

Institute for Language, Logic and Information

**TENSES, ASPECTS,
AND THEIR SCOPES IN DISCOURSE**

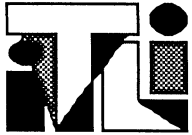
Renate Bartsch

ITLI Prepublication Series

for Logic, Semantics and Philosophy of Language LP-88-07



University of Amsterdam



Institute for Language, Logic and Information
Instituut voor Taal, Logica en Informatie

TENSES, ASPECTS, AND THEIR SCOPES IN DISCOURSE

Renate Bartsch
Department of Philosophy
University of Amsterdam

Part I: Analysis of scope phenomena and TENSE and ASPECT

1. Preliminaries: The model of regions, situations, and constellations
2. Examples for scopes of TENSE and time adverbs
3. The four notions: speech time, "Betrachtzeit", reference time, event time
4. PRESENT TENSE in German
5. The analytic future expression: PRES(*WERDEN*(INFINITIVE))
6. The analytic past expression: TENSE(*HABEN*(PERF(PART)))
7. The participles

Part II: Grammars with TENSE and ASPECT

8. An overview of tenses and aspects
9. Simplifications and reductions from situations to times
10. Flexible Grammars for handling scopes

Part III: References

Received May 1988

Correspondence to:

Faculteit der Wiskunde en Informatica
(Department of Mathematics and Computer Science) or
Roetersstraat 15
1018WB Amsterdam

Faculteit der Wijsbegeerte
(Department of Philosophy)
Grimburgwal 10
1012GA Amsterdam

realization of the concept. If we have a region on which the action concept "write a letter" is realized, the result of the action is achieved, namely at the final border. For action concepts maximal regions of concept realization are the only regions on which the concept is realized. If we have a maximal region on which the activity concept "be writing a letter" is realized, there are borders that close the activity of writing a letter, but the letter need not be finished, merely the activity is finished. The notion of a border does not preclude that the activity is taken up again at another region and might achieve its intended result then. All the parts of a maximal region of an activity concept α (and also of a non-resultative process concept and of a state concept, i.e. a [+dur,-res] concept) can trivially also be taken as "closed" in the weaker sense that they contain a border on which the concept is true. But this does not mean that they are closed with respect to α , they are α -open. Since this does not preclude that the activity (process or state) goes on outside the border of these weakly "closed" regions, the concept α cannot define the parts of the maximal region, though it does characterize them. They have to be defined by another concept β : This means that the subregions of a maximal region of α are not closed with respect to α , rather they might be closed with respect to β . Such a concept can be 'for three hours'. With this, 'walking for three hours', a [+dur, +res] concept, defines a closed maximal region, though this region need not be closed with respect to 'walking'. A concept can only define its maximal regions. These are the regions which are the α -closed regions. A concept α is realized at a space time region r if the space-time region on which α is realized overlaps with r . This means that the maximal region of α has at least a common boundary with r . - We shall see later that the notion even comprises immediate precedence of r with respect to the maximal region of α . Therefore ' α is realized at r ' is the weakest notion among these three. At the same time it is the basic notion of narrative connectedness between situations expressed by simple parataxis of sentences, and of the hypotactic connectedness by the connectives *als/wenn* 'when'.

What these definitions amount to is different for different aktionsarten: For a [+durative,- resultative] concept α (states, non-telic processes, activities) there are maximal regions on which α is realized. These regions do not contain parts on which α is not realized: every part of such a maximal region is also a region on which α is realized; i.e. the concept α is true of a maximal region and of every part of it. For a [+durative,+resultative] concept α (telic processes, actions, non-punctual events), the maximal regions on which α is realized are the only regions on which α is realized. This means that such a concept, if true on a region, defines this region in the sense that it delimits it together with its boundaries. Such a region has an interior on which the process or activity is realized that leads to the result expressed in the concept. The maximal region on which a [-durative] concept α (i.e. a punctual event) is realized is the smallest region, a point in the sense that it has no parts on which the concept is also true. It is interesting to notice that also [+durative, + resultative] concepts are not true on the parts of their maximal regions, and therefore in this sense their maximal regions have also been referred to as "points", for example by Kamp (1979). But I shall not adopt this terminology, because it is misleading. It does not take into account that the durative aspect of these concepts makes some part of these concepts, namely the included activity or process (for example "writing a letter" as a part of "write a letter") true on all the interior parts of a maximal region. The interesting property that the two [+durative] classes of concepts have in common is, that they can define a region, i.e. their maximal region, on which they are true. Therefore these concepts are always suitable to define this region as the distinguished region they are true of, especially to fix its time-projection. Besides this [+durative, - resultative] concepts may be true on a region without defining it. Only when they are used to characterize a maximal region they define this region at the same time.

The notion of a maximal region is problematic for concepts which express 'infinite' states and processes; here often either a begin point of the state can be fixed, but no end point (e.g. all PERFECTIVE verbs), or an end point, but no begin point (all WERDEN verbs, i.e. future expressing verbs). This plays a role with respect to the formation of the progressive form; we can form a progressive only of verbs designating a process or state that can be non-permanent with respect to its end point. All habitual processes are permanent processes, for example "The sun circles around the earth". Bach (1981: 78) distinguishes in this context two kinds of states, the temporary and the non-temporary ones. The first class contains, e.g., 'live', 'know', 'love' in its supposedly permanent stative meaning, the second 'hang', 'stand', 'live' in a non-permanent meaning such that we can form 'be hanging', 'be standing', 'be living', etc. And a similar

division can be made for adjectives.³ We can say that the non-permanent concepts can define a finite maximal region, the others only an open ended, or infinite maximal region. The simple tense form of a basic or complex [-permanent] verb defines a maximal region, i.e. a region that is closed with respect to the concept expressed in the verb. This means, verbs, whether in progressive form or not, can serve to fix a time interval or point as being their maximal interval, if the concept they express is [- permanent]. The last is always the case for progressive forms and it is never the case for perfective forms. Perfective verb forms can merely fix, as a distinguished time, the begin point of their maximal interval, but not the interval itself, because it has no end. Thus the state expression "John loved Mary" does not delimit a time, but "John ate his breakfast" or "John was sitting in his arm chair" do. The maximal region of a progressive simple or complex verb α -ing, i.e. an imperfective concept IMPERF(α), is closed with respect to that very concept, i.s. with respect to IMPERF(α), though it might not be closed with respect to α itself. This can happen, as has been stated above, if α is [+durative,+resultative].

For many purposes it is useful to be able to refer to the space-time region of a situation s , i.e. the maximal region on which the respective concept is realized, separately from the concept that defines the type of situation. This region r_s is the space-time projection of s . Besides this we can refer separately to the space-projection of s , i.e. its place or location l_s , and its time-projection, i.e. its time t_s . Then $r_s = (l_s, t_s)$, and $s = (r_s, c)$, where c is the situational concept or situation type. Inclusion, overlap, and union of situations are defined on the basis of the respective operations on the space-time projections and the situational structures of the involved situations. The situational structure of a situation s is the set of subsituations defined by the situational concepts that, with realizing c , are realized in s : each such concept singles out a maximal subregion on which it is realized, and forms together with this subregion a subsituation of s .⁴ This situational structure c_s is the realization of the concept realized on s . I also call the situational structure of s its 'conceptualization', meaning that the region of s is viewed in the light of a certain concept which is realized on it. One and the same region can be conceptualized differently and can thus carry two different situations, which, in extreme cases, would merely be regionally identical.

The notion of identity between situations is not a single one, but there are several relevant notions of identity:

1. Two situations are strictly identical if and only if their regions are identical and their conceptualizations are identical.
2. Two situations are weakly identical if and only if their regions are identical and the conceptualization of one of them is included in the other.
3. Two situations are partly identical, if and only if they overlap. (Note that the overlap concerns the region as well as the situational structure. The last means that they have common subsituations.)
4. Two situations are extensionally identical iff their regions are identical. They overlap extensionally if their regions overlap. This can be weakened to either, location or time.

A further important notion is that a certain event or situation s'' happens or takes place at another situation s' . This means that s'' takes place at the space time region of s' ; a special case is that s'' takes place in s' , which means that s'' takes place in the space time region of s' . These relationships can be weakened to either location or time. In this paper I shall consider them with respect to time, if nothing to the contrary is said explicitly. The relationships 'after' and 'before' are mainly restricted to time, but especially in narratives they are restricted to a scene, which means that also the local relationships 'at' or 'in' are involved.

³ The progressive cannot be applied to progressive forms, and also not to verbs that in their context clearly denote permanent processes or states because that would be tautological or redundant: a state or process that is known to be extending beyond the time of evaluation does not need to be marked for doing that. The use of the progressive presupposes that the situation referred to has an end, and it says that it does not have its end at the time of evaluation. Because the situation has an end the maximal situation can serve as a discourse referent that specifies time, for example *When did this happen? It happened while I was living in Berlin.*

⁴ Formal definitions of all these notions can be found in Bartsch 1981/1986.

A situation, for example one on which the concept "running" is realized, is described only partially by this concept, though it implies that in normal cases there is some human or animal that does the running. I assume that all which is part of what running normally is, belongs to the conceptualization that is imposed by the realization of this concept on the respective space-time region. This information is what we find in the lexical frame of the verb *run* in the lexicon. What is still missing in the description of the situation is, who is doing the running. And further we might want to know, how he runs, whether he wears running shoes, etc. The answers to these and other questions give rise to elaborations of the running situation and are conceptually more complex: They are weakly identical with the running situation. In the course of adding step by step information concerning the running situation we get a series of weakly identical situations where the previous one is included in the next, conceptually more complex one. If we have a discourse referent *s* introduced for a situation, let's say for the running situation, we start out with the condition 'running(*s*)'. An assignment *g* that assigns some situation *g*(*s*) to *s* satisfies this condition if and only if the realization of "running" is part of the known or perceived structure $c_{g(s)}$, i.e. of the conceptualization of *g*(*s*). If in the text further conditions are placed on *s*, *g*(*s*) has to satisfy those likewise. Instead of employing a sequence of situation markers *s'*, *s''*, *s'''* which denote weakly identical situations, where the following is a specification of the first, I just use one variable *s*: this variable stands for the whole equivalence class of weakly identical situations and can be understood as the total situation that is the limit of all the specifications of *s*, namely *s'*, *s''*, *s'''*, etc. The identity conditions for situations of the kind of *s* are given by the verb, like the identity conditions for kinds of objects are given by the respective nouns. The verb, like the noun, is the head of an endocentric construction of adding modifiers (adnominals, adverbials), specifiers (propositional and postpositional phrases and nominal terms in cases), and determiners (noun determiners, simple and complex ones, and verb determiners, i.e. tenses and their modifications). In a discourse, each verb characterizes its own situation.

Other than in Barwise and Perry's (1983) *Situation Semantics*, a situation is not characterized by a set of quite disparate sentences with different verbs, but by just one verb, simple or complex. The main finite verb defines the reference situation or reference situations of a sentence, which can stand in a constellation with other situations. If there are more verbs, negation, universal quantification or disjunction, we speak of a constellation of situations. A constellation that is bound together by local and temporal connectedness is a scene. And there are other noteworthy kinds of constellations, that are defined by other kinds of connectedness, e.g. causal, motivational, oppositional connectedness. 'Constellation' is the most general term, it can mean a constellation of constellations or of situations, and a situation is a borderline case of a constellation, which just contains one element. For example, all the situations that contribute to the verification of a universal sentence together form a constellation. Likewise, the speech situation together with possible reference situations (or verifying situations) form a constellation. It is such a constellation, which can make a sentence true.

A constellation is a structure consisting of entities, situations and relationships between them, namely a minimal set of entities and situations with a certain structure on this set such that it verifies a tensed expression. Let us consider the sentence

A man eats every hering

in the interpretation with a small scope for TENSE which amounts to the constellation that for a man in a certain situation there exists with respect to every hering in this situation an eating-event such that it is one in which the man eats the respective hering. The constellation is minimal in the sense that it only contains the entities mentioned and the situations mentioned. If the sentence is extended by, for example, *with a knife and a fork*, from the above set of verifying constellations those are chosen that also contain a knife and a fork such that in each situation of eating a hering the man uses the knife and the fork, if that phrase has broad scope with respect to *every hering*, or such that for each situation of hering-eating there is a knife and a fork, if that phrase has small scope with respect to *every hering*. A constellation that verifies the sentence *a man eats every hering with knife and fork*, in the above reading, comprises a constellation which verifies *a man eats every hering*. On the other hand we can say, a constellation that verifies the extended sentence is an extension of a constellation that verifies the unextended sentence.

Although we use in the representation language variables referring to total situations and thus take an ontological stand, in an epistemically adequate model we always have situations as they are perceived or known, and against these a text is evaluated for truth. Besides the internal specifications of a situation there are external ones by which the situation is considered in relationships with other situations. This way, we form constellations of situations; for these also notions of inclusion and (partial) identity are definable on the basis of the logical notion of consequence. For the time being, the model contains total situations to which the situational variables are assigned, like the entity variables are assigned to total entities. It is important to keep in mind that even for a total situation the verb defines this situation in the sense that it provides the kind of identity notion for this situation, like a noun does for an object. Furtheron it is relevant with respect to which concept a situation is characterized within a temporal scope: Tense introduces the situational discourse referent, and the situation it refers to is characterized by the verb and its modifications and specifications as far as these are within the scope of TENSE. This notion of characterization of a situation by a concept is important for aspectual and other temporal properties associated with the situation referred to. This kind of scope related partiality is compatible with treating situations as total in the evaluation of formulas.

The notion of 'situation' employed here strokes to some extent with the one in Situations Semantics of Barwise and Perry (1983), where a state of affairs is a set of partial information (i.e. a situation type) that holds in a space-time region, there 'location'. These partial states of affairs, called 'factual states of affairs', are distinguished from the actual ones which contain total (i.e. complete) information about everything that is and goes on in a space-time region. Evaluation of sentences with respect to a situation is, from an epistemological point of view, treated as checking the situation type for whether or not the information expressed in the sentence or its negation is part of it. To see whether a sentence is true with respect to a state of affairs amounts to checking into its situationtype that holds at the respective location. Though interpretation with respect to partial information seems to be necessary for giving a satisfactory semantics for propositional attitudes, I will not attempt to formulate such a semantics along the lines of Barwise and Perry (1983), and a well elaborated theory of partial interpretation which I just could adopt is not available yet.

An alternative to Barwise and Perry (1983) is the one of Data Semantics (Veltman 1985 and Landman 1986). According to this approach we could take partial situations 'provisionally' as total: We assume only two truth-values, 'verified' or 'not verified'. If a situation did not verify a condition, but does so when further information is added to it, we would not speak of the same situation, but of a new one, which is weakly identical with the first. Thus, a sentence that is not verified by a situation might be verified by one that is weakly identical with it. This then has to be a conceptual refinement of the first, i.e. the situational structure of the first has to be part of the structure of the second. This, of course, can only happen if the first situation did not contain information that contradicts the one given in the sentence to be evaluated.

For the time being, I shall use the semantics of Dynamic Predicate Logic (Groenendijk and Stokhof 1987), extended to a Ty2 Logic. This means that in the model we have to evaluate with respect to a total world, total situations, and total entities. This is quite correct under an ontological point of view as long as epistemic propositional attitudes are not considered. For those, we would need to consider situations, as far as they are believed to be known by the subjects of the propositional attitude at the moment of evaluation.

The logical Ty2 language I shall use has two low types, the type 'entity' and the type 'situation'. Although an entity can be described as a special type of situation, namely a connected path through space and time formed by situations on which the entity's properties are realized (c.f. for example Russell 1921), I take it to be a basic type (i.e. a soort) apart because of the unity which defines the whole individual such that we see it as the same as it appears in the different space-time slices we may consider. This notion of identity is different from the ones relevant for situations, and especially, for events, actions, states, processes and activities. It involves an identity of the individual between different space-time regions, established by the continuous realization of some 'essential' properties and a notion of continuous change that is compatible with the identity of the individual.

All untensed verbs, including untensed sentences as a special kind of complex verbs are predicates over situations. They are all translated into the form ' $\lambda s \alpha(s)$ '. This means, an untensed verb, and all modifications of it by adverbials or nominal complements, up to a whole untensed sentence, are of the same type, namely of type $\langle s, t \rangle$ ⁵. Tensing means, that a discourse referent of the type 'situation' is introduced (located according to the temporal concept included in the respective Tense) such that the situational concept $\lambda s \alpha(s)$ is applied to it, i.e. α is a condition on it. All nouns are translated into $\lambda x s \alpha(x, s)$, where x is of the type 'entity' and s of the type 'situation'. This means that nouns express two-place properties predicated about entities at a certain situation, i.e. of type $\langle e, s, t \rangle$.⁶ It is a situational slice of an entity of which the predicate is true. Thus, an individual of which it is true that he is a boy at a certain situation might at another situation later on be a man. Someone who is a patient at some situation may be a teacher at some other.

Tensing of verbs (infinitives) to create verbal terms is formally the same as determining nouns to create nominal terms by means of a determiner: discourse referents or hypothetical referents are introduced on which the concept in the nominal or verbal term is a condition, along with other conditions that might be included in the logical form of the determiner.⁷ Further conditions are placed on these by adnominal or adverbial modifiers and verb compliments. Instead of the existential and universal quantifier used in predicate logic I use only one 'quantifier', $[x]$, $[y]$, etc. which introduces a referent x , y , etc. and thus amounts to the existential quantifier. Like in DRT, the difference between the determiners *a* and *every* is expressed by the syntactic form: '*a*(A,B)' becomes ' $[x] A(x) \& B(x)$ ', while '*every*(A,B)' becomes ' $[x] A(x) \rightarrow B(x)$ ', where x is any newly introduced variable of type 'entity'. The variable introduced in the conjunction is a real discourse referent, while the one introduced in the conditional (and likewise in disjunctions and under negation) is merely a hypothetical referent. A real discourse referent can be coreferential with an anaphoric variable used further on in a text, while a hypothetical or conditional referent cannot be coreferential with anything outside its scope. The dynamic semantics is such that this is secured.⁸ Often, both kinds of referents are just called discourse referents, because their difference is merely due to the structure related to it; it is not a property of the discourse referent itself. The different structures related to it give it a different function in the further discourse. By itself it is just a variable introduced by a determiner, which can function as a discourse referent within certain subordinated structures.

2. Examples for scopes of TENSE and time adverbs

I shall not present a systematic treatment of time adverbs. Rather I shall treat some of them incidentally to point out certain scope properties of tenses and aspects. The advantage of having several possibilities for the scope of TENSE is that this permits us to treat coreference of situation-pronouns with the whole content of the scope of TENSE. Such a representation within a scope of TENSE refers to a situation, and especially an event. Consider the following examples:

Ein Mann löst jedem Jungen jede Aufgabe. Dies mißfällt dem Lehrer.

'A man solves for each boy every math problem. This (i.e. the whole situation) is disapproved of

⁵ s is the type of situations, e the type of entities, and t the type of the truth values.

⁶ They are of the relational type $\langle e, s, t \rangle$; $\lambda x s \alpha(x, s) = \lambda s x \alpha(x, s)$. From this relational expression the higher order functions $\lambda x \lambda s \alpha(x, s)$ or $\lambda s \lambda x \alpha(x, s)$ can be constructed.

⁷ This view is adopted in Bartsch (1987); it is a radicalization of Kamp's (1979) and Partee's (1984) position that tenses are a kind of determiners on untensed sentences. Determiners on nouns are relationships between nouns and verbs. Together with a noun a determiner forms a 'generalized quantifier', type $\langle (e, t), t \rangle$, mapping properties of entities on truth-values. Analogously, TENSE is a generalized quantifier of type $\langle (s, t), t \rangle$, mapping situational properties on truth-values. A similar type $\langle (i, t), t \rangle$ is assigned by Post (1987), where $\langle i, t \rangle$ is the type of temporal properties which are expressed by untensed sentences and also by temporal adverbs.

⁸ Besides the static conditional and the static universal quantifier there are also a dynamic ones in the semantics of Groenendijk and Stokhof (1988) which can provide discourse referents for anaphoric pronouns in the following text.

by the teacher.'

Here, *this* can be anaphoric to the whole preceding sentence. A suitable discourse referent is secured by giving TENSE broadest scope:

TENSE(Ein Mann jedem Jungen jede Aufgabe lösen).

(Note, that the sentence can also have fact-interpretations, no matter how broad the scope of TENSE is. These I shall treat later.)

Ein Mann löst jedem Jungen jede Aufgabe. Das kostet ihn viel Zeit.
'A man solves for a boy every math problem. This takes him much time.'

In this example, *das* 'this' is anaphoric to *löst jedem Jungen jede Aufgabe*. If we let TENSE have in its scope this phrase, there is one big situation or constellation in which a man solves every problem for every boy:

(Ein Mann (TENSE(jedem Jungen jede Aufgabe lösten))).

Consider next:

Ein Mann löst jedem Jungen jede Aufgabe, was dem jeweiligen Jungen gefällt.
'A man solves for each boy every math problem, which pleases the respective boy.'

Here, *was* 'which' is anaphoric to *jede Aufgabe löst*. If we take merely this phrase as being within the scope of TENSE we refer, for every boy respectively, to a situation in which the man solves every problem for this boy:

(Ein Mann jedem Jungen (TENSE(jede Aufgabe lösen)))

Another scope possibility is:

Ein Mann löst jedem Jungen jede Aufgabe. Das ist nicht immer einfach.
'A man solves for each boy every math problem. This is not always easy.'

Here, *das* 'this' is anaphoric to solving a single problem. The scope for TENSE is smallest:

(Ein Mann einem Jungen jede Aufgabe (TENSE(lösen))).

The application of TENSE with a certain scope means that the situation described by the phrase within the scope is referred to. Besides the interpretations mentioned the pronoun can also refer back to constellations, for example to one for the expression *jede Aufgabe (TENSE(lösen))*, or for the expression *einem Jungen jede Aufgabe (TENSE(lösen))*, or for the expression *(Ein Mann einem Jungen jede Aufgabe (TENSE(lösen)))*.

In fact-interpretations, a pronoun can refer back to a fact stated by a simple or complex tensed verb (verbal term: VT = V) in the preceding sentence, though not with an untensed verb (V^S). TENSE(*jede Aufgabe lösen*), for example, gives rise to different interpretations. The pronoun either refers to the fact that there is a situation in which every problem gets solved (i.e. the boy is pleased that there is a situation in which every problem is solved) or to the situation itself (i.e. the boy is pleased about the situation in which every problem is solved, for example by the elegance and quickness of the problem solving). If the pronoun corefers with the VT *jede Aufgabe(TENSE(lösen))* it refers to the fact that for every problem there is a situation in which it gets solved.

This means that a pronoun may not only refer to constellations or situations, i. e. be of basic type *s*, or to entities, i. e. be of basic type *e*, but it also may refer to a fact, namely that there are in the world certain situations or constellations of situations. On the DRS-level facts are expressed by discourse representations, i.e. constants, expressing propositions. Pronouns can be coreferential with constants. In a representation of a pronoun the identity with a constant is expressed, for example: [P] $P = \wedge \text{DRS}(\text{jedem Jungen}(\text{jede Aufgabe}(\text{TENSE}(\text{lösen}))))$ whereby *P* is a variable over propositions, especially facts. Note, that fact variables are of quite a different type than situational and individual variables. Their basic semantic type is "proposition", i.e. assuming possible worlds intensionality, they are of type $\langle w, t \rangle$. They are true propositions. We take the set of worlds in which the representation is true, to "be" the fact if the real world is a member of it. The difference between facts and, on the other hand, constellations, situations, and especially events, processes, and states can also be expressed in the following way: Facts are relations between representations (or semantically speaking: sets of worlds in which they are true, i.e. propositions) and the real world, established by true making assignments for the occurring situational and individual variables; but situations, events, states, processes, and individuals are in the real world, even though they can be referred to only by making use of conceptualizations that are dependent on linguistic and perceptual means of representation.

Before going into the treatment of TENSE let us consider some further data that require scope differences for TENSE, or, equivalently, a treatment by flexible type assignment with a fixed scope for TENSE, which then would get broadest scope. I use German subordinate clause word order, because this way we do not have discontinuous constituents, which would mess up a simple scope representation by parenthesis.

die Königin kurz vor dem zweiten Weltkrieg geboren wurde
 'The queen was born shortly before World War II'

According to the facts about Dutch history, this sentence can only be true if TENSE has small scope. It is the queen here and now, and not the one who reigned then, who was born shortly before World War II. The categorial structure should be:

(Die Königin(PAST(kurz vor dem zweiten Weltkrieg(geboren werden))))

or

(Die Königin((kurz vor dem zweiten Weltkrieg(PAST))(geboren werden))).

In the first version, the time adverbial modifies the verb, in the second the time adverbial modifies the TENSE-operator. Both versions lead to the same correct results, because in both versions the adverbial comes down to a condition on the event variable, i.e. are a restriction on the time-location of the event of birth. Instead of speaking of different scopes for TENSE two other options are possible here: 1. We take *die Königin* to be a deictic expression with *die* 'the' being bound by the speech situation. Then the phrase may be under the scope of TENSE, but is stable with respect to it, since it has no free situational variable. Or, 2. we use flexible type-assignment such, that *die Königin* in effect becomes 'de re' by t-raising⁹ the types of the arguments of the verb.

Similar examples can be constructed with FUTURE tense, but the facts are somewhat different with respect to TENSE+PERFECT, with TENSE:= PAST, PRES, FUT. The sentence

die Königin während des zweiten Weltkriegs in London gewohnt hat
 'The queen has lived in London during World War II.'

Here we refer to the queen now, namely Beatrix, and not to Wilhelmina. This sentence is a sentence in PRESENT TENSE and expresses PERFECT ASPECT. Tense, here PRESENT TENSE, determines the interpretation of *die Königin* if the latter is in its scope. Note that deictic interpretation of *die Königin*, or small scope of TENSE, would give the same result. The only thing that is excluded here is that *die Königin* is within the scope of the PERFECT operator, because that would make it refer to Wilhelmina. This would take away 'present relevance', because the topic of the sentence would not be part of the speech

⁹ cf. Hendriks (1987) and (1988) for the relevant kinds of type raising.

situation. An interpretation under the scope of PERFECT would be possible if "die Königin" would be understood as an institution, i.e. an individual concept. This also exists now and is presently relevant, but would get the extension Wilhelmina under the scope of PERFECT.

Since Present Tense in German can also be used in referring to something in the past if the 'Betrachtzeitpunkt' is separated from the speech time and transferred into the past ('historisches Präsens'), we can, in certain contexts, interpret the sentence with respect to the queen then:

Versetzen wir uns zurück in das Jahr 1946. Die Königin hat während des zweiten Weltkriegs in London gewohnt und ist nun zurückgekehrt.

In this text, we refer back to the queen in 1946, to Wilhelmina. But, in principle, such a piece of text could also refer to the queen now. The sentence could not refer to somebody who is queen during the time she lived in London, but is not queen anymore at the "Betrachtzeit" 1946. Imagine, Juliana would have succeeded Wilhelmina already in 1946. Then this sentence could not refer to Wilhelmina. According to Reichenbach's analysis of TENSE+PERFECT, the event has taken place before a reference point and the position of the reference point is determined by TENSE. For PRESENT tense he took the reference time to be identical with the speech time. This is not quite correct for German because of the broad use of PRESENT tense: the reference time merely has to be identical with the "Betrachtzeit", and the "Betrachtzeit" is identical with the speech time only if the text provides no other clues for the position of the "Betrachtzeit".¹⁰ The "Betrachtzeit" can be dislocated from speech time and with this the condition for the use of PRESENT TENSE is loosened to the condition "Betrachtzeit = Reference time = Event time". Only in the prototypical case of use of this tense is "Betrachtzeit = Speech time". But as a result of the following discussion, I shall dispense with the notion "Betrachtzeit". We have no need for it in our formal representation, though it has an intuitive explanatory value. Temporal expressions and narrative boundedness will capture what this notion has been made to capture in the literature on tense.

3. The four notions: speech time, "Betrachtzeit", referenc time, event time

The following text illustrates the employment of all four notions:

Die Königin wohnte während des zweiten Weltkriegs in London 'The queen lived in London during World War II' (event time₁ is during Betrachtzeit₁, which is World War II; Betrachtzeit₁ is before speech time). *Sie hatte bereits vor Beginn des Krieges den Umzug nach London geplant.* 'Already before the beginning of the war she had planned her move to London' (event time₂ is within Betrachtzeit₂, which is before the beginning of World War II, and before reference time₂, which is identical with event time₁; reference time₂ is before speech time).¹¹

With respect to the second sentence of this text, a potential reference time of PERF(α) is any part of the time at which she had made the plan, i.e. any part of time at which she has the property of having made the plan. The event time carries a restriction provided by the Betrachtzeit, the time before the beginning of

¹⁰ Fabricius-Hansen (1886) distinguishes next to Reichenbach's event time, reference time, speech time the 'Betrachtzeit' as a fourth category. The 'Betrachtzeit' is explicated by time adverbials (Bäuerle 1979). Bäuerle dismisses Reichenbach's notion 'reference time'. Eisenberg (1986) uses the concept "Betrachtzeit" instead of Reichenbach's reference time. Ballweg (1983: 250) uses the concept "Betrachtzeit" in his semantics of the German PRESENT Tense in the following way: PRES(α) is true if and only if there is a time interval e (event time) at which α is true, such that e overlaps with the "Betrachtzeit". There is no restriction on the position of the "Betrachtzeit" with respect to speech time. The "Betrachtzeit" may be identical with the speech time, but it can also be before (historical present) or after (prospective present).

¹¹ The second sentence can also be analysed with Betrachtzeit₂ = reference time₂ before reference time₁.

World War II, and the speech time is the time of utterance of the whole text. We see that in this example the "Betrachtzeit" does not play any essential theoretical role, it is just a condition on the event time.

"Betrachtzeit" only plays a role in the explanation of why German PRESENT TENSE can, besides for present events, also be used to report past and future events. In this explanation, the notion of "Betrachtzeit" makes it possible to provide a common property for the three major meanings of PRESENT TENSE: it expresses 'at the Betrachtzeit', as argued by Ballweg (1983). But this use of the notion of "Betrachtzeit" is another one, than the use of this term in the last example. There, the event time was restricted by a "Betrachtzeit" expressed by time adverbials. This now implies, that also for PAST TENSE the relationship "Speech time after Betrachtzeit = reference time = event time" holds, but by this condition also PRESENT TENSE would have to be appropriate as historical PRESENT: *Die Königin wohnt während des zweiten Weltkriegs in London*. In order to have a different condition of use for PAST and PRESENT, we would need to say that PAST TENSE has the condition "Speech time = Betrachtzeit, which has to be after reference time = event time". But then time adverbials like *during World War II* cannot define the Betrachtzeit. Thus, the use of the notion "Betrachtzeit" in the definition of PRESENT TENSE is not consistent with its use for the time singled out by a time adverbial. If we restrict it to being the time singled out by a time adverbial, the difficulty with the notion "Betrachtzeit" is that it is not always fixed by a time adverbial. The adverbial is often lacking when the PRESENT TENSE is used in referring to a future event: *Hans kommt nach Frankfurt* is just as appropriate as *Hans kommt bald (in zwei Jahren)* or *Hans kommt morgen nach Frankfurt*. Further, the notion "Betrachtzeit" is rather vague: With a sentence like *Hans kommt in zwei Jahren* the "Betrachtzeit" even seems to extend from the speech time to the event time, and this would justify the expectation that if such a "Betrachtzeit" would extend from the speech time to an event in the past, we also could use PRESENT TENSE instead of PAST TENSE, but that is not the case.

Hans kommt in zwei Jahren
 'John will come in two years'
 * Hans kommt vor zwei Jahren
 'John came two years ago'

To interpret a deictic adverb like *in zwei Jahren* or *morgen* 'tomorrow', we have to see the whole state of affairs from the point of view provided by speech time, and this therefore seems to be the "Betrachtzeit". This is different for adverbs that fix a date independently from speech time. But if we think of the deictic adverb 'tomorrow' as providing the "Betrachtzeit" for the event itself then this would not be compatible with the following fact: The adverbs *morgen* 'tomorrow' and *gestern* 'yesterday', which both would then fix a "Betrachtzeit", behave quite differently with respect to the use of PRESENT TENSE with respect to this Betrachtzeit:

Hans kommt morgen lit. 'John comes tomorrow'
 *Hans kommt gestern. lit. 'John comes yesterday'

The information that John came yesterday has to be expressed by PAST TENSE, though the information that he will come tomorrow may be expressed by PRESENT TENSE instead of FUTURE TENSE. Note, that what cannot be done in a simple report of a fact is appropriate in telling a story about a past event. This can be done in PRESENT TENSE:

Also: Hans kommt gestern in die Klasse und sagt zum Lehrer
 lit. 'Listen: John comes into class yesterday and says to the teacher

It is evident that a stylistic device is used to make the story vivid by creating a "Betrachtzeit" or an imagined situation of observation right at the time and place where the action is. If merely an information is exchanged, like that John came yesterday, there is no reason for creating such an additional situation of observation, the state of affairs is simply represented as being before the time of speech which also is the "Betrachtzeit". But then the question arises why we, after all, should assume a Betrachtzeit dislocated from the speech time when we interpret statements about future events. Why should we create a Betrachtzeit in

the future when we want to express facts about the future, without creating any vividness of report or narrative mood. These considerations make the use of the notion "Betrachtzeit" dubious as a means to explain the use of PRESENT TENSE.

The stylistic value of having an additional situation of observation established at right where the action is and looking at it from there instead of from the speech situation, and the unsymmetric behaviour of the use of PRESENT TENSE for past and future events, are arguments in favour of treating PRESENT TENSE in German as 'not marked for past'. This means it may refer to present or future events.¹² And it may refer to past events as long as it need not express that it refers to the past. This then explains the special stylistic value which the use of the PRESENT TENSE has in expressing past events, but which it does not have when it expresses future events. An additional "Betrachtzeit" is then not necessary in the semantics of tense. "Betrachtzeit" is merely a stylistic fiction: a copy of the speech situation is transferred to another time, for example right to the event, in order to become a situation of observation from where the event is described.

Something similar is true of 'inner speech' and the expression of contents of propositional attitudes in the past. It is important to notice that also in inner speech and in the expression of propositional attitude contents, presence and past are distinguished with respect to the situation of inner speech or expression of the attitude content by PRES and PAST tenses. In these cases we assume a secondary speech situation or propositional attitude situation, the position of which can be restricted by the adverbials that are taken to fix "Betrachtzeit" in the literature on tense in German (Bäuerle 1979, Fabricius-Hansen 1986). But these adverbials can simply be taken as temporal relationships and concepts that restrict the situations to more specific time intervals than can be done by just using the tenses. From these considerations, I conclude that the notion "Betrachtzeit" is not of use as a theoretical term in the logical representation of the tenses in German.

The Reichenbachian notion "reference time" will get another, but a clear meaning in our theory. Reference time is the time projection of the discourse referent that is introduced with tensing a basic or complex verb, and event time is the time projection of the discourse referent that is introduced with applying the basic verb. These two will not be identical if the verbs are aspectually marked. There is an unmarked relationship "AT" included in every analysis of TENSE. By this relationship the reference situation of a sentence is linked to an anaphoric or deictic reference situation. The anaphoric reference marker will be the main situational referent of the preceding sentence, or another available discourse referent. It is this anaphoric situational discourse referent which often is identical with Reichenbach's reference time. But it is not the reference time of the following sentences, which has its own reference time introduced by TENSE.

Other than Hinrichs (1986) I do not have a preceding sentence introduce a separate reference time, which would be the reference time of the following sentence. Each sentence has its own reference time introduced by TENSE, and these reference times are related automatically by the unmarked temporal relationship "AT". With this I can handle the examples Hinrichs uses in arguing for his separately introduced prospective reference time. If a situational referent introduced by TENSE is embedded in a conditional, disjunction, or under negation, which can happen if TENSE has small scope, either the closest available situational discourse referent will be used for the anaphoric binding, or we have a modal subordination¹³ by which the embedded situational referent of the preceding sentence becomes available for an anaphoric variable used in the analysis of TENSE in the following sentence.

4. PRESENT TENSE in German

In the Grammar of German, PRESENT TENSE has been referred to as the unmarked category, i.e. neither marked for past, nor for future (Eisenberg 1986, Ludwig 1971). This claim does not preclude that

¹² This is also the position of Vater (1975).

¹³ Cf. Roberts (1987). In modal subordination a following sentence is integrated under a conditional in the preceding sentence and can thus have anaphoric relationships with the referents introduced within the conditional. For example: *Every alcoholic gets sick. He develops a liver problem.* The second sentence has to be part of the consequence of the conditional that represents the first sentence. The *he* can be bound anaphorically. Groenendijk and Stokhof (1988) give a non-syntactic but purely semantic solution for this kind of binding from within a conditional.

PRESENT TENSE can be used in referring to events that took place in the past or will take place in the future, but it excludes that, whenever PRESENT TENSE is used in referring to such a past or future event it does not by itself express past or future. It also does not mean that PRESENT TENSE can be equally well be used for past, present and future. If misunderstanding can arise, past or future marking has to occur, be it by context, adverbials or tense morphology. In German Grammar 4 or 7 types of use of PRESENT TENSE are distinguished.¹⁴

I distinguish, following Helbig and Buscha (1974: 124 ff.) four main variants of meaning for PRESENT tense in German. It may refer to an existential or to a general temporally not restricted constellation of events or states, to an actual event, to a future event, or to a past event by anaphoric binding. The formal representations are:

$\lambda P[s_i] \text{ Truth}(s_i) \ \& \ P(s_i)$; or short: $\lambda P[s_i] P(s_i)$; this means s_i is a temporally neutral situation; the universal version of this is: $\lambda P[s_i] \text{ Truth}(s_i) \rightarrow P(s_i)$.

$\lambda P([s_i] P(s_i) \ \& \ s_i \text{ AT } s_0)$; this means that s_i is an actual event or state.

$\lambda P([s_i] P(s_i) \ \& \ s_i \text{ AT } s_j)$; the NARRATIVE PRESENT, whereby we get the HISTORICAL PRESENT if s_j is a past situation, the LIVE REPORT, if s_j is in the present situation, and a 'narrative' PLAN if s_j is a future situation.

$\lambda P([s_i] P(s_i) \ \& \ s_i > s_0)$; this means s_i is a future event

The common meaning of PRESENT TENSE in German is 'not marked for past'. If nothing to the contrary is said, the relationships between the situations are restricted to their respective time projections, i.e. we have to read them as \supset_t , $<_t$, and $>_t$. The variable 'P' is of the type of situational concepts, i.e. the type of simple or complex infinitives. Whenever these λ -expressions get applied to a situational concept this concept replaces P in 'P(s_i)' and ' λP ' gets cancelled. The event, process, or state described by the situational concept is then referred to by the discourse referent s_i , which has been introduced by TENSE, here PRES. For example, PRES(α) results by functional application into the following representations,

$[s_i] \alpha(s_i)$; $[s_i] \text{ Truth}(s_i) \rightarrow \alpha(s_i)$; $[s_i] \alpha(s_i) \ \& \ s_i \text{ AT } s_0$;
 $[s_i] \alpha(s_i) \ \& \ s_j \text{ AT } s_i$; $[s_i] \alpha(s_i) \ \& \ s_i > s_0$,

respectively.

Ehrich (1987ms) takes the identity of speech time, reference time and event time as prototypical for PRESENT TENSE in German, with an additional possibility of pushing the reference time, and with it the event time, forward or backward on the time axis. This assumption of a prototypical use of PRESENT TENSE seems reasonable in the light of the fact that the following sentences just express present states of affairs:

Hans schläft. 'John is asleep' (reaction: I am quiet.)
 Fritz hustet. 'Fred is coughing' (reaction: Let's get him a medicine.)
 Hans kommt um die Ecke 'John is coming around the corner'(reaction: watch out!)
 Fritz kommt 'Fred is coming' (reaction: Where? I don't see him.)

In a context like *Wer kommt zu dem Fest?* 'Who will come to the party?', the answer *Hans kommt* will

¹⁴ Wunderlich (1970), Ludwig (1971) distinguish 7, Helbig and Buscha (1974) distinguish 4 main uses.

be appropriate in German to express the future event. On the other hand *Wer kommt um die Ecke?* can only be understood as referring to a present event, except when, for example, discussing a play that will be played in which somebody has the role of coming around the corner. Then the question can refer to a future event that will take place when the play is performed.

We are far from knowing the conditions which govern the interpretation of sentences in PRESENT TENSE in German. Therefore I rather assume different semantic representations for PRES and thus take PRES to be polysemic, though with a common meaning. This will give too many interpretations, but the right one will be among them.

If we just take PRESENT TENSE in its weakest form, as for example Ludwig (1971) does, who takes as the basic semantics of PRES(α) that there is a situation describable by α , without any time restriction expressed by the PRES-morphology itself, we do well with respect to sentences like *Hans spricht Chinesisch* 'John speaks Chinese', which cannot not just mean that John has the ability of speaking Chinese without ever having spoken any Chinese, and thus requires that there is at least one situation where he speaks Chinese, as Ludwig (1971) argues. But then we have to derive all the other interpretations from this 'neutral' one, together with the respective context. This is the pragmatic approach, which since then repeatedly has found supporters¹⁵, and it would be the most elegant one if the derivation of the right interpretation could proceed formally. But we are far from being able to develop such a device of interpretation. Pursued informally, this approach seems easy enough. This very attractive approach that builds on a very weak semantics and the principle of adding information from the context or even adding non-expressed, missing, information in order to make the utterance relevant, not only leaves us with the task of developing a formal theory of pragmatics, but it also does not answer the question posed above: Why can we not express the information that John came yesterday just by *Hans kommt gestern* 'John comes yesterday'? A neutral present tense should permit this. But we can only use PRESENT TENSE here if we start a story, for example: *Hans kommt doch gestern in die Klasse und ...* Lit. Listen, yesterday John comes into the class and ...!

The last argument justifies scepticism with respect to the assumption of the 'neutral' meaning as the basic meaning of PRESENT TENSE. It leaves the position unimpaired that PRESENT TENSE in German comprises present and future situations, and does not mark past events as such. The broad usability of PRESENT TENSE in German has, of course, effects for the use of PRESENT PERFECT. 'PRESENT PERFECT(α)' can be true if α describes a situation before speech time, but also if it describes a situation that holds in the future.

Gestern habe ich diesen Brief geschrieben.
'Yesterday I have written this letter'
Morgen habe ich den Brief geschrieben.
'Tomorrow I will have written the letter'

But without a time adverbial that restricts the reference time, with respect to which the event is anterior, the PRESENT PERFECT does not relate to an event in the future. The sentence

Ich habe den Brief geschrieben
'I have written the letter'

can only mean that the letter is already written at speech time. This can be taken as an argument that the use of PRESENT TENSE, which is part of the compositional build up of PRESENT PERFECT, can only secondarily be interpreted as relating to some future event. PRESENT PERFECT only can relate to a future event if a future expressing adverbial or an anaphoric relationship restricts the position of the reference time with respect to which the event is a 'perfect' one as being in the future. The use of PRESENT PERFECT leaves open the possibility that the event has already taken place before speech time:

¹⁵ The last one I am aware of is Vennemann (1987).

Morgen hat Fred dein Auto repariert, vielleicht ist er sogar jetzt schon fertig. lit. 'Tomorrow Fred has repaired your car. Maybe he has finished the repair already now'

It is by pragmatic reasons that without explicitly opening that possibility, the sentence suggests that the car is not yet finished at speech time: because if it were and the speaker knew this it would be misleading, though not untrue, to refer to tomorrow as the time when the car is repaired.

Also FUTURE PERFECT needs an adverbial or anaphoric restriction on the reference time; without it an epistemic interpretation would be forced:

Morgen wird Fred dein Auto repariert haben. (FUT PERF.)
'Tomorrow Fred will have repaired your car'

Fred wird dein Auto repariert haben. (EPISTEMIC PERF.) 'Fred has probably repaired your car'

5. The analytic future expression: PRES(WERDEN(α_{INF}))

Vater (1975) has argued that there is no German future tense, which, by the way may be the reason why PRESENT TENSE systematically is used for referring to future events. The analytic form ' α werden' with α as an infinitive has, according to Vater, basically a modal meaