be derived from this discourse. In fact, this information is of no importance, since the narrator wants to focus on one common time interval where all the described propositions hold. This is furthermore emphasised by the elliptic construction in German (i.e. *die Straße (war) naß*).⁸

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

- (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, *Fedezeen*, p. 72)
 It was a long walk to grandfather's, tiring and often dangerous, there was a stale taste

⁷The section headings are of the form *situation type.situation type* indicating the sequence of two sentences of certain situation types which are separated by a full stop (or another punctuation mark).

⁸Ellipsis seems to be a tool to bind situations together and also to indicate the temporal relation which hold between the situations. For (4.3) this seems to be the common time interval all situations share. Later, we will see that a sequence of bounded situations can be tied together, when presented as an elliptic construction.

to the biscuits in the tin box, and at night the old tenement made me feel scared. (De Bruyn, *Fedezeen*, p. 73)

This description in (4.4) is stative, since the *activities* are seen as habituals. The situations are all presented as overlapping. 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 adverbials like *abends* ('at night')⁹ to express a stative description.

But 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.¹⁰

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*

⁹There seems to be a cultural difference about when the term *Nacht* ('night') applies (*abends* Engl. *evenings*).

¹⁰Compare with the discourse examples in section 3.3.1 on page 53.

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, auch die anderen Fische steigen herauf aus der Dämmerung unten, aber bewegen sich kaum, stehen und lassen sich die dunklen Rücken bescheinen. (Bobrowski, *Lobellerwäldchen*, 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, *Lobellen Grove*, 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'):

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

- (4.9) Da kann man auch wieder gehen. Sich zu den Pferden stellen, (...) And then you can set off again. Walk over to your (lit: *the*) horses (...)

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 koppschellern¹², 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 *semelfactive* (i.e. *to shout 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 vielmehr die zielbewußten Wolken für ästhetischer als den Anblick einer Horde Grimassen schneidende, völlig überdrehte Rüpel. (Grass, *Die Blechtrommel*, p. 62)
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:

- (4.12) Durch eine infame Architektur um einen lohnenden Ausblick gebracht, schaute ich mir nur noch den Himmel an und fand schließlich darin Genüge. Immer neue Wolken wanderten von Nordwest nach Südost aus, als hätte jene Richtung den Wolken etwas Besonderes zu bieten gehabt. Meine Trommel, die bisher keinen Schlag lang ans Auswandern gedacht hatte, klemmte ich mir zwischen die Knie und das Fach der Schulbank (...).
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 (...).

¹²cf. *koppschlagen* — to shake hands at the conclusion of a deal.

To sum up, the descriptive mode in this example text does introduce several situations which all overlap. That is, they share a common time interval which furthermore was restricted to a specific day of the week. That this is not a description which contains only habituals can be seen from the *semelfactive* which marks the beginning of a forward movement of time in this narrative.

However, this phenomenon does not seem to be restricted to a descriptive mode predominantly occurring at the beginning of a story. Examples like (4.11) show that even in English *activities* can be used for describing an overlapping of situations.¹³

It is important to stress that the co-occurrence of *states*, especially universal statements, indicates the descriptive mode. However, in contrast to English, the *activities* in German can also allow an overlapping reading, when combined with a situation with definite end points.¹⁴ In English, the choice between the *simple aspect* and *progressive form* might have a further influence on the inference which can be drawn.

As a result of the observations made in this section, it may be concluded for German that *states* as well as *activities*, if they occur together, generally indicate that the described situations overlap. That temporal relations are expressed by these situation types can be seen when a situation with definite end points is added which moves the narrative time. In contrast to English, note furthermore that in German the background provided by a preceding *activity* as in (4.10) does not have to be marked by a *progressive form*.

The temporal relation which can be derived by the *state/activity.state/activity* constellation is graphically expressed in table 4.2. Only one common period of time can be inferred, nothing can be said about the beginning and end points (indicated by ??).

		unbounded	
		durative	
		<i>sta</i>	<i>act</i>
unbounded	durative	<i>sta</i>	??-??
		<i>act</i>	??-??

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

¹³It is beyond the focus of this thesis to give a precise explanation how this can be explained for English.

¹⁴There are example discourses conceivable where *activities* overlap with bounded events. But this is not the default case one comes across in a narratives, whereas *activities* in German generally overlap with a subsequent or preceding event.

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 forms*) and shuffling around the remaining sentences and expresses no advancement of narrative time:

- (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 #):

- (4.17) a. #We rehearsed before Mary left but we weren't finished when she returned.
b. #We 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 consequently 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 counterexamples. 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 mich 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)

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)

When her father came in I had just sat down, I stood up at once. He was as embarrassed as I was, and just as shy (...) (Böll, *The Clown*, p. 57)

- (4.26) Maria baute ein Haus (*acc*). Die Zinsen waren sehr günstig (*sta*).
Mary built a house. The interest rates were very reasonable.

- (4.27) Peter klopfte einmal kurz an der Tür (*sem*). Er war triefend naß (*sta*).
Peter knocked once at the door. He was soaking wet.

As in English, the stative situation is interpreted as giving further background information. No forward movement of narrative time is indicated by such a constellation, provided no consequentiality relation can be inferred.

It has to be noted that the temporal relation which is perceived by an *event.state* sequence is rather a subset relation (\subseteq) than an overlapping. The stative situation has started before the *event*. The *event* is presented as embedded within the *state*. An overlapping means that the second situation starts after the first situation has started. An expressive time logic which allows to pinpoint this difference is given in the following chapter.

event.activity. Interestingly enough, this situation type allows a background reading in German quite easily. The two following examples reflect discourses where an overlapping is the most likely interpretation for (4.28) and a sequential reading can be perceived for (4.29). However, it has to be stressed that these are only preferred readings due to our world knowledge. While reading the text, the reader probably does not care whether the writer refers to an overlapping or a sequence of two situations.

- (4.28) (...), und er griff sofort hinter sich ins Regal und gab mir zwei Schachteln (*acc*). Er weinte. (Böll, *Ansichten eines Clowns*, p. 94)
(...) and he at once reached toward the shelf behind him and gave me two boxes. He was crying. (Böll, *The Clown*, p. 58)

- (4.29) Nun zischte der Delphin seinem Reiter einen Strahl mitten ins Gesicht (*ach*). Der Fisch lachte. (Penzoldt, *Der Delphin*, p. 36)
Now the dolphin squirted a jet of water into the rider's face. The fish laughed. (Penzoldt, *The Dolphin*, p. 37)

The temporal relation expressed by an *event.activity* sequence in German is apparently quite fuzzy with respect to a serial and a parallel reading. In most contexts, it is not entirely clear when the situation described by the *activity* has started. It might have been before the first mentioned situation, the two situations might share the same beginning point or they only overlap for a certain period of time.

The translations of the example discourses show that *activities* in German can be interpreted as overlapping or sequential depending on the world knowledge we have about the situations. (4.28) is most likely interpreted as overlapping, but a sequential reading is still available. The translator though had to decide for one viewpoint. In (4.28) she chose an overlapping reading. On the other hand, in (4.29) the *laughing* can be seen as a reaction of the dolphin's action,

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:

- (4.31) Moira war wütend. Sie stand nun wieder und stampfte heftig mit dem Fuß auf. Sie drohte mit geballter Faust nach dem Meere. (Penzoldt, *Der Delphin*, p. 38)
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 *stamping*¹⁵ 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

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

¹⁶Note 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.

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 klopfte einmal an ihre Wand. Hanna tat, als schlief 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 English 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. \subseteq). *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*.

			unbounded	
			durative	
			<i>sta</i>	<i>act</i>
bounded	punctual	<i>sem</i>	[]	[]
		<i>ach</i>]– }–[]	???)..[]
<i>event</i>		<i>acc</i>	[.]	[.]
	durative]– }–[]	???)..[]

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.

¹⁷A stylistic way to emphasise the sequence of the two (or more) *events* is by ellipsis like in (4.36) or (4.38). The English translation repeats quite often the subject or the objects, whereas the German text only contains an elliptic construction (i.e. *nach dem Frühstück (schrieb ich ihr) noch einen (langen Brief) in (4.36) and wir gingen (...), (wir) aßen... in (4.38)*).

- (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 Cafe 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) (W)ir gingen zu einer der Buden auf der Venloer Straße (*acc*), aßen jeder zwei Portionen Gulasch (*acc*), kauften uns eine Flasche Rotwein (*acc*) und gingen nach Hause (*acc*). (Böll, *Ansichten eines Clowns*, p. 196)
(W)e 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 schälte 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 adverbials 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*).

- (4.37) The same person cannot go to a cafe and sit down at a table at the same time. Note the indirect inference to the cafe 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:

- (4.41) Der Angeklagte konsumierte einige Gläser Bier in einer Kneipe. Dann fuhr er nach Hause. Am Brandenburger Tor hatte einen Unfall und beging Fahrerflucht. Die Polizei konnte ihn jedoch an seinem Haus verhaften, da ein Zeuge seine Autonummer notiert hatte.

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 aßen unsere Ananas (*acc*), wir

bückten uns vornüber (*ach*), so tropfte es, dann über die Steine hinunter, um die zuckerigen Finger zu spülen; (Frisch, *Homo Faber*, p. 41)

Suddenly it was midday.

We were standing outside on an embankment, (...) eating our pineapple; we leaned forward because of the dripping juice, then we bent down over the stones and rinsed our sugary fingers; (Frisch, *Homo Faber*, p. 38)

In (4.42) a man's coming to the school is described. The second sentence gives a more detailed description of how he is coming up the road into the village (i.e. *Dorfweg*). The third sentence makes clear where the narrator's point of view is, namely the location of the school.

Discourse (4.43) elaborates the consumption of a pineapple. More detailed information is added by the following *achievement* (i.e. *we leaned forward*). Note that a *progressive form* in English was used, because of the temporal reference to *midday* in order to obtain an overlapping with this point in time.

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.

			bounded event		
			punctual		durative
			<i>sem</i>	<i>ach</i>	<i>acc</i>
<i>event</i>	durative	<i>acc</i>	[.]???	[.]???	[.]???
			∥	∥	[.]

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

sequences.

4.3.4.1 Consequence

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 Stechardin*, 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*), Marie zögerte einen Augenblick (*sem*), bevor sie ja sagte, dann ging ich rein (...). (Böll, *Ansichten eines Clowns*, p. 54)
(I) 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 earsplitting 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) (D)ie runde geschliffene Scheibe (...) zersprang (*ach*), fiel, teilweise nochmals
The round polished crystal (...) burst, fell, partly again
zerscherbend, auf die braunroten Dielen (*acc*).
splintering, on the reddish-brown floor(board).
(Grass, *Die Blechtrommel*, p. 52)
The polished round crystal (...) burst and fell to the floor(...), where the destruction was completed. (Grass, *The Tin Drum*, p. 62)

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.

4.3.4.2 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 a iteration as already resolved and consider the whole situation as an *activity*.

Table 4.5 summarises the possible temporal relations:

			bounded event	
			punctual	durative
		sem	ach	acc
bounded	punctual	sem		
		ach		[???.]

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 (*ach*). (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.

- (4.54) Maria starrte Peter an (*act*). Er gab ihr das Stück Pizza zurück (*acc*).
Mary stared at Peter. He gave back her piece of pizza.
- (4.55) Maria war wütend (*sta*). Peter gab ihr das Stück Pizza zurück (*acc*).
Mary was angry. Peter gave back her piece of pizza.
- (4.56) (sie) (...) **starrte** (*act*) (...) den Acker entlang bis zum nahen Horizont mit den einteilenden Telegrafentangen (...). Es **bewegte** (*act*) sich etwas zwischen den Telegrafentangen. Meine Großmutter **schloß** den Mund (*ach*), (...) **verkniff** die Augen (*ach*). Es **bewegte** sich etwas zwischen den Telegrafentangen... (Grass, *Die Blechtrommel*, p. 13)
(she) gazed wide-eyed across the field towards the nearby horizon, sectioned by telegraph poles (...). Something was moving between the telegraph poles. My grandmother closed her mouth. Something was jumping about. (Grass, *The Tin Drum*, p. 16)
- (4.57) Maria war überrascht. Sie stand auf.
Mary was surprised. She stood up.

However, a difference between *states* and *activities* with respect to the number of possible temporal relations can be observed. In (4.54) the *activity* may have stopped before Peter started to give back her piece of pizza, the two situations may overlap or the *activity* may even last longer than the *accomplishment* in the second sentence. In (4.56) two *activities* are described as overlapping. The *achievement* moves forward the narration, but the *activities* are assumed to be going on. The *staring* is subsequently terminated, because the reader is provided with the information about the straining of the eyes (i.e. *verkniefen*).¹⁸ The movement between the telegraph poles, on the other hand, continues which is emphasised by the repetition of the same sentence in the German text.

In (4.55) the *state* in the first sentence can only be seen as lasting longer than the *accomplishment*. This is probably due to the internal structure of *states*. This can be sustained by the way we can perceive *states* in contrast to *activities*. Since *states* are stative, we are not able to distinguish a certain stage of *being angry*, for instance.

The following table summarises the findings of this section (*states* and *activities* are presented as one (i.e. →) as well as the punctual events and the *accomplishments*):

			bounded event	
			punctual	durative
		sem	ach	acc
unbounded	durative	sta		{???
		act		[.].

Table 4.6: *States* and *activities* precede a bounded event

¹⁸Surprisingly enough, the translator simply omitted this sentence.

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 context can have on the temporal interpretation of *semelfactives*, 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.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. #Er nahm einen kräftigen Schluck.
Peter opened the biscuit box. #He took a long drink.

However, sequences 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.

¹⁹See section 6.2.1.1 for a formal definition of this relation.

It may be concluded that we need to derive a *consequence* or *contingency* relation between the situations in order to understand the narration as a progression of subsequent events. Caenepeel (1989, p. 77) defines two situations s_1 and s_2 (or *state of affairs*) as *contingently related* to each other “if s_1 can be causally related to s_2 , or if s_1 is felt to enable, or create the appropriate conditions for, s_2 .” In particular the second and third conditions are covered by so-called *script* knowledge. Observe what happens when such conditions are voluntarily violated like in the short story *Arbeitstag* (‘Working Day’) by Herta Müller:

- (4.61) Morgens halb sechs. Der Wecker läutet.
Ich stehe auf, ziehe mein Kleid aus, lege es aufs Kissen, ziehe meinen Pyjama an, gehe in die Küche, steige in die Badewanne, nehme das Handtuch, wasche damit mein Gesicht, nehme den Kam, trockne mich damit ab, nehme die Zahnbürste, kämme mich damit, nehme den Badeschwamm, putze mir damit die Zähne. Dann gehe ich ins Badezimmer, esse eine Scheibe Tee und trinke eine Tasse Brot. (Müller, *Arbeitstag*, p. 142)
In the morning half five. The alarm clock rings.
I get up, take off my dress, put it on the pillow, put on my pyjamas, go to the kitchen, get into the bathtub, take the towel, wash my face with it, take the comb, dry myself with it, take the tooth brush, comb my hair with it, take the sponge, brush my teeth with it. Then I go into the bathroom, eat a slice of tea and drink a cup of bread.

The aim of this mixup is to focus on the repetitiveness of the working day. Every day seems to be the same, they are interchangeable. The author changes the verbs and objects associated with a normal working day to draw our attention to it.

These data shows that we expect a subsequent situation which is somehow contingently connected to the previous one.

Now I want to take a closer look at *accomplishments* as the first sentence in a two sentence discourse. If an *accomplishment* is used for the first sentence, a culmination can be inferred by our world knowledge, but it can also be overridden provided the context indicates that. It may be concluded from the examples discussed in section 3.2.2.3 that *accomplishments* are not always reliable candidates for the forward movement of narrative time in German. It should therefore not come as a surprise that two observations can be made which are peculiar to German:

- The great number of *achievements* which indicate a culmination via a prefix like *-ver*, *-zer* or *-er*: *kochen* — *zerkochen* (‘to cook’ — ‘to cook to a pulp/overcook’), *reden* — *zerreden* (‘to talk’ — *fig*: ‘to flog to death’), *raten* — *erraten* (‘to guess’ — ‘to guess (the answer to)’, *schießen* — *erschießen* (‘to shoot’ — ‘to shoot (dead)’).²⁰
- The usage of connectives like *dann*, *danach* or *nachdem* to indicate a sequence or *während*, *als* or *indem* to refer to an overlapping reading.

These *devices* are used to compensate for the lack of a clear *contingency structure* introduced by *accomplishments* in German which is due to the temporal information expressed by the *open-*

²⁰Compare with Comrie (1976, p. 46–47) who presents more examples.

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 zerkochte 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 *zerkochen* 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 interpreted 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 klopfte. 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.

- (4.66) Pater Wunibald wurde wütend, klopfte mit dem Finger aufs Pult, 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)

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

Her representation sees the culmination (i.e. the turning the corner) as part of the *state* of *the village's 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) The room was dark. Peter switched on the light.

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.

– 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 those 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.

²¹Compare with van den Berg (1996b).

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. α_1) precedes the end point of the second situation (i.e. ω_2).²²

Considering this constraint, a *revised* version of Dowty's TDIP can be stipulated:

TDIP 2 (revised) Given a sequence of sentences S_1, S_2, \dots, S_n to be interpreted as a narrative discourse, the interval I_i of a situation s_i described by the sentence S_i (for $1 < i \leq n$ and α_i referring to the beginning point of I_i and ω_{i+1} to the end point of I_{i+1}) is interpreted to be

1. a period of time consistent with the definite time adverbials in S_i if there are any,
2. otherwise, a period of time which fulfils the following constraint: $\alpha_i < \omega_{i+1}$, 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 $\alpha_i < \alpha_{i+1}$.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:

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-perfective* 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-perfective* 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.

			unbounded		bounded event		
			durative		punctual	durative	
			<i>sta</i>	<i>act</i>	<i>sem</i>	<i>ach</i>	<i>acc</i>
unbounded	durative	<i>sta</i>	??-??]--{????		
		<i>act</i>	??-??		[..]		
bounded	punctual	<i>sem</i>	□	□	□ □	□	
		<i>ach</i>] - } -[???.]..[[???.]	
event	durative	<i>acc</i>	[..]	[..]	[..]???	[..]???	
] - } -[???.]..[□	[..]	

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.

FIVE

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 *cause* 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 explanation for representing coarse temporal knowledge.

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-

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 Schilder (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 $\prec, \circ, \sqsubseteq: S \times S$, *before*, *overlap*, *subset* : $I \times I$ and $<: P \times P$ in the following section.

Note that the set of temporal relations is going to be extended in section 5.2.2.2. For the time being, I need only this restricted set of temporal relations: $\prec, \sqsubseteq, \circ$ (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.¹ 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: $e, e', e'' \dots$ referring to events and $s, s', s'' \dots$ referring to states. I will argue against this view. Instead I will assume situations $s, s', s'' \dots$ 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) $\exists e \exists x \exists p \exists t (\text{buttering}(e, \text{Jones}, x) \wedge \text{toast}(x) \wedge \text{bathroom}(p) \wedge \text{midnight}(t) \wedge \text{in}(e, p) \wedge \text{at}(e, t))$

¹In order to avoid confusion caused by the term *event* which was only used for the *bounded* situation types in the previous chapters, note that only the *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).² It is not the case that *I was ill* sometimes is conceptualised as an event and sometimes as a state.

²Rhetorical relations like *result* and *termination* provide the formal justification for this behaviour. See section 6.2.1 for more details.

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 $\mathcal{S} = \langle S, \prec, \circ \rangle$, where \prec is the temporal precedence and \circ the temporal overlap relation between situations.³ Additionally, the following axioms hold:⁴

$$S_1 \quad \forall s, s' (s \prec s' \rightarrow \neg(s' \prec s)) \text{ (asymmetric)}$$

$$S_2 \quad \forall s, s', s'' ((s \prec s' \wedge s' \prec s'') \rightarrow s \prec s'') \text{ (transitive)}$$

$$S_3 \quad \forall s (s \circ s) \text{ (reflexive)}$$

$$S_4 \quad \forall s, s' (s \circ s' \rightarrow s' \circ s) \text{ (symmetric)}$$

$$S_5 \quad \forall s, s' (s \prec s' \rightarrow \neg(s' \circ s))$$

$$S_6 \quad \forall s, s', s'', s''' ((s \prec s' \wedge s' \circ s'' \wedge s'' \prec s''') \rightarrow s \prec s''')$$

$$S_7 \quad \forall s, s' ((s \prec s') \vee (s' \prec s) \vee (s \circ s'))$$

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. \sqsubseteq). A slightly different ontology for time proposed by van Benthem (1983) introduces this relation beneath the precedence relation.

The following axioms have to hold:

$$S_8 \quad \forall s, s' ((s \sqsubseteq s' \wedge s' \sqsubseteq s) \rightarrow s' = s) \text{ (anti-symmetric)}$$

$$S_9 \quad \forall s, s', s'' ((s \sqsubseteq s' \wedge s' \sqsubseteq s'') \rightarrow s \sqsubseteq s'') \text{ (transitive)}$$

$$S_{10} \quad \forall s (s \sqsubseteq s) \text{ (reflexive)}$$

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.

³Note that the latter relation is a rather coarse temporal relation which only has to fulfil the following axioms. (cf. the *overlap* relation between intervals defined by Allen which is more restrictive in section 5.2.2).

⁴The same set of axioms is found in (Kamp and Reyle 1993, p. 667). S_2 (transitivity) can be derived from S_3 (reflexivity) and S_6 (generalised transitivity).

5.2.1.2 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 $\mathcal{P} = \langle P, < \rangle$ as a second irreducible primitive, we can assume an abstract structure of points which fulfils the following axiom system:

$$P_1 \quad \forall p (\neg(p < p)) \text{ (irreflexive)}^6$$

$$P_2 \quad \forall p (p < p' \rightarrow \neg(p' < p)) \text{ (asymmetric)}$$

$$P_3 \quad \forall p, p', p'' ((p < p' \wedge p' < p'') \rightarrow p < p'') \text{ (transitive)}$$

$$P_4 \quad \forall p, p' ((p < p') \vee (p < p') \vee (p = p')) \text{ (linear)}$$

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:

$$P_5 \quad \forall p, p' (p < p' \rightarrow \exists p'' (p < p'' \wedge p'' < p'))$$

Taking the given axioms into account, we can take the set of real numbers (\mathcal{R}) or rational numbers (\mathcal{Q}), which fulfil 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 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 $\mathcal{I} = \langle I, \text{before}, \text{meets}, \text{subset} \rangle$, where before is the temporal precedence ordering, 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. $<$) 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 Habel (1994) for further discussion of this topic.

intervals i_1 and i_2 meet if they share one common time point)⁸ 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 \mathcal{P} and the temporal precedence relation $<$, 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:** $]p_1, p_2[=_{def.} \{p \mid p_1 < p < p_2\}$
- **Closed Interval:** $[p_1, p_2] =_{def.} \{p \mid p_1 \leq p \leq p_2\}$
- **Right Semi-Open Interval:** $]p_1, p_2] =_{def.} \{p \mid p_1 < p < p_2\}$
- **Left Semi-Open Interval:** $]p_1, p_2[=_{def.} \{p \mid p_1 < p \leq p_2\}$

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 LOC which maps each situation s of S to an interval of \mathcal{I} . Following the approach described by Kamp and Reyle (1993, p. 671), I assume a point structure $\mathcal{P}(S)$, which is a substructure of \mathcal{P} . I stipulate furthermore that the situation structure S and the point structure \mathcal{P} are related by the function LOC . This function assigns to each situation s of S an interval i of the interval structure \mathcal{I} which is derived from the point structure $\mathcal{P}(S)$. This function LOC has to fulfil the following requirements:⁹

1. $s < s' \rightarrow LOC(s) \{\text{before} \vee \text{meets}\} LOC(s')$
2. $s \circ s' \rightarrow (LOC(s) \cap LOC(s') \neq \emptyset)$
3. $s \sqsubseteq s' \rightarrow LOC(s) \subseteq LOC(s')$
4. $\forall p \in \mathcal{P}(S) \bigcap \{LOC(s) : s \in p\} \neq \emptyset$

There has been an extensive discussion in the literature how this function¹⁰ 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)).

⁸In Kamp and Reyle (1993) the symbol \supseteq is used.

⁹Note that a disjunction between the two temporal relations before and meets is required for the temporal precedence relation $<$.

¹⁰There are several proposals which all stipulate a function (or relation) which relates situations to intervals (or points). Shoham (1987), for instance, introduces a relation *Holds*.

But the conditions when the *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:¹¹

- $\alpha([p_1, p_2]) =_{def} p_1$
- $\omega([p_1, p_2]) =_{def} p_2$
- $\alpha([p_1, p_2]) =_{def} p_1$
- $\omega([p_1, p_2]) =_{def} p_2$
- $\alpha([p_1, p_2]) =_{def} p_1$
- $\omega([p_1, p_2]) =_{def} p_2$
- $\alpha([p_1, p_2]) =_{def} p_1$
- $\omega([p_1, p_2]) =_{def} p_2$

The end points of an interval become accessible with the functions α and ω . 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.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 *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.

¹¹As already informally used in the previous chapter for the revised TDIP, α_n is the short form for $\alpha(i_n)$, given that i_n is an interval.

¹²The 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 \prec and \circ 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 \supseteq (*meets*) 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.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 predictions 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 (\prec) and the general *overlap* relation (\circ). Additionally, there may be more explicit relations defined on this level. The sub-situation relation (\sqsubseteq) is more restrictive than the “overlap” relation (\circ). 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.

¹³See footnote 76 in Kamp and Reyle (1993, p. 668).

Definition 3 Initial and final parts of a situation are defined as follows:

- $initial(s, s') =_{def} s \sqsubseteq s' \wedge \neg \exists s'' (s'' \sqsubseteq s' \wedge s'' \prec s)$
- $final(s, s') =_{def} s \sqsubseteq s' \wedge \neg \exists s'' (s'' \sqsubseteq s' \wedge s \prec s'')$

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 given 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(efore)*, *m(eets)*, *o(verlaps)*, *s(tarts)*, *d(uring)*, *f(inishes)*, the 6 reverse relations *bi*, *mi*, *oi*, *si*, *di* and *fi* and *eq(ual)* (cf. figure 5.1).

Formally, the 13 relations can be defined via the relations between the end points. The two functions α and ω 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.

Other definitions of the interval relations are possible, as has been done in the literature. Allen and Hayes (1989), for example, define the *meets* relation as a primitive and the remaining 12 relations can be derived by further axioms. Another approach is given by van Benthem (1983) who shows that 13 relations are the only ones which can be derived for holding between these two-dimensional objects.

In the following, I will employ Allen's system defined by the point relations for the representation of temporal relations within the model described in the previous section. Since this system has been widely investigated with respect to its computational properties, it also is a good candidate for a possible implementation.

Summing up, we saw that intervals are seen as abstract temporal entities without any internal structure. It has to be stressed that every conclusion with respect to features concerning

Relation	Symbol	Inverse	Meaning
x before y	b	bi	
x meets y	m	mi	
x overlaps y	o	oi	
x starts y	s	si	
x during y	d	di	
x finishes y	f	fi	
x equal y	eq	eq	

Figure 5.1: The 13 interval relations

situations (e.g. *punctuality*) has to be drawn on the situation structure level. But, although the information about the different situation types has been lost, an exhaustive set of temporal relations can be offered.

5.2.2.3 Points

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. *stative*, *bounded*, *punctual*, *telic*) may have further influences on the other two levels.

	α_1, α_2	ω_1, ω_2	α_1, ω_2	ω_1, α_2
b	<	<	<	<
m	<	<	<	=
o	<	<	<	>
s	=	<	<	>
d	>	<	<	>
f	>	=	<	>
eq	=	=	<	>
fi	<	=	<	>
di	<	>	<	>
si	=	>	<	>
oi	>	>	<	>
mi	>	>	=	>
bi	>	>	>	>

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 fulfil 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 infon σ) which is expressed in a situation semantical 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 *hired*(*Jones*, *Smith*).

I will define how situations can be categorised according to the properties of the predicates

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 $2 + 2 = 4$.

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 categorised 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 $\forall s, s' (P(s) \wedge s' \sqsubseteq s) \rightarrow P(s')$

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 *state* 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

¹⁵See discussion on events and states on page 105.

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 situation s , 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 $\forall s, s' (P(s) \wedge s' \sqsubset s \rightarrow \neg P(s'))$

A *bounded* predicate P consequently holds only for situations with the temporal extension $LOC(s) = [p, p']$ 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 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. $LOC(s) =]p_1, p_2[$). 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. \circ). We can only think of two *unbounded* situations in a

¹⁶Compare with Shoham (1987) who defines an *interval-downward-hereditary* property which would apply to *activities*.

¹⁷The strict inclusion relation is defined as $s \sqsubset s' \wedge \neg(s = s')$.

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 (*un*)*boundedness* 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 $\forall s (P(s) \rightarrow \forall s' (s' \sqsubseteq s \rightarrow s' = s))$

Bear in mind that such a situation should not be seen as a point without any duration. Since we want to represent situations on a level which reflects the properties we can recognise of the real world corresponding to the linguistic categories, *punctual* situations are categorised as atomic elements of the situation structure which still possess a duration.

This way of representing *punctual* situations as situations 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 \mathcal{R} (or \mathcal{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.

¹⁸Temporal adverbials like *four hours later* may have a similar effect.

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 representation 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)

$$\forall m, j \text{ (moment}(m) \rightarrow m \{b, m, eq, s, d, f, mi, bi\} j)$$

Lemma 2 (MO2)

$$\forall i, j \text{ (moment}(i) \wedge \text{moment}(j) \rightarrow i \{b, m, eq, mi, bi\} j)$$

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* iff $\exists P \forall s \quad \Box(P(s) \rightarrow \exists s', s'' (\neg P'(s') \wedge P'(s'') \wedge LOC(s') =]p, p'[\wedge LOC(s) =]p', p''[\wedge LOC(s'') =]p'', p'''[)$

A predicate is *telic* iff 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 accidentally 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 different from a situation s''' such that P holds for 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: $C = \diamond(P'(s''') \wedge \neg \exists s''' (P(s''')))$.¹⁹

This additional constraint C has to exclude predicates which are dependent on the existence of 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 *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 *just being after p* 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 preceding 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 *intergressive*. 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. *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. [\pm CHANGE(-OF-STATE)] by Sandström (1993, p. 113) or Dowty's BECOME in Dowty (1979, p.141)).²⁰

¹⁹Compare with Egg (1995, p. 323).

²⁰The 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.²¹ 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:

- Another situation is mentioned which overrides the natural end point of the first situation (cf. discourse sequence (3.15) on page 40).
- 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:
 $\text{op}(me(\alpha), P) > P(me(\alpha))$

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 $\langle \rangle$ introduced by Lascarides and Asher (1993) to relate a newly processed sentence β to an already existing discourse γ via a sentence α . 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 $me(\alpha)$ is not of type *P*.

- the *open-perfective* viewpoint allows an *ingressive* reading, where P_i is a predicate describing a situation which interrupts the first mentioned situation of type *P*:
 $\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), P) \wedge \text{op}(me(\beta), P_i) \wedge \text{interrupt}(me(\alpha), me(\beta))\} > \neg P(me(\alpha))$

Another axiom has to be defined to clarify what predicate actually describes $me(\alpha)$:

²¹Compare with the definition of *initial* on page 112.

- Interrupted situations describe the preparatory phase leading to a situation of type *P**, which describes a situation lasting until the interruption:

$$\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), P) \wedge \text{op}(me(\beta), P_i) \wedge \text{interrupt}(me(\alpha), me(\beta))\} \rightarrow \\ \exists s (\text{initial}(me(\alpha), s) \wedge P^*(s) \wedge \text{prep}(me(\alpha), s))$$

These formulae can be applied to the discourse example in (3.15):

$$\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), \text{drive}(\text{defendant}, \text{home})) \wedge \text{op}(me(\beta), \text{have}(\text{defendant}, \text{accident})) \wedge \text{interrupt}(me(\alpha), me(\beta))\} > \neg \text{drive}(\text{defendant}, \text{home})(me(\alpha))$$

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 $me(\alpha)$ 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:

$$\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), \text{drive}(\text{defendant}, \text{home})) \wedge \text{op}(me(\beta), \text{have}(\text{defendant}, \text{accident})) \wedge \text{interrupt}(me(\alpha), me(\beta))\} \rightarrow \\ \exists s \text{initial}(me(\alpha), s) \wedge \text{drive}(\text{defendant}, \text{loc}(\text{accident}))(s) \wedge \text{prep}(me(\alpha), s)$$

Secondly, a *state* allows us to focus on the preparatory phase of a situation described by *P*:

- the *open-perfective* viewpoint allows an *open* reading when combined with a *stative* situation described by P_s :
 $\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), P) \wedge \text{op}(me(\beta), P_s)\} > \exists s (\text{initial}(me(\alpha), s) \wedge P(s) \wedge \text{prep}(me(\alpha), s))$

Another situation is introduced by this default rule, namely a situation *s* of type *P*. 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. $P(me(\alpha))$), the Complex Penguin Principle has to be applied.²²

- Complex Penguin Principle:

$$\Box(\phi \rightarrow \psi), \psi > \chi, \phi > \zeta, \Box(\chi \rightarrow \theta), \Box(\zeta \rightarrow \neg\theta), \phi \not\approx \zeta$$

The reason why this Complex Penguin Principle is required is that there are not two defensible rules which allow us to derive $\neg\zeta$ and ζ , respectively. Instead we have to derive the conflict between two axioms which are imposed on the consequences of the default rules (i.e. χ and ζ). Moreover, another axiom $\Box(\phi \rightarrow \psi)$ is necessary.

This axiom is easily derived by the laws of logic:

$$\Box(\{[\gamma, \alpha, \beta] \wedge \text{op}(me(\alpha), P) \wedge \text{op}(me(\beta), P_s)\} \rightarrow \text{op}(me(\alpha), P))$$

The two remaining axioms express a certain conflict for the information given by χ (i.e. $P(me(\alpha))$) and ζ (i.e. $\exists s \text{initial}(me(\alpha), s) \wedge P(s) \wedge \text{prep}(me(\alpha), s)$), the two consequences of the default rules.

The first axiom is again derived from the laws of logic:

$$\Box(P(me(\alpha)) \rightarrow P(me(\alpha)))$$

²²Cf. 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 :

$$\Box[(\exists s \text{ initial}(me(\alpha), s) \wedge P(s) \wedge \text{prep}(me(\alpha), s)) \rightarrow \neg P(me(\alpha))]$$

Assuming these axioms and the given two default rules, we can now non-monotonically infer that $me(\alpha)$ is described by the preparatory process of a situation s , which is of type P . Note that for this constellation the situation $me(\alpha)$ is only the preparatory phase of P , assuming that there is still a completed situation.²³

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:²⁴

- **Asher's default definition for the *progressive*:**

$$\forall s (\text{prog}(\phi)(s) > \exists e (s \sqsubseteq e \wedge \phi(e)))$$

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) 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) 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:²⁵

(5.12) ?? Maria durchquerte das Minenfeld. Sie versuchte sich umzubringen.

Mary was crossing the mine field. She was trying to kill herself.

²³Should the subsequent context override this information, note that a more specific default is required here as well.

²⁴The operator **prog** takes an event-predicate ϕ and returns a state-predicate **prog**(ϕ).

²⁵Variant 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:²⁶

(5.13) 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. $I_1 \{ \text{before} \vee \text{meets} \vee \text{overlaps} \} I_2$). 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) Maria ging den Strand entlang. Die Seemöwen kreischten. Sie war ruhig und ausgelassen

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

²⁶Note that again the *progressive form* may not be the best choice for translating this sequence. *She started to cross the mine field* captures more the ingressive meaning of the German.

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 \circ 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 `meets` relation is required.

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

On the other hand, the latter accounts which choose to use the strict `overlap` 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. α and ω). A further subset of the full algebra, the convex interval relation algebra, for example, fulfils 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. $\alpha_1 R_1 \alpha_2$, $\omega_1 R_2 \omega_2$, $\alpha_1 R_3 \omega_2$ and $\omega_1 R_4 \alpha_2$). See figure 5.2 for a graphical representation of the required relations for this algebra.

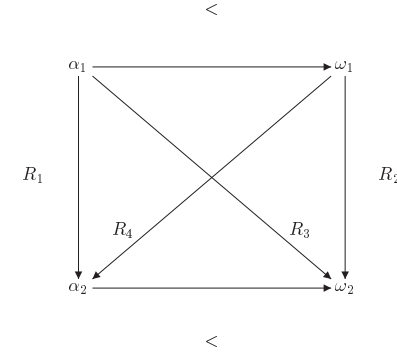




Figure 5.2: The four point relations, which hold between the end points of the two intervals

In order to describe a convex relation the following relation-sets are allowed: $\{<\}, \{=\}, \{>\}, \{<, =\}, \{=, >\}, \{<, =, >\}$. A convex relation evolves when the four relations R_1 to R_4 are assigned to one of those 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).²⁷ 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 $Rel = \{r | r_1 \sqsubseteq r \sqsubseteq r_2\}$.

Note that therefore the disjunction of the two Interval relations `before` and `after` (i.e. $\{before \vee after\}$) cannot be represented by this algebra. The point-relation set $\{<, >\}$ would be required to describe this interval relations set²⁸

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 $R_{\{1..4\}}$, where R_i is one of $\{<, =, >, \leq, \geq, ?\}$.

²⁷This representation is used by (Freksa 1992) for an iconic representation of the neighbourhood relations.  reflects the structure of the ordering in table 5.2. The dots represent the possible interval relations. For example,  describes the two interval relations `before` and `meets`.

²⁸In the following I will use the abbreviations $<, =, >, \leq, \geq, \neq, ?$ for the point-relations $\{<\}, \{=\}, \{>\}, \{<, =\}, \{=, >\}, \{<, >\}, \{<, =, >\}$.

		R_2				
		$\omega_1 < \omega_2$	$\omega_1 = \omega_2$	$\omega_1 > \omega_2$		
R_4	$\omega_1 < \alpha_2$	b			$\alpha_1 < \alpha_2$	R_1
	$\omega_1 = \alpha_2$	m	o	fi	di	
	$\omega_1 < \alpha_2$		s	eq	si	
			d	f	oi	
				mi		
				bi		
		$\alpha_1 < \omega_2$	$\alpha_1 = \omega_2$	$\alpha_1 > \omega_2$		
		R_3				

Table 5.2: The fine relations and the point relation constraints

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 α_i and ω_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 \leq relation, because $\{<\} \subseteq \{<, =\}$.

Secondly, the compose operation for the point relations (\odot), which is necessary for determining the transitive closure, can be looked up in table 5.3 (e.g. $(p_1 \leq p_2 \wedge p_2 = p_3) \rightarrow p_1 \leq p_3$).

The following equations constrain the 4-tuples, so that ill-formed relations can be ruled out (see example 1).

$$\begin{aligned}
 R_1 &\preceq_{det} < \odot R_4 & (5.16) \\
 &\preceq_{det} R_3 \odot >
 \end{aligned}$$

$$\begin{aligned}
 R_2 &\preceq_{det} > \odot R_3 & (5.17) \\
 &\preceq_{det} R_4 \odot <
 \end{aligned}$$

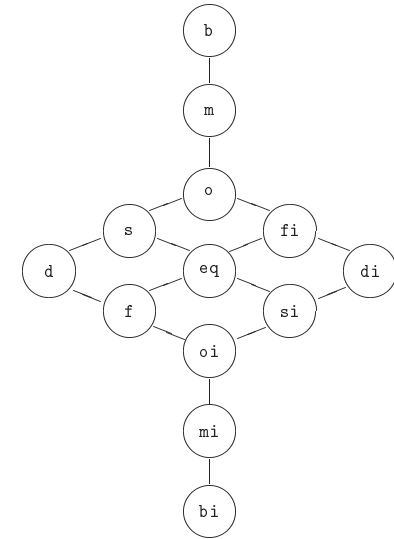


Figure 5.3: The convex relations in a strict ordering

$$\begin{aligned}
 R_3 &\preceq_{det} < \odot R_2 & (5.18) \\
 &\preceq_{det} R_1 \odot <
 \end{aligned}$$

$$\begin{aligned}
 R_4 &\preceq_{det} > \odot R_2 & (5.19) \\
 &\preceq_{det} R_1 \odot >
 \end{aligned}$$

\odot	$<$	$=$	$>$	\leq	\geq	$?$
$<$	$<$	$<$	$?$	$<$	$?$	$?$
$=$	$<$	$=$	$>$	\leq	\geq	$?$
$>$	$?$	$>$	$>$	$?$	$>$	$?$
\leq	$<$	\leq	$?$	\leq	$?$	$?$
\geq	$?$	\geq	$>$	$?$	\geq	$?$
$?$	$?$	$?$	$?$	$?$	$?$	$?$

Table 5.3: The compose operation for point relations

Example 1 $\{<, =, <, <\}$ is not well-formed!

The constraints for R_2 are not fulfilled, because a different relation can be derived for this relation (i.e. $<$):

$$= \underset{det}{\leq} > \odot <$$

$$\underset{det}{\leq} < \odot <$$

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

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.

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

²⁹This list is taken from Schilder (1993).

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*.

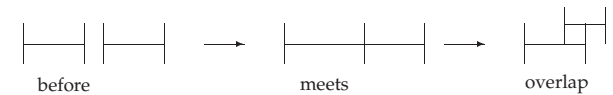


Figure 5.4: Conceptual Neighbours

A neighbourhood can now be defined as a set of path-connected relations through conceptual neighbourhood 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 startte 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 fulfils the neighbourhood definition without being a convex relation is, for example, $\{s, d, f\}$ (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

³⁰The convex relation algebra can only capture the \sqsubseteq 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 fulfils 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 conceptual 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 `order` (\uparrow), 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 $=$ 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_2 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_3 has to be $<$. This can be

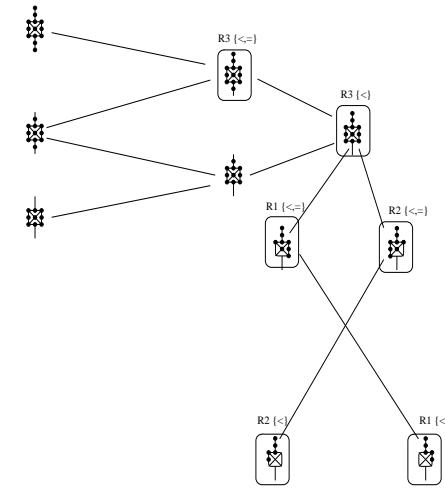


Figure 5.5: A part of the hierarchy

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_1 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` (\uparrow), while the `finish_inverse` relation (\downarrow), for

³¹This 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).

³²My emphasis.

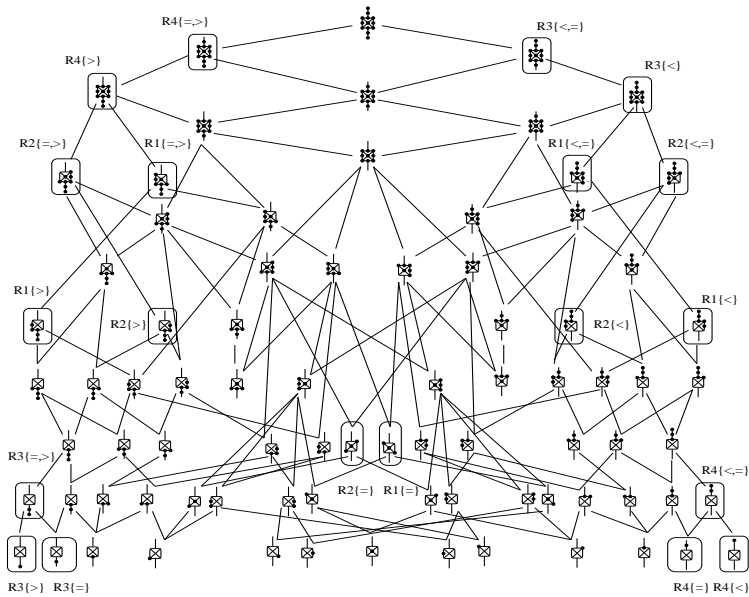


Figure 5.6: The full hierarchy of the 82 convex relations

instance, possesses $R_2 \equiv =$ which is subsumed by $R_4 \equiv >$. Consequently, only this constraint is needed to derive the $R_4 \equiv >$.

Table 5.4 shows the minimal point relations, which are shadowed.

The hierarchy of the 82 convex relations can be used to derive the constraints which are required for determining the remaining coarse temporal relations. I would like to point out that only a small set of relations are constrained by only one point relation. As it can easily be seen by the hierarchy in figure 5.6, the other relations can be described via a combination of two relations which are on a higher level of the hierarchy apart from the `overlaps` and `overlaps_inverse` relation, as discussed in this section.

The following section summarises the findings of the previous chapter and applies the proposed time logic to the discourse sequences discussed.

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

Fine Relation	Point Constraints	Inverse Relation	Point Constraints
b	[<, <, <, <]	bi	[>, >, >, >]
m	[<, <, <, =]	mi	[>, >, =, >]
o	[<, <, <, >]	oi	[>, >, <, >]
f	[>, =, <, >]	fi	[<, =, >, <]
s	[=, <, <, >]	si	[=, >, <, >]
d	[>, <, <, >]	di	[<, >, <, >]
eq	[=, =, <, >]	eq	[=, =, <, >]

Table 5.4: The 13 fine relations and their point constraints.

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.

- 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 inferable. 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:³³

Name	Point Relations	Interval Relations	Icon
ct	[?, ?, <, >]	{o, fi, di, s, =, si, d, f, oi}	

An example discourse discussed earlier which yields this coarse temporal relation can be found in (5.21).³⁴

- (5.21) (...) Die Delphine stimmten jedenfalls, die sich aus den Meereswogen, so schienen 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:³⁵

Name	Point Relations	Interval Relations	Icon
o1	[<, ?, <, ?]	{b, m, o, fi, di}	
sb	[?, <, <, ?]	{b, m, o, s, d}	

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.

The relation *o1der* 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).³⁶ 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.³⁷

- (5.22) Maria starrte 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 (*ach*). 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 embarrassed 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 punctual. 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 following constraint can only be imposed when information from a situation type is considered.

³⁶Compare with (4.54) 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.

5.5.2 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.

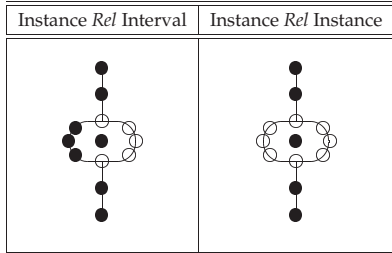


Figure 5.7: The relations between instances and intervals

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

Name	Point Relations	Interval Relations	Icon
pr	$\{<, <, <, \leq\}$	$\{b, m\}$	
eq	$\{=, =, <, >\}$	$\{eq\}$	
superset	$\{\leq, \geq, <, >\}$	$\{fi, di, =, si\}$	
subset	$\{\geq, \leq, <, >\}$	$\{f, d, =, s\}$	

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

³⁸Note that *succeeds* 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.

³⁹See section 5.2.3.3 on page 117 and also the appendix B.

can be derived from the hierarchical presentation of the convex relations, a small set of point relation constraints can be given. Within the three-fold system proposed earlier, we are now also able to capture the influence of the situation type more precisely. The feature *punctual* actually forces us to the further assumption that the derived time interval $LOC(s)$ cannot overlap with other time intervals.

Lemma 2 (PU1a)

$$\forall s, s' (punctual(P) \wedge P(s) \rightarrow LOC(s) \{ \omega_1 \leq \alpha_2 \vee (\alpha_1 \geq \alpha_2 \wedge \omega_1 \leq \omega_2) \vee \alpha_1 \geq \omega_2 \} LOC(s'))$$

Lemma 3 (PU1b)

$$\forall s, s' (punctual(P) \wedge P(s) \rightarrow LOC(s') \{ \omega_1 \leq \alpha_2 \vee (\alpha_1 \leq \alpha_2 \wedge \omega_1 \geq \omega_2) \vee \alpha_1 \geq \omega_2 \} LOC(s))$$

Lemma 4 (PU2)

$$\forall s, s' (punctual(P) \wedge P(s) \wedge punctual(s') \rightarrow LOC(s) \{ \omega_1 \leq \alpha_2 \vee (\alpha_1 = \alpha_2 \wedge \omega_1 = \omega_2) \vee \alpha_1 \geq \omega_2 \} LOC(s'))$$

The lemma PU2 can be derived from the two preceding lemmas, which means that only PU1a and PU1b have to be considered.

Using these lemmas, the following temporal relations can be derived for the example discourses (5.25) to (5.27):

- (5.25) Peter betrat die Kneipe (*ach*). Er bestellte ein Bier (*ach*).
Peter entered the pub. He ordered a beer.
- (5.26) Die Bombe explodierte (*ach*). Ein ohrenbetäubender Knall erschütterte die Innenstadt (*ach*).
The bomb exploded. An earsplitting bang shook the city centre.
- (5.27) Der Gemeinderat baute eine neue Brücke (*acc*). Man beauftragte einen einheimischen Architekten mit der Erstellung der Pläne (*ach*).
The district council built a new bridge. They commissioned a local architect to draw the plans.



The last example (5.27) normally invites the reader to draw the conclusion that the punctual situation described by the second sentence occurred at the beginning of the first mentioned situation. Note that this restriction is due to our explicit knowledge of the domain involved.

Another inference, however, shows the limitation of the chosen algebra of convex relations. Our world knowledge of durative and punctual situations tells us that the punctual situation cannot last as long as the durative one. In this case a proper subset relation is required which cannot be expressed by a convex relation.

Future research should focus on this issue and propose a time logic which can also cover this particular case appropriately. Note that the convex relation algebra is expressive enough to deal with all the other temporal constellations discussed.

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 *precedes* 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 set *initial_super*, 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.

Name	Point Relations	Interval Relations	Icon
is	 , ?, <, ?	{b, m, o, fi, di, s, =, si}	

This decision can be justified, because a rhetorical relation is derived in any case which would lead to the *precedes* (i.e. *narration* in (5.28) or *superset* (i.e. *elaboration* in (5.29)).

- (5.28) (W)ir gingen zu einer der Buden auf der Venloer Straße (*acc*), aßen jeder zwei Portionen Gulasch (*acc*), kauften uns eine Flasche Rotwein (*acc*) und gingen nach Hause (*acc*). (Böll, *Ansichten eines Clowns*, p. 196)
 (W)e 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)
- (5.29) 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)

5.5.4 Forward movement

As discussed in section 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, fi, di, s, =, si, d, f, oi} ().

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:

$$\forall e_1, e_2 (e_2 \text{ not-before } e_1 \leftrightarrow e_1 < e_2 \vee (e_1 \circ e_2 \wedge (\forall e_3 (e_3 < e_1 \rightarrow e_3 < e_2))))$$

However, note that this definition excludes the *overlap_inverse* 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.⁴⁰ 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, fi, di, s, =, si} the point constraint $\alpha_1 \leq \alpha_2$ is required.⁴¹

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 Bürckert (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:

⁴⁰He obviously uses the point algebra, but he does not make clear whether this is restricted to the convex relations algebra.

⁴¹Note that he forgets to mention the *meets* relation which has to be included as well.

- The relation `initial_super` includes `b,m,o,fi,di,s,=,si`. The relations `o` and `s` do not occur for punctual situations. If the two situations are both punctual, also `fi,di` and `si` should be omitted. The proposed lemmas exclude these relations, but the convex relation algebra alone cannot satisfy this constraint.
- The same relation `is` 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.⁴²

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. $R_3 \equiv < \wedge R_4 \equiv >$). 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 `survived by` is inferred.
- *Unbounded* situations may be equal to the result state of a *bounded* situation.⁴³ Moreover, not much attention has been given to the constellation where an *unbounded* situation is terminated by a *bounded* one. Note that the fine `meets` 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`).

⁴²Compare the approaches proposed by Hinrichs and Partee which rely only on the information given by the situation type, with non-monotonic frameworks which take rhetorical relations into account (Lascardes and Asher 1993).

⁴³Unfortunately, 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 `meets` relation in (4.20), for instance.

			unbounded		bounded event	
			durative		punctual	durative
			<i>sta</i>	<i>act</i>	<i>sem</i>	<i>ach</i>
					<i>acc</i>	
<i>unbounded</i>	durative	<i>sta</i> <i>act</i>	$R_3 \equiv < \wedge R_4 \equiv >$ 		$R_1 \equiv <$ 	
bounded	punctual	<i>sem</i> <i>ach</i>	$R_2 \equiv <$ 	$R_4 \equiv \leq$ 	$R_2 \equiv \leq$ 	
event	durative	<i>acc</i>	$R_2 \equiv <$ 	$R_1 \equiv \leq$ 	$R_1 \equiv \leq$ 	

Table 5.5: All combinations of situation types and the associated temporal relations

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 (`o/o`) 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 `o`).⁴⁴

⁴⁴Only 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.

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

(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 a 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

¹It is furthermore debatable whether the claim made by Lascarides and Asher (1993) that the *explanation* relation can hold between two sentences in the *simple 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.²

- (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 pyjamas, 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 (1993, 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_1 , 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 TDIP 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. *after*, *meets_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.³

- **Narration:**

²See page 95 for the full text.

³The Greek symbols α, β 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.

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{enablement}(me(\alpha), me(\beta)) > \text{narration}(\alpha, \beta)$$

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 by the relation *LOC* are used in the axiom.

- **Axiom on Narration:**

$$\Box(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$$

Translating this relation into the point relation constraint representation and considering the minimal point relations, only one constraint has to be introduced: $R_4 \equiv <$.⁴

6.2.1.2 Elaboration

Following Lascarides and Asher (1993), an elaboration of a situation α is given if β 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 β is in the preparatory phase of the situation in α . 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. $\text{prep}(me(\alpha), me(\beta))$) 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 *superset* relation can be postulated for this rhetorical relation:⁵

- **Elaboration:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{prep}(me(\alpha), me(\beta)) > \text{elaboration}(\alpha, \beta)$$

- **Axioms on Elaboration:**

$$1. \Box(\text{elaboration}(\alpha, \beta) \rightarrow \text{superset}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$$

⁴Compare with the previous chapter and see also appendix B.

⁵See appendix B.

$$2. \Box(\text{elaboration}(\alpha, \beta) \rightarrow \neg \text{narration}(\alpha, \beta))$$

The point relation constraints for the coarse temporal relation is as follows: $R_1 \equiv <$ and $R_4 \equiv >$.

6.2.1.3 Background

The default assumption within the system proposed by Lascarides and Asher (1993) for the relation *background* is that the second situation must be a *state* which backgrounds the first situation which is a *bounded* situation. The more detailed analysis of German discourses in chapter 4 took also *activities* into account. This situation type shows also a tendency to background an earlier mentioned *bounded* situation.

The findings of the previous chapter led to the conclusion that we should allow *states* as well as *activities* to background. Furthermore, two possibilities have to be distinguished with respect to the sequence of the *bounded* and *unbounded* situations. A *background* relation where a sentence describing an *unbounded* situation precedes a sentence about a *bounded* situation is called *reverse background* and conveys consequently the reverse temporal relation. The *normal background* relation allows three temporal relations, namely *overlaps*, *starts* and *during*. The reverse relation is *overlaps*, *finish_inverse* and *during_inverse*. The two convex relations, which encompass these three fine relations respectively, are called *survived* by *contemporary of* (*bc*) and *older & contemporary of* (*oc*) (see Freksa (1992, p. 21)).

- **Unbounded situations convey an survived by/older & contemporary of relation with bounded ones:**

1. $\langle \gamma, \alpha, \beta \rangle \wedge \text{bounded}(me(\alpha)) \wedge \neg \text{bounded}(me(\beta)) > \text{bc}(LOC(me(\alpha)), LOC(me(\beta)))$
2. $\langle \gamma, \alpha, \beta \rangle \wedge \neg \text{bounded}(me(\alpha)) \wedge \text{bounded}(me(\beta)) > \text{oc}(LOC(me(\alpha)), LOC(me(\beta)))$

- **Background Relation:**

1. $\langle \gamma, \alpha, \beta \rangle \wedge \text{bc}(LOC(me(\alpha)), LOC(me(\beta))) > \text{background}(\alpha, \beta)$
2. $\langle \gamma, \alpha, \beta \rangle \wedge \text{oc}(LOC(me(\alpha)), LOC(me(\beta))) > \text{background}(\beta, \alpha)$

The following axiom constrains the possible temporal relations as strict knowledge:⁶

- **Axiom on Background:**

$$\Box(\text{background}(\alpha, \beta) \rightarrow \text{bc}(LOC(me(\alpha)), LOC(me(\beta))))$$

Since the default rules cover both possibilities by inverting the order of the arguments for the *background* relation, only one axiom has to be stipulated. The point relation constraints are $R_2 \equiv <$ and $R_4 \equiv >$.

Additionally, I introduce a new rhetorical relation called *scenesetting*. This relation establishes a common background which is given when two *unbounded* situations are described.

⁶See appendix B.2.2.

- **Two unbounded situations share a common time interval:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \neg \text{bounded}(me(\alpha)) \wedge \neg \text{bounded}(me(\beta)) > \text{contemporary of}(LOC(me(\alpha)), LOC(me(\beta)))$$

The default rule which licenses the *scenesetting* 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:**

$$\text{contemporary of}(LOC(me(\alpha)), LOC(me(\beta))) > \text{scenesetting}(\alpha, \beta)$$

This relation allows only a very coarse temporal relation, as the analysis of discourse sequences in chapter 4 has shown.

- **Axiom on Scene Setting:**

$$\Box(\text{scenesetting}(\alpha, \beta) \rightarrow \text{contemporary of}(LOC(me(\alpha)), LOC(me(\beta))))$$

The point relation constraints are $R_3 \equiv <$ and $R_4 \equiv >$.⁸

6.2.1.4 Result

This relation is defined as in Lascarides and Asher (1993):

- **Result:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{cause}(me(\alpha), me(\beta)) > \text{result}(\alpha, \beta)$$

The temporal relation evoked by this rhetorical relation is *meets*:

- **Axiom on Result:**

$$\Box(\text{result}(\alpha, \beta) \rightarrow \text{meets}(LOC(me(\alpha)), LOC(me(\beta))))$$

6.2.1.5 Termination

The inverse relation is called *termination*:

- **Termination:**

$$\langle \gamma, \alpha, \beta \rangle \wedge \text{stop}(me(\alpha), me(\beta)) > \text{termination}(\alpha, \beta)$$

The *stop* relation is actually a specific *cause* relation and should be read as situation $me(\beta)$ causes situation $me(\alpha)$ to be terminated⁹

Consequently, again a *meets* relation is stipulated by this relation:¹⁰

⁷Cf. [?, ?, <, >] for *contemporary of* with [?, <, >] for *survived by & contemporary of* and [$<$, ?, <, >] for *older & contemporary of*.

⁸Compare with appendix B.2.1.

⁹Consider 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.

¹⁰See appendix B.

- **Axiom on Termination:**

$$\Box(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta))))$$

After introducing the rhetorical relations I want to use, I will discuss the hierarchical structure of a discourse sequence with more than two sentences in the following section.

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 derived discourse tree should look like and therefore it is unclear 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).

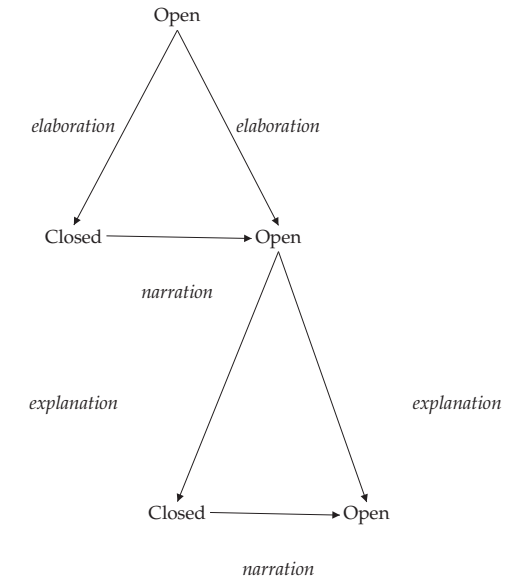


Figure 6.1: Openness by Lascarides and Asher (1993)

The formal definition of subordination and openness is given in Lascarides and Asher (1993, p. 458) (τ is a Discourse Representation Pair (DRP) containing the DRSs α and β):

Definition 10 (Subordination) α is subordinate to β if:

- (i) $\text{explanation}(\beta, \alpha)$ or $\text{elaboration}(\beta, \alpha)$ holds; or
- (ii) γ is a DRS in τ such that $\text{explanation}(\gamma, \alpha)$ or $\text{elaboration}(\gamma, \alpha)$ holds, and γ is subordinate to β .

Definition 11 (Openness) A DRS α is open in the DRP τ iff α is the DRS representing the previous clause in the text, or this DRS is subordinate to α .

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.

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 a 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: $\langle\langle(6.4a-d), (6.4a), (6.4e)\rangle, \langle\langle(6.4a-d), (6.4b), (6.4e)\rangle, \langle\langle(6.4a-d), (6.4d), (6.4e)\rangle\rangle$. First, we need a rule which allows us to derive *–elaboration*:

Rule 1 $\langle\tau, \beta, \epsilon\rangle > \text{–elaboration}(\beta, \epsilon)$

¹¹This phenomenon was noted earlier by Grosz and Sidner (1985).

¹²The definition of the Nixon Diamond can be found on page 22.

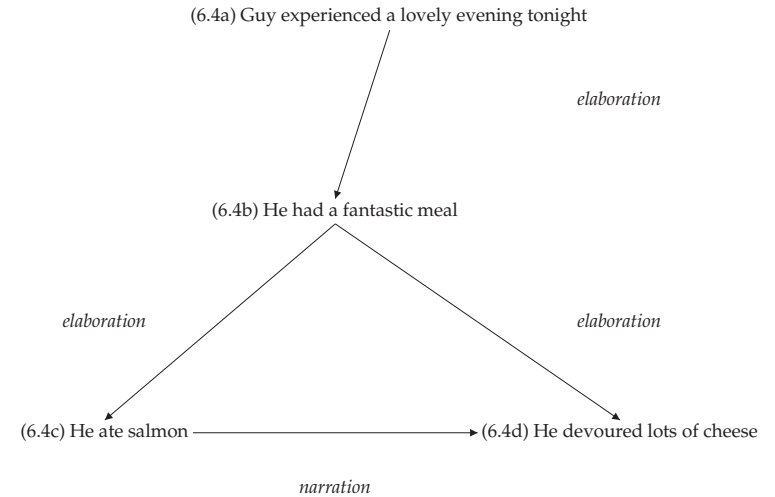


Figure 6.2: The hierarchical structure according to Lascarides and Asher (1993)

Moreover, *–narration* has to be derived in order to obtain the irresolvable conflict:

Rule 2 $\text{elaboration}(\beta, \delta) \wedge \text{–elaboration}(\beta, \epsilon) > \text{–narration}(\delta, \epsilon)$

Since *narration* for clause (6.4d) and (6.4e) can be derived by $\langle\langle(6.4a-d), 6.4d\rangle, (6.4e)\rangle$ 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 (6.4a). According to our world knowledge the two following relations can be derived: *elaboration*(6.4a, 6.4e) and *narration*(6.4b, 6.4e).¹³

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

¹³These 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.

¹⁴This example discourse is taken from Cooreman and Sanford (1996).

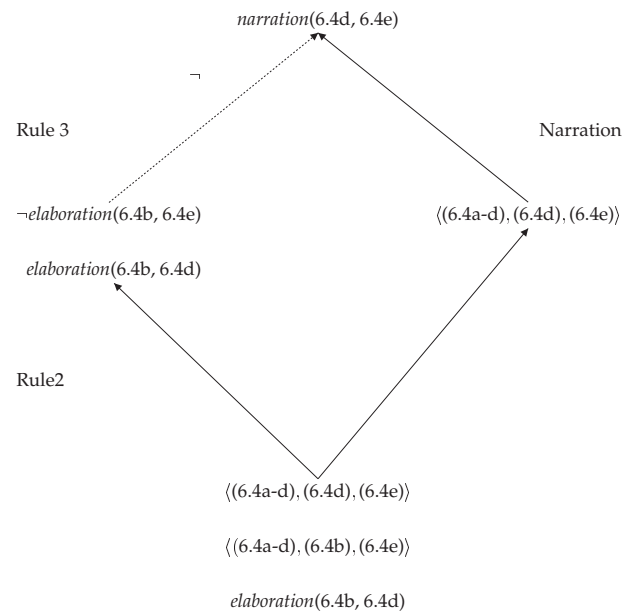


Figure 6.3: The Nixon Polygon which arises

- (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.

Sentence (6.5a) and (6.5b) are connected via *narration*. If we followed Lascarides and Asher (1993), this would close the clause (6.5a) and makes it unavailable for the third clause (6.5c). A more flexible notion of openness which considers the interaction between the rhetorical and syntactic structure is needed here.

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.

Another effect which can be quite often observed is a *flashback* sequence like in (6.6):

- (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 spin-

ning 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 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):

- (6.7) 'Ladies and gentulmun ...' 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.

The example discourse in (6.6) refers back to a situation which happened earlier with respect to the flow of the occurrences, however the whole sequence is not perceived as a badly constructed discourse.¹⁵ Contrarily, a *repair* sentence like (6.4f) or a text like in (6.7) is relatively difficult to process. A theory on discourse processing should provide an explanation why these two cases differ so much with respect to the coherence of a text.

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):

- (6.8) (a) Um drei Uhr verließ Peter die Bergstation. (b) Es schneite fürchterlich. (c) Trotzdem fuhr er recht flott hinunter zum Käslühüttli.

¹⁵Note 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 Käslühüttli.

In this sequence, sentence (6.8a) is backgrounded by an *activity* in (6.8b).¹⁶ 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 formerly 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

¹⁶In English, the same effect is obtained by the usage of the *progressive form*.

¹⁷The 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

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. \triangleleft^*) and immediate dominance (i.e. \triangleleft) relation are introduced.¹⁸ The tree in figure 6.4 can be described by the following set of constraints which hold between the labels: $\{k_1 \triangleleft k_2, k_1 \triangleleft k_3, k_3 \triangleleft^* k_4, k_4 \triangleleft k_5, k_4 \triangleleft k_6\}$.

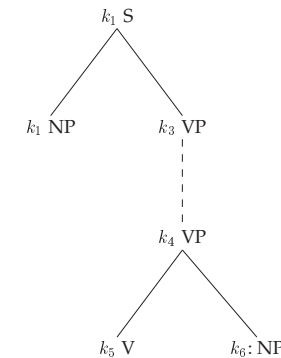


Figure 6.4: A labelled tree description

One more word has to be said about the description of trees constraints by the given labels.

(1988) for a definition of FTAGs.

¹⁸Compare 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 fulfil 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 $\langle N, T, \triangleleft, \triangleleft^*, \prec, \prec, S \rangle$ 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 $G = \langle N, T, \triangleleft, \triangleleft^*, \prec, \prec, S \rangle$, such that:

- N and T are disjoint finite sets for the nonterminal and terminal symbols.
- \triangleleft is the parent relation (i.e. immediate dominance) which is irreflexive, asymmetric and intransitive.
- \triangleleft^* is the dominance relation which is the transitive closure of \triangleleft .
- \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 $\langle a, \alpha_a \rangle$, where α_a is a partial function from N to V and a is the unique name of α_a .

For the application of the TDG as a discourse grammar only two categories are necessary, namely **D**(iscourse) and **S**(entence). 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.¹⁹ 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 CONTENT as in the following feature structure:

$$\left[\begin{array}{l} \text{CONTENT:} \\ \text{DR: } \langle x \rangle \\ \text{COND: } \langle \text{peter}(x), \text{schmarchl}(x) \rangle \end{array} \right]$$

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 Rel .²⁰ 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).

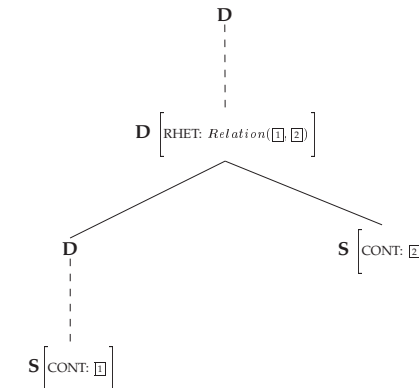


Figure 6.5: A tree description for a sentence embedded in a discourse

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 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

¹⁹I do not discuss the question here whether a sentence or a clause has to be taken as the lexical entry on the discourse level.

²⁰Note that these labels belong to the feature structure and should not be mistaken for tree node labels.



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 \mathbf{D} of a second tree description β . Formally, the combined tree description can be derived by the following label equivalence: $k_1 \approx k_2$.²¹

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 \mathbf{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: $k_3 \approx k_4 \wedge k_5 \approx k_6$.

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. $s = mc(\alpha)$).

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:

²¹See Kallmeyer (1996, p. 4) for the definition of intuitively clear equivalence relation between labels.
²²The 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).

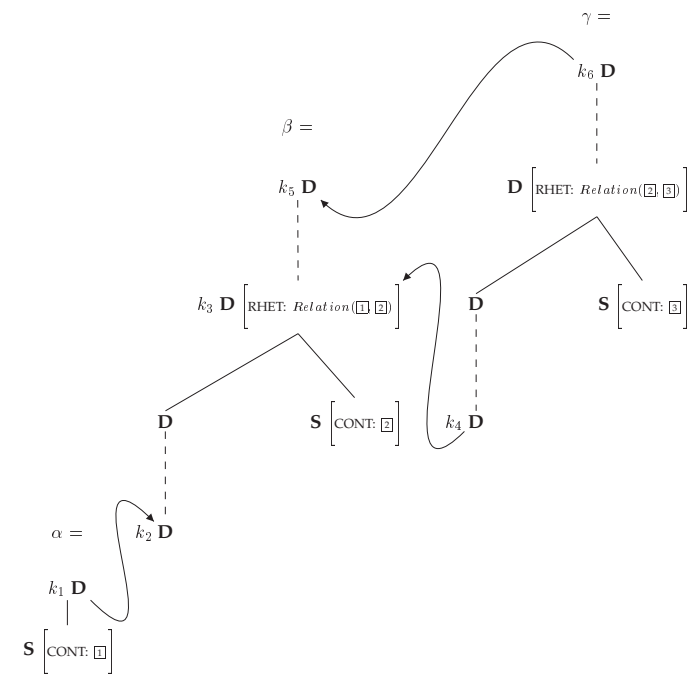
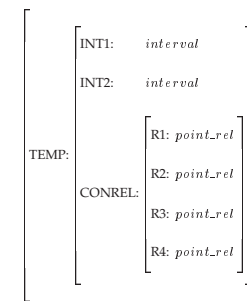


Figure 6.7: Substitution and adjunction operation on tree descriptions



The value of **CONREL** will be quite often abbreviated with the name of the convex relation (e.g. *ct* for *contemporary of*).

Thirdly, I will argue against accounts developed by Polanyi (1988), Gardent (1994) and

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*, *scenestting* 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

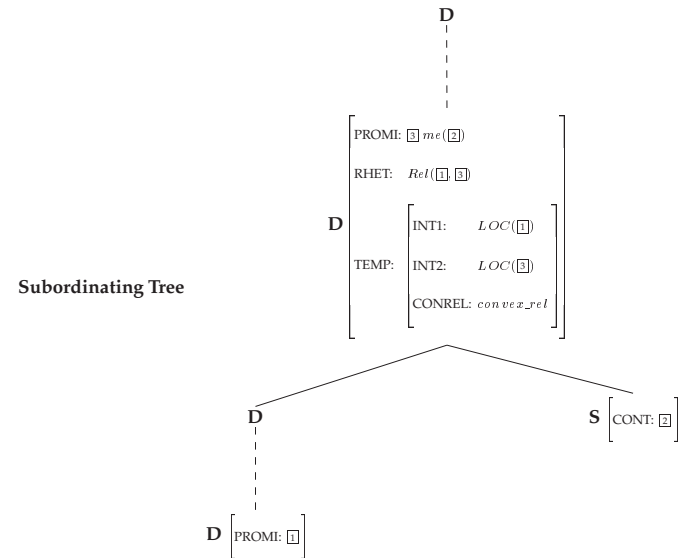
Additionally to the tree description, further constraints have to be added. It has to be ensured that the situations fulfil the requirements imposed by the rhetorical relation. That is, the *enablement* relation, for instance, requires that the second situation can be seen as a narrative continuation 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-

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.



Subordinating Tree		
relation	convex_rel	icon
narration	before (b)	⌞
result termination	meets (m)	⌞

Table 6.1: The rhetorical relations and the temporal constraints for a subordinating tree

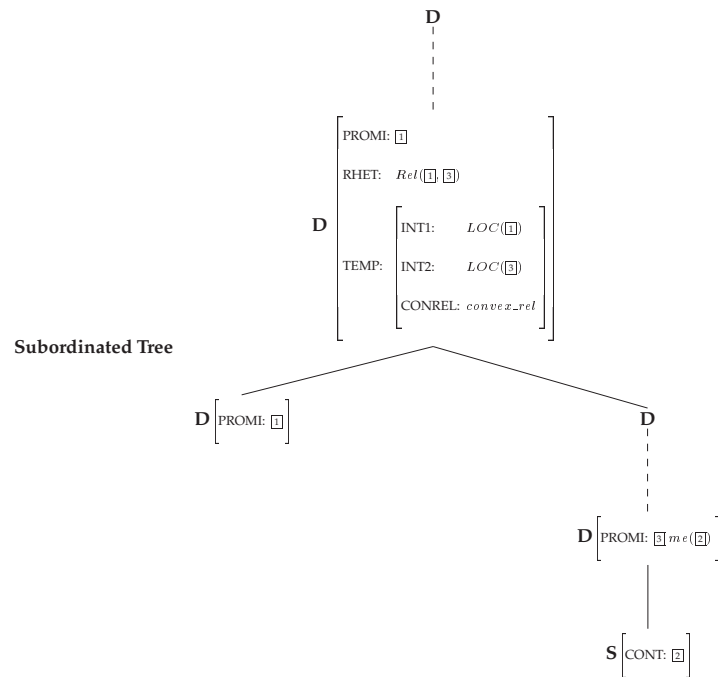
categorisation principle).

6.3.2.2 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.



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.

Subordinated Tree		
relation	convex_rel	icon
<i>background</i>	survived by & contemporary of (bc)	
<i>scen setting</i>	contemporary of (ct)	
<i>elaboration</i>	superset (sp)	

Table 6.2: The rhetorical relations and the temporal constraints for a subordinated tree

The *reverse* case — sentence α describing the *unbounded* situation precedes sentence β describing the *bounded* situation — is transformed into a *background* relation by reversing the order of α and β (i.e. *background*(β, α)). 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:

$$\left\langle \mathbf{D}, \mathbf{D} \left[\text{PROMI: } [1] \right], \mathbf{D} \left[\begin{array}{l} \text{PROMI: } [1] \\ \text{RHET: } \textit{Background}([1], [2]) \end{array} \right], \mathbf{S} \left[\text{CONT: } [2] \right], \mathbf{D} \left[\text{PROMI: } [1]me([2]) \right], \mathbf{D} \right\rangle$$

6.4 Planting a forest

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)

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.²⁶

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*, *scenestetting* 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

²⁶See Asher (1993) for other counter examples.

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):²⁷

- (6.9) (a) 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.

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 α in figure 6.8 reflects the discourse structure up to (6.9c). The next utterance signals a repair of the discourse structure.²⁸ 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 subsertion 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

²⁷This 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.

²⁸Compare with the usage of the asterisk in (6.7).

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 $rel(\boxed{\square}, \boxed{\square}) = elaboration$. The label $\boxed{\square}$ 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:

$$D \left[\begin{array}{c} \text{PROMI: } \boxed{\square} \\ \end{array} \right] \triangleleft D \triangleleft^* D \left[\begin{array}{c} \text{PROMI: } \boxed{\square} \\ \end{array} \right] \rightarrow rel(\boxed{\square}, \boxed{\square}) = elaboration.^{29}$$

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 (1993).

²⁹The relations \triangleleft and \triangleleft^* actually hold between labels, but for the sake of clarity I refrain here from the formally correct specification.

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 stampfte 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 stampfte 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. bc). 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 fürchterlich. (b) Trotzdem fuhr Peter recht flott hinunter zum Käslhüttli.
It was snowing terribly. Nevertheless, Peter skied quite quickly down to the Käslhüttli.

³⁰The acceptability judgement ^(??) applies only if (6.13) is seen as adding more information to the general scene description (i.e. *scenesetting* relation).

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:

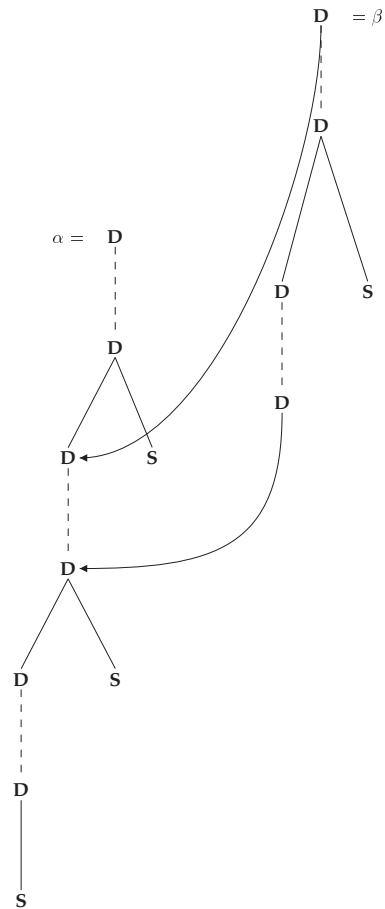
- The hierarchical structure of a discourse can be described via a well-defined tree generation grammar. The minimal trees constitute subordinated and subordinating dependencies between the discourse segments.
- The discourse attachment is possible at the *right frontier* of the discourse tree as former 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.

³¹The following chapter shows in more detail how the tree discourse structure can be constructed for a *reverse background*.

Figure 6.8: The example discourse *repaired*

SEVEN

The Fragment

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:¹

- (7.1) (a) Um drei Uhr verließ Peter die Bergstation. (b) Es schneite fürchterlich.
At 3pm, Peter left the summit station. It was snowing terribly.
- nar. (c) Trotzdem fuhr er recht flott hinunter zum Käslhüttli. (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 Käslhüttli. **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).

ela. (c') Trotzdem fuhr er recht flott hinunter zum Käslühüttli. (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.

Nevertheless, he skied quite quickly **towards** the Käslühüttli. At the middle station he had a real fall, but he picked himself up quickly again. **He brushed the snow off his clothes**, continued wedelling,² and was at the bottom at around half past four.

int. (c'') Trotzdem fuhr er recht flott hinunter zum Käslühüttli. (d'') Bei der Mittelstation erfasste ihn eine Lawine. (e'') Ein freundlicher Bernhardiner grub ihn aber aus und (f'') versorgte ihn mit Kräuterschnaps, bis (g'') der Rettungshubschrauber eintraf.

Nevertheless, he skied quite quickly **towards** the Käslühüttli. At the middle station an avalanche caught him. A friendly Saint Bernard dug him up and provided him with herbal schnapps until the rescue helicopter arrived.

7.2 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:

²From the German *wedeln*: to ski downhill from side to side.

- What is the crucial difference from the previous discourse where Peter nevertheless made it to the Käslühüttli?
- Where do we continue after the end of situation (7.1c'') in the discourse structure?

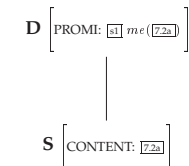
7.2.1 Narration

The following discourse sequence contains mainly *narration* relations and consequently represents several situations which are ordered according to the temporal precedence relation (i.e. *before*). Only the second sentence describes a *state* which establishes a *background* relation which can be derived from our knowledge of *unbounded* situations.³

- (7.2) (a) Um drei Uhr verließ Peter die Bergstation. (b) **Es schneite fürchterlich**. (c) Trotzdem fuhr er recht flott hinunter zum Käslühüttli. (d) Er klopfte sich den Schnee aus den Kleidern. (e) Dann trat er ein und (f) bestellte sich einen Glühwein.
 (a) Around 3pm, Peter left the summit station. (b) It was snowing terribly. (c) Nevertheless, he skied quite quickly down to the Käslühüttli. (d) He brushed the snow off his clothes. (e) Then he entered and (f) ordered a Glühwein (mulled wine).

In the following I provide a more detailed analysis of this discourse sequence sentence by sentence.

(7.2a) The first sentence refers to a *punctual* situation (i.e. *achievement*). Assuming that we have encountered a narrative text, we can derive the following start tree for this first situation.



The label $\boxed{7.2a}$ refers to the semantic content of sentence (7.2a) that was obtained from the syntactic parse of the sentence. The function $mc(\boxed{7.2a})$ extracts the *main eventuality* which is described by (7.2a) (i.e. s_1). Within a DRT semantics framework, the representation could be as follows:

³Example text (7.1nar) is repeated here as (7.2).

x y s_1 i_1 t n
named(x , Peter)
Bergstation(y)
op($\lambda s'$ verlassen(s' , x , y), s_1)
3 Uhr(t)
LOC(s_1) = i_1
i_1 during t
i_1 before n

We can already learn certain things from this semantic analysis about the temporal constraints which are introduced by this sentence.

- The described situation s_1 has a temporal extension i_1 which is assigned to it by the function *LOC*.
- The situation type of *verlassen* ('to leave') is *punctual*, therefore the described situation s_1 is *punctual* as well. Note that for *punctual* situations there are no sub-situations.⁴ Representing this information within a situation theoretical framework, we could assume a situation type here $S : \text{verlassen}(x, y)$.
- The situation occurred at a time t , which refers to 3 Uhr ('3 pm').
- The situation happened before the utterance time n .

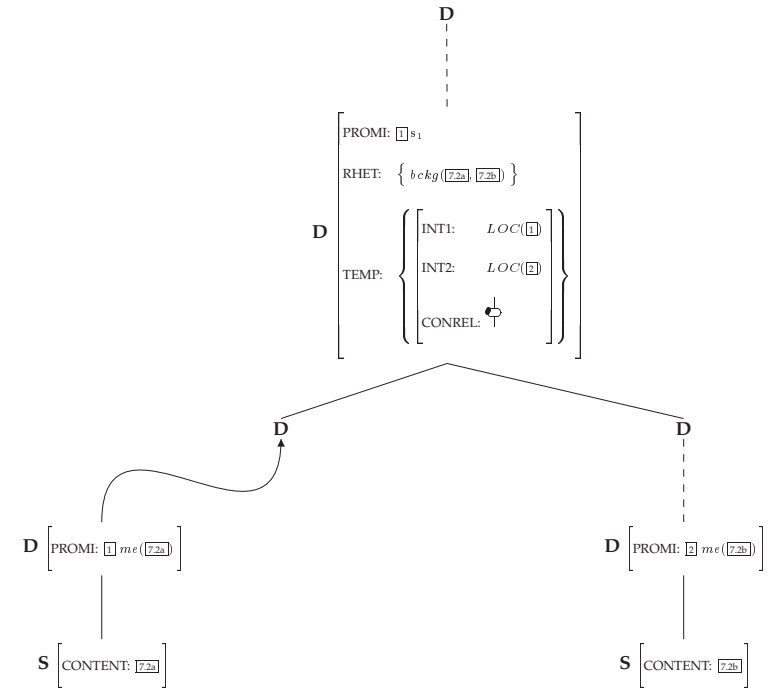
I will omit the value of the content feature in the following, but it should be borne in mind that this constitutes the semantic content to which ensuing situations can be related.

(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 $\&$ *contemporary* of (bc) can be derived at first. This relation which includes three interval relations (i.e. {*overlaps*, *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.⁵ 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.

⁴Compare with the definition of *punctual* on page 117.

⁵See section 5.5.1 on the interaction between open can closed intervals.

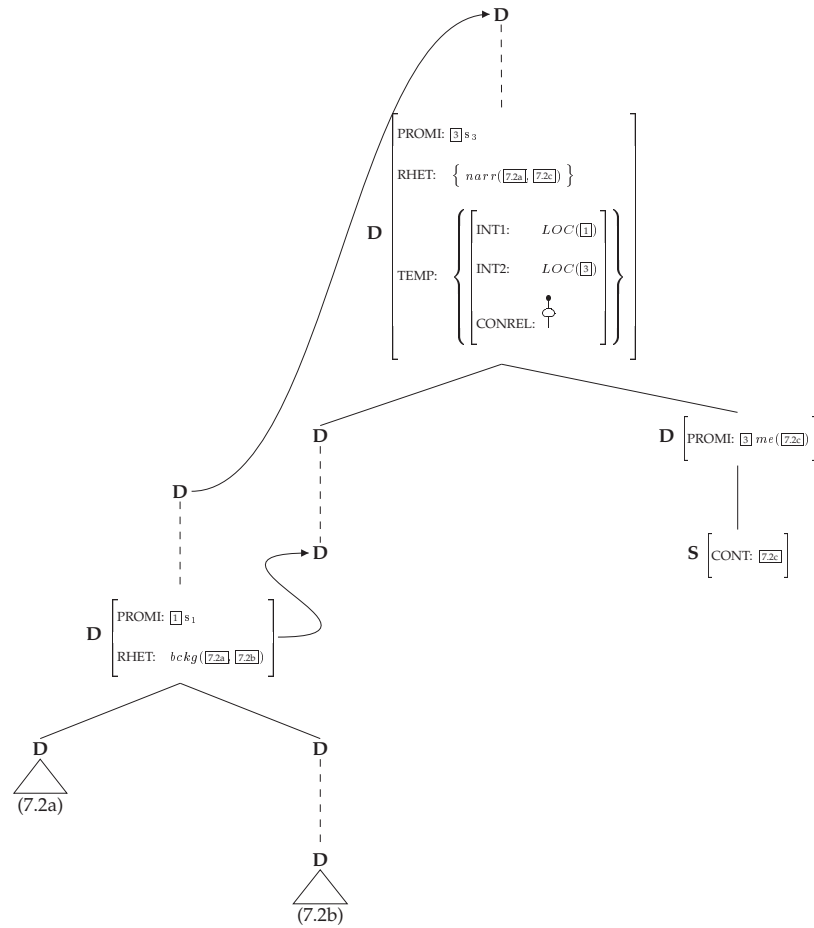
The derived discourse structure looks as follows:⁶



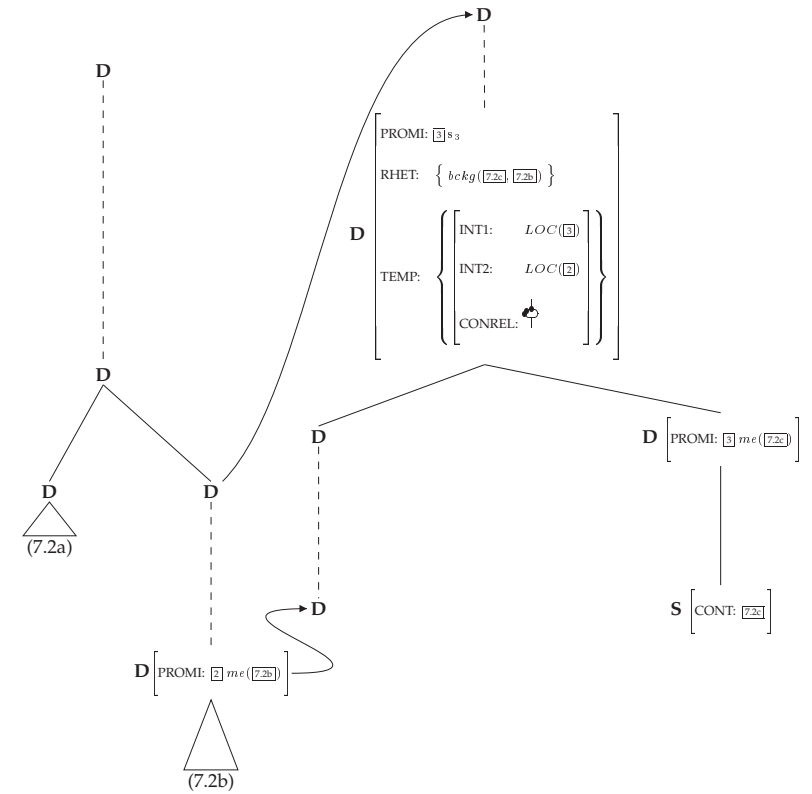
(7.2c) Trotzdem fuhr er recht flott hinunter zum Käsilihüttli. The next sentence (7.2c) contains a *bounded* situation which can be either seen as a continuation of (7.2a) licensed by our script knowledge or as the foreground situation which is backgrounded by (7.2b). The value of the RHET and TEMP feature 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 [PROMI: [] s_1], D [PROMI: [] s_2] }).⁷ The output is a set of all derivable rhetorical relations which can be established between the open discourse segments 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):

⁶The convex relation is presented as icon for the sake of brevity.

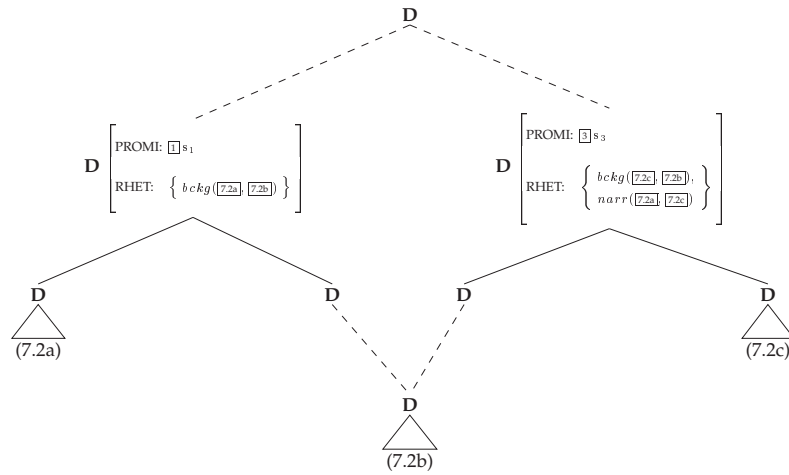
⁷In order to get to the semantic content of the sentence describing these situations, one simply has to follow the path down to the S leaf of the discourse tree.



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:



(7.2d) *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:

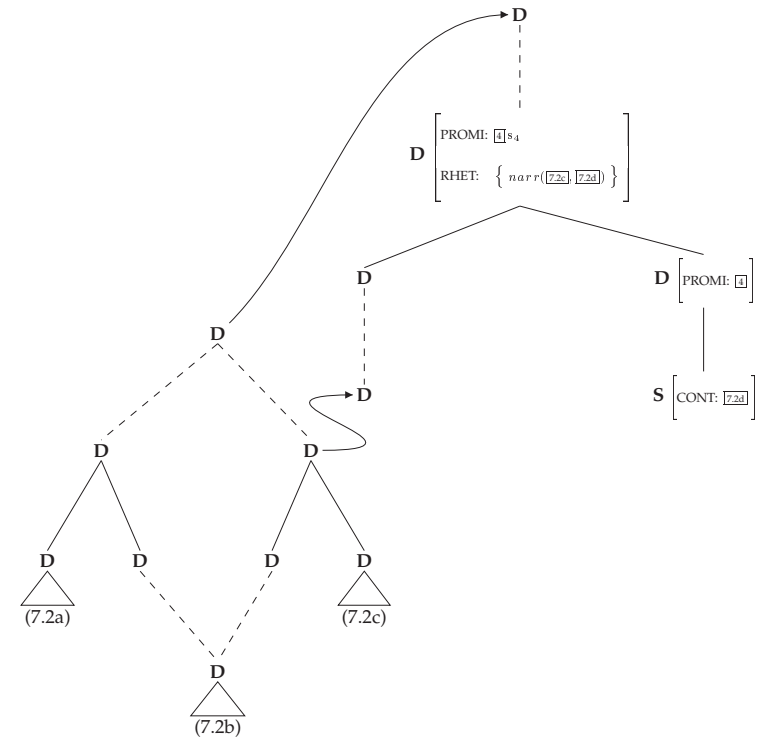
x_1 z s_3 i_3 n
$x_1 = x$
Käslihüttli(z)
$op(\lambda s''' \text{ hinunterfahren}(s''', x_1, z), s_3)$
$LOC(s_3) = i_3$
i_3 before n

The *open-perfective* viewpoint allows us to infer per *default* that the situation s_3 is of a situation type *hinunterfahren zur Käslihüttli*:

$$op(\lambda s''' \text{ hinunterfahren}(s''', x_1, z), s_3) > \lambda s''' \text{ hinunterfahren}(s''', x_1, z) s_3$$

Note also that anaphoric resolution is needed for x_1 (i.e. *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 Roßdeutscher (1994)), but further research is definitely needed here.

Now, the following situation of *brushing off snow* seems to be a plausible continuation:



(7.2e+f) *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 Käslihüttli). 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 fürchterlich. (c') Trotzdem fuhr er recht flott hinunter zum Käslihüttli. (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 Käsilihüttli. (d') At the middle station he had a real fall, (e') but he picked himself up quickly again. (f') **Her 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 Mittelstation* 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:

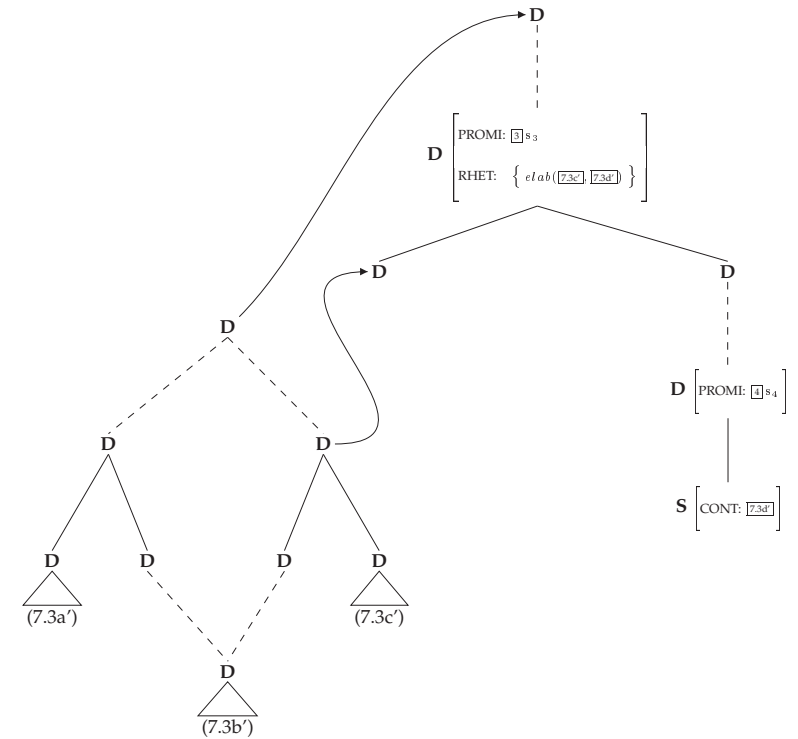
$$[(7.3a'-d'), (7.3c'), (7.3d')] \wedge \text{op}(s_3, \lambda s''' \text{ hinunterfahren}(s''', x_1, z)) \wedge \text{op}(s_4, \lambda s'''' \text{ stürzen}(s''''', x_1, m)) \wedge \text{interrupt}(s_3, s_4)] > \neg \text{hinunterfahren}(s_3, x_1, z)$$

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):

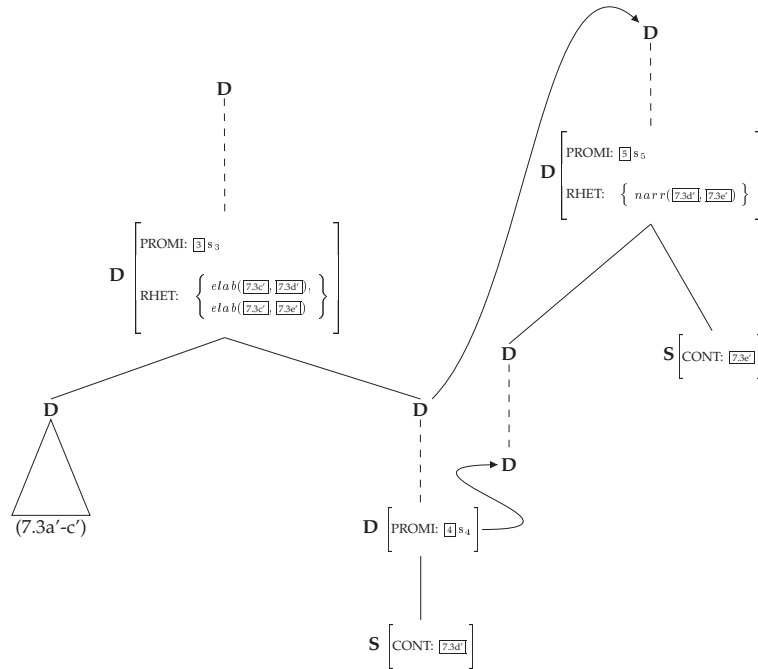
$$\text{initial}(s_3, s) \wedge \text{hinunterfahren}(s, x_1, m) \wedge \text{prep}(s_3, s)$$

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').

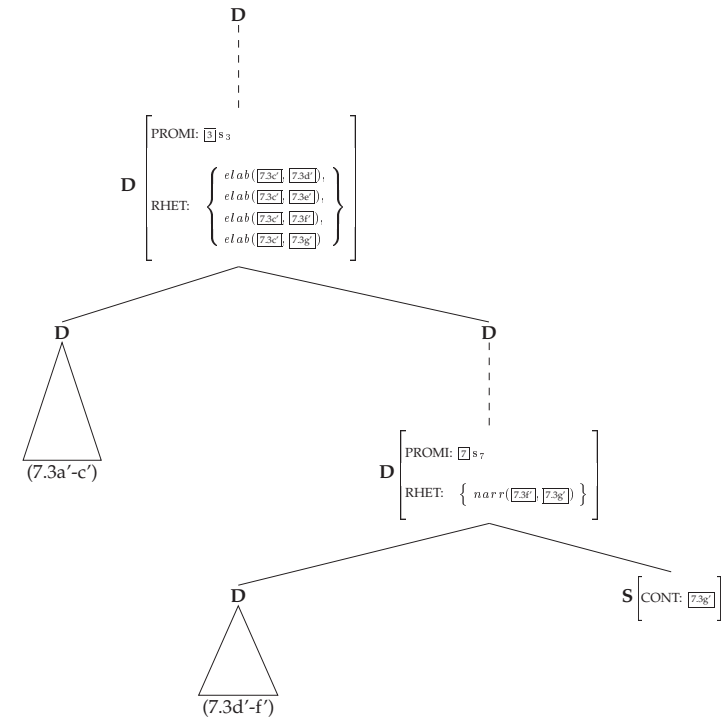
The tree representation for the German discourse follows:



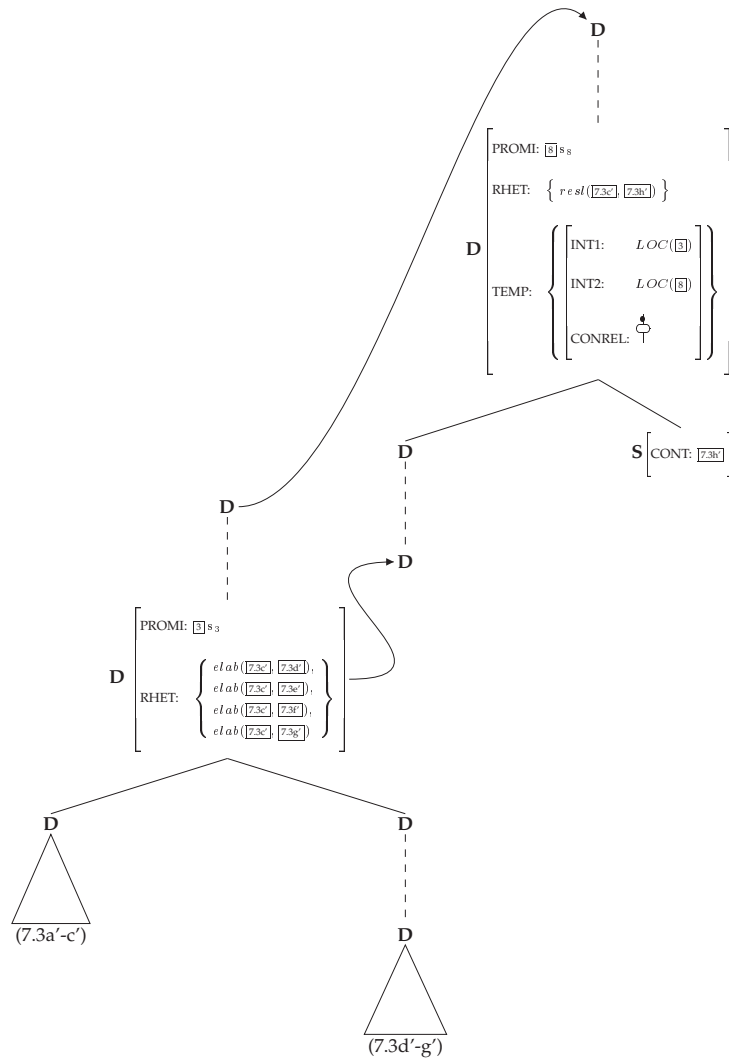
(7.3e') *rappelte sich aber schnell wieder auf*. A *narration* relation can now be derived between (7.3d') and (7.3e'). The further constraint of (7.3e') being an *elaboration* of (7.3c') is sustained by the inference that the situation took place at the middle station as well (cf. section 6.4.3 on multiple rhetorical relations). In this case the tree structure predetermines which rhetorical relation has to be derived between (7.3c') and (7.3e'), namely *elaboration*:



(7.3f'+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.



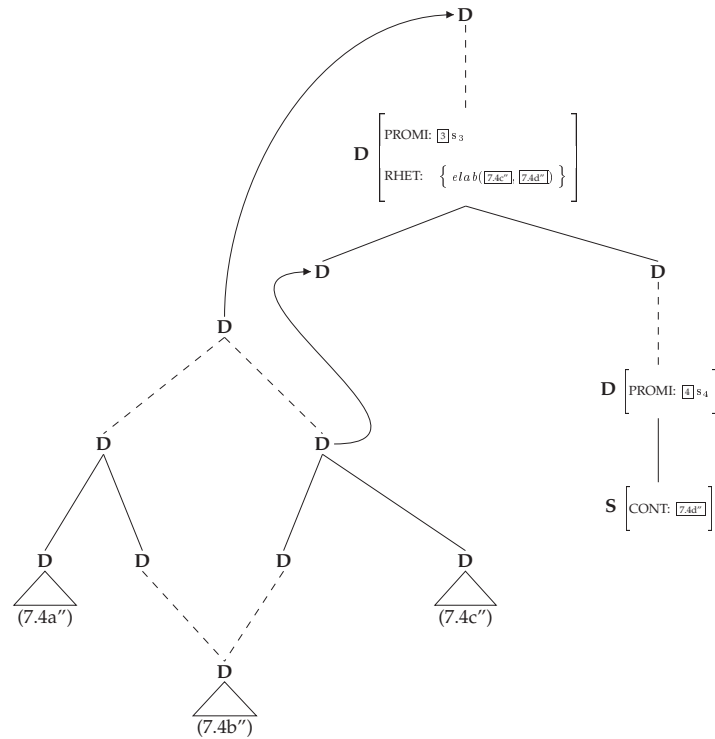
7.2.3 Interruption

- (7.4) (a'') Um drei Uhr verließ Peter die Bergstation. (b'') Es schneite furchterlich. (c'') Trotzdem fuhr er recht flott hinunter zum Käslihüttli. (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 Käslihüttli. (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_3 is captured by a predicate $hinunterfahren(s'''_{,x_1,z})$ 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.

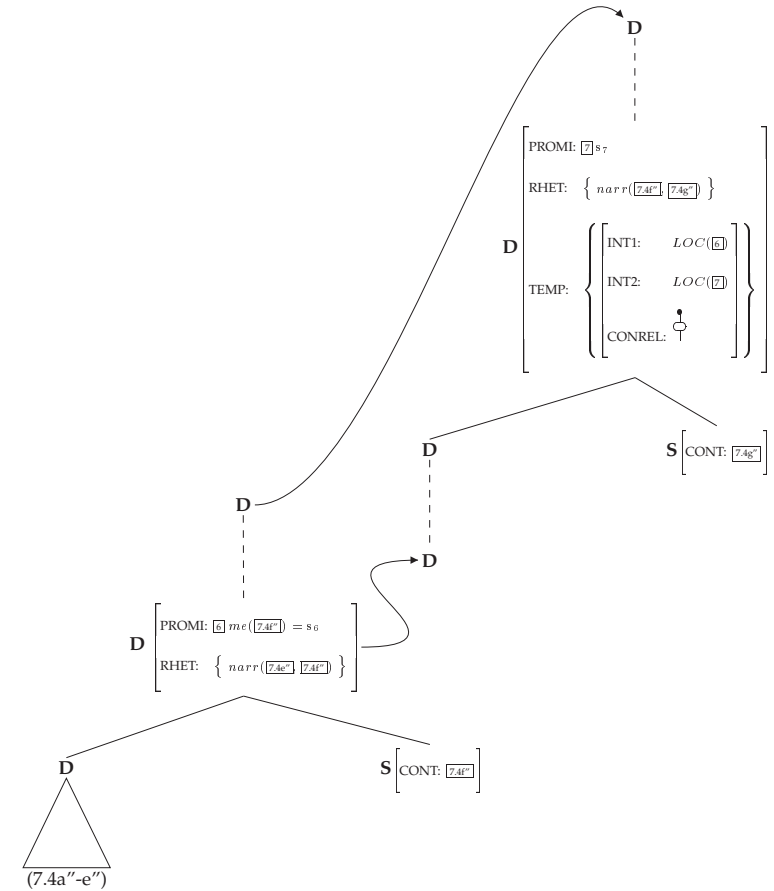
Although the discourse structure of (7.4) does not look different from (7.3) after the third situation, the only attachment site for this constellation is the node containing s_3 as PROMI value because no information is provided that this situation continues, and more details on it are given in the subsequent discourse.



(7.4e''-f'') Ein freundlicher Bernhardiner grub ihm aus und versorgte ihn mit Kräuterschnapps. 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 schnapps* 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.



EIGHT

Conclusion

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.

- 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 Verlaufsform* 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 fulfil 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 (\subset) 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 Future research

Future research should focus on two areas. First, a formalism which can fulfil 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. There 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 analyse 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.

A All 82 Convex Relations

name	constraints	Allen relations	icon
<	[[<], [<], [<], [<]]	[<]	
m	[[<], [<], [<], [=]]	[m]	
o	[[<], [<], [<], [>]]	[o]	
pr	[[<], [<], [<], [<=]]	[<,m]	
nn	[[<], [<], [<], [=, >]]	[m,o]	
ob	[[<], [<], [<], [<=, >]]	[<,m,o]	
fi	[[<], [=], [<], [>]]	[fi]	
di	[[<], [>], [<], [>]]	[di]	
nn	[[<], [<=], [<], [>]]	[o,fi]	
nn	[[<], [<=], [<], [=, >]]	[m,o,fi]	
nn	[[<], [<=], [<], [<=, >]]	[<,m,o,fi]	
nn	[[<], [=, >], [<], [>]]	[fi,di]	
oc	[[<], [<=, >], [<], [>]]	[o,fi,di]	
nn	[[<], [<=, >], [<], [=, >]]	[m,o,fi,di]	
ol	[[<], [<=, >], [<], [<=, >]]	[<,m,o,fi,di]	
s	[[=], [<], [<], [>]]	[s]	
=	[[=], [=], [<], [>]]	[=]	
si	[[=], [>], [<], [>]]	[si]	
b	[[=], [<=], [<], [>]]	[s,=]	

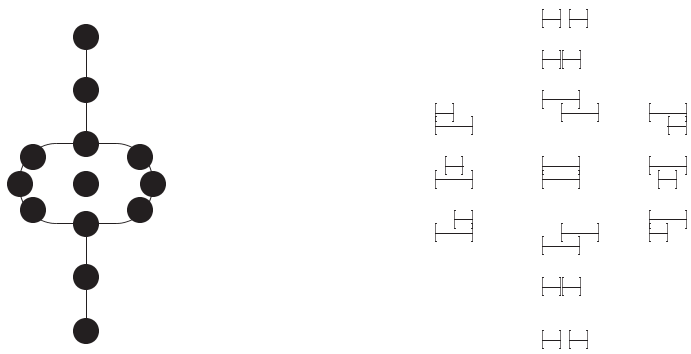
name	constraints	Allen relations	icon
bi	[[=], [=, >], [<], [>]]	[=,si]	
hh	[[=], [<=, >], [<], [>]]	[s,=,si]	
d	[[>], [<], [<], [>]]	[d]	
f	[[>], [=], [<], [>]]	[f]	
oi	[[>], [>], [<], [>]]	[oi]	
mi	[[>], [>], [=], [>]]	[mi]	
>	[[>], [>], [>], [>]]	[>]	
nn	[[>], [>], [<=], [>]]	[oi,mi]	
sd	[[>], [>], [=, >], [>]]	[mi,>]	
ys	[[>], [>], [<=, >], [>]]	[oi,mi,>]	
nn	[[>], [<=], [<], [>]]	[d,f]	
nn	[[>], [=, >], [<], [>]]	[f,oi]	
nn	[[>], [=, >], [<=], [>]]	[f,oi,mi]	
nn	[[>], [=, >], [<=, >], [>]]	[f,oi,mi,>]	
yc	[[>], [<=, >], [<], [>]]	[d,f,oi]	
nn	[[>], [<=, >], [<=], [>]]	[d,f,oi,mi]	
yo	[[>], [<=, >], [<=, >], [>]]	[d,f,oi,mi,>]	
nn	[[<=], [<], [<], [>]]	[o,s]	
nn	[[<=], [<], [<], [=, >]]	[m,o,s]	
nn	[[<=], [<], [<], [<=, >]]	[<,m,o,s]	
ei	[[<=], [=], [<], [>]]	[fi,=]	
nn	[[<=], [>], [<], [>]]	[di,si]	
nn	[[<=], [<=], [<], [>]]	[o,fi,s,=]	
nn	[[<=], [<=], [<], [=, >]]	[m,o,fi,s,=]	
nn	[[<=], [<=], [<], [<=, >]]	[<,m,o,fi,s,=]	
nn	[[<=], [=, >], [<], [>]]	[fi,di,=,si]	
nn	[[<=], [<=, >], [<], [>]]	[o,fi,di,s,=,si]	
nn	[[<=], [<=, >], [<], [=, >]]	[m,o,fi,di,s,=,si]	
is	[[<=], [<=, >], [<], [<=, >]]	[<,m,o,fi,di,s,=,si]	
nn	[[=, >], [<], [<], [>]]	[s,d]	

name	constraints	Allen relations	icon
en	[[=, >], [=, <], [<, >]]	[=, f]	
nn	[[=, >], [>, <], [<, >]]	[si, oi]	
nn	[[=, >], [>, <], [=, >], [>]]	[si, oi, mi]	
nn	[[=, >], [>, <], [=, >], [>]]	[si, oi, mi, >]	
ss	[[=, >], [<, =], [<, >]]	[s, =, d, f]	
nn	[[=, >], [=, >], [<, >]]	[=, si, f, oi]	
nn	[[=, >], [=, >], [<, =], [>]]	[=, si, f, oi, mi]	
nn	[[=, >], [=, >], [<, =, >], [>]]	[=, si, f, oi, mi, >]	
nn	[[=, >], [<, =, >], [<, >]]	[s, =, si, d, f, oi]	
nn	[[=, >], [<, =, >], [<, =], [>]]	[s, =, si, d, f, oi, mi]	
nn	[[=, >], [<, =, >], [<, =, >], [>]]	[s, =, si, d, f, oi, mi, >]	
bc	[[<, =, >], [<, <], [>]]	[o, s, d]	
nn	[[<, =, >], [<, <], [<, [=, >]]	[m, o, s, d]	
sb	[[<, =, >], [<, <], [<, <], [<, =, >]]	[<, m, o, s, d]	
tt	[[<, =, >], [=, <], [<, >]]	[fi, =, f]	
sc	[[<, =, >], [>, <], [>]]	[di, si, oi]	
nn	[[<, =, >], [>, <], [=, >], [>]]	[di, si, oi, mi]	
sv	[[<, =, >], [>, <], [=, >], [>]]	[di, si, oi, mi, >]	
nn	[[<, =, >], [<, =], [<, >]]	[o, fi, s, =, d, f]	
nn	[[<, =, >], [<, =], [<, [=, >]]	[m, o, fi, s, =, d, f]	
nn	[[<, =, >], [<, =], [<, <], [<, =, >]]	[<, m, o, fi, s, =, d, f]	
nn	[[<, =, >], [=, >], [<, >]]	[fi, di, =, si, f, oi]	
nn	[[<, =, >], [=, >], [<, =], [>]]	[fi, di, =, si, f, oi, mi]	
nn	[[<, =, >], [=, >], [<, =, >], [>]]	[fi, di, =, si, f, oi, mi, >]	
ct	[[<, =, >], [<, =, >], [<, >]]	[o, fi, di, s, =, si, d, f, oi]	

name	constraints	Allen relations	icon
nn	[[<, =, >], [<, =, >], [<, [=, >]]	[m, o, fi, di, s, =, si, d, f, oi]	
bd	[[<, =, >], [<, =, >], [<, <], [<, =, >]]	[<, m, o, fi, di, s, =, si, d, f, oi]	
nn	[[<, =, >], [<, =, >], [<, =], [>]]	[o, fi, di, s, =, si, d, f, oi, mi]	
nn	[[<, =, >], [<, =, >], [<, =], [=, >]]	[m, o, fi, di, s, =, si, d, f, oi, mi]	
nn	[[<, =, >], [<, =, >], [<, =], [<, =, >]]	[<, m, o, fi, di, s, =, si, d, f, oi, mi]	
db	[[<, =, >], [<, =, >], [<, =, >], [>]]	[o, fi, di, s, =, si, d, f, oi, mi, >]	
nn	[[<, =, >], [<, =, >], [<, =, >], [=, >]]	[m, o, fi, di, s, =, si, d, f, oi, mi, >]	
?	[[<, =, >], [<, =, >], [<, =, >], [<, =, >]]	[<, m, o, fi, di, s, =, si, d, f, oi, mi, >]	

B Convex Relations and Intervals

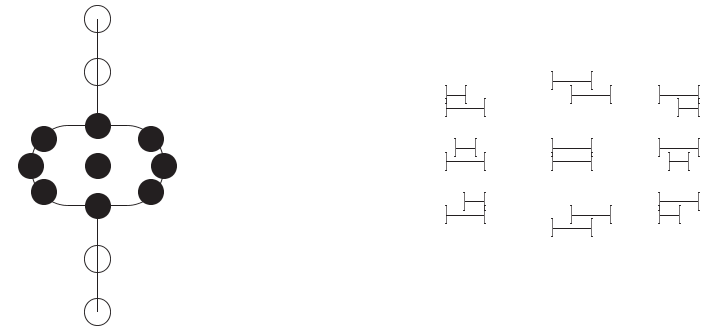
B.1 All possible temporal relations



- Note that the top interval corresponds to the situation described by the first sentence.

B.2 Open intervals

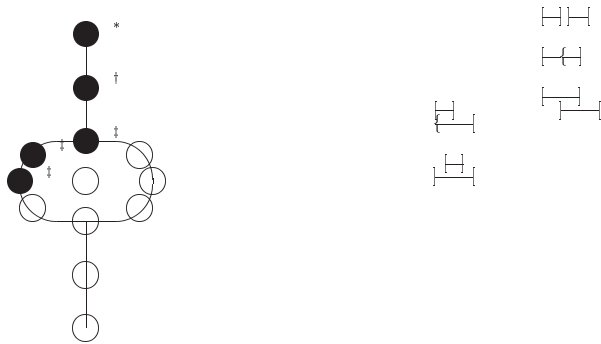
B.2.1 Two open intervals



- 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:
 $\square(\text{scenesetting}(\alpha, \beta) \rightarrow \text{contemporary of}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 contemporary of = [?, ?, <, >]

B.2.2 One open interval encounters a border

B.2.2.1 background



- * This constellation appears if the script knowledge supports a sequence:
 $\Box(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{before} = [<, <, <, \boxed{<}]$
- † World knowledge with respect to causation or termination of the *unbounded* situation is required here:
 $\Box(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\Box(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{meets} = [<, <, <, \boxed{=}]$
- ‡ Second situation backgrounds the first one:
 $\Box(\text{background}(\alpha, \beta) \rightarrow \text{survived by} \ \& \ \text{contemporary of}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{survived by} \ \& \ \text{contemporary of} = [?, \boxed{<}, <, \boxed{>}]$

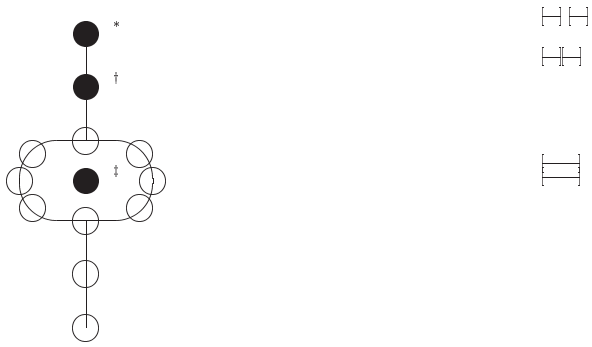
B.2.2.2 Reverse background



- * This constellation appears if the script knowledge supports a sequence:
 $\Box(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{before} = [<, <, <, \boxed{<}]$
- † World knowledge with respect to causation or termination of the *unbounded* situation is required here:
 $\Box(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\Box(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{meets} = [<, <, <, \boxed{=}]$
- ‡ First situation backgrounds the second one (i.e. *reverse* background):
 $\Box(\text{background}(\alpha, \beta) \rightarrow \text{older} \ \& \ \text{contemporary of}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{older} \ \& \ \text{contemporary of} = [\boxed{<}, ?, <, \boxed{>}]$

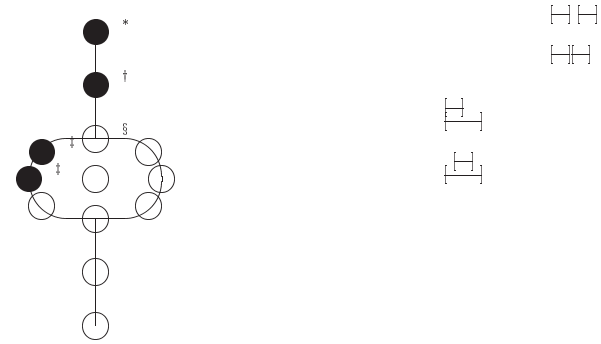
B.3 Punctual intervals

B.3.1 Two punctual situations



- * This constellation appears if the script knowledge supports a sequence:
 $\Box(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{before} = [<, <, <, \boxed{<}]$
- † When a situation is caused or terminated by the other one, the following constrains are valid, respectively:
 $\Box(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\Box(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{meets} = [<, <, <, \boxed{=}]$
- ‡ The second situation has to elaborate the first one and considering that these two relations are *punctual* the *equals* relation can be derived:
 $\Box(\text{elaboration}(\alpha, \beta) \rightarrow \text{superset}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$ $\text{superset} = [\boxed{\leq}, \boxed{\geq}, <, >]$
 $\forall s, s' (\text{punctual}(s) \wedge \text{punctual}(s') \rightarrow \text{LOC}(s) \{ \omega_1 \leq \alpha_2 \vee (\alpha_1 = \alpha_2 \wedge \omega_1 = \omega_2) \vee \alpha_1 \geq \omega_2 \} \text{LOC}(s'))$
(Lemma PU2) $\rightarrow R_1 \equiv = \wedge R_2 \equiv =$

B.3.2 A punctual situation followed by a durative one



- * This constellation appears if the script knowledge can be derived:
 $\Box(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{before} = [<, <, <, \boxed{<}]$
- † When a situation is caused or terminated by the other one, the following constraint is valid:
 $\Box(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\Box(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{meets} = [<, <, <, \boxed{=}]$
- ‡ 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:
 $\Box(\text{background}(\alpha, \beta) \rightarrow \text{survived by } \& \text{ contemporary of}(\text{LOC}(me(\alpha)), \text{LOC}(me(\beta))))$
 $\text{survived by } \& \text{ contemporary of} = [?, \boxed{<}, <, \boxed{>}]$
 $\forall s, s' (\text{punctual}(s) \rightarrow \text{LOC}(s) \{ \omega_1 \leq \alpha_2 \vee (\alpha_1 \geq \alpha_2 \wedge \omega_1 \leq \omega_2) \vee \alpha_1 \geq \omega_2 \} \text{LOC}(s'))$
(Lemma PU1b) $\rightarrow R_1 \equiv \geq$
- § 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:
 $\square(\text{narration}(\alpha, \beta) \rightarrow \text{before}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta))))$
 $\text{before} = [\langle, \langle, \langle, \langle]$
- † Appropriate world knowledge for triggering (or terminating) the following situation is required here:
 $\square(\text{result}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta))))$
 $\square(\text{termination}(\alpha, \beta) \rightarrow \text{meets}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta))))$
 $\text{meets} = [\langle, \langle, \langle, \equiv]$
- ‡ Second situation elaborates the first one which establishes a superset relation:
 $\square(\text{elaboration}(\alpha, \beta) \rightarrow \text{superset}(\text{LOC}(\text{me}(\alpha)), \text{LOC}(\text{me}(\beta))))$
 $\text{superset} = [\leq, \geq, \langle, \rangle]$
- § Borderline cases which are only required if a coarse convex relation is needed for representing.

Glossary

accomplishment (p. 10, 32) An \Rightarrow aspectual class or \Rightarrow situation type. This type is *durative* and *telic* (e.g. *to destroy*, *to create*).

achievement (p. 10, 32) An \Rightarrow aspectual class or \Rightarrow situation type. This type is *punctual* and *telic* (e.g. *to notice*, *to win*).

activity (p. 10, 32) An \Rightarrow aspectual class or \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*, *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 *fällen*, *legen*, *setzen* ('to fell', '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 *zaiigrat'* ('to start playing') via the prefix *-za*.

\Rightarrow 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

aspectual 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) "(T)he 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 aspectual 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) Sandström (1993, p. 63) defines this relation as a relation holding between two events e_1 and e_2 "by virtue of the state of e_1 , which is such as to make e_2 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 a situation which can consist of a *preparatory process* (⇒ *activity*), a *culmination* (⇒ *achievement*), a *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 ⇒ aspectual class or ⇒ situation type. This type is *punctual* and not *telic* (e.g. *to knock*, *to cough*).

situation (p. 114) A situation (or \Rightarrow 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. \Rightarrow situation type, aspect

situation type (p. 30, 31) Aspectual 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*. \Rightarrow aspectual class, Aktionsart (Germanic tradition)

state (p. 10, 32) An \Rightarrow aspectual class or \Rightarrow 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. \Rightarrow state

telic (p. 31, 118) This feature reflects the observation that a telic situation introduces a consequent state. \Rightarrow achievement, accomplishment, culmination

viewpoint (p. 30, 36) aspectual information understood as a view on a situation. Smith (1991) distinguishes three different viewpoints: *imperfective*, *perfective* and *neutral* (cf. \Rightarrow *open-perfective* viewpoint) \Rightarrow aspect, Aktionsart (Slavonic tradition)

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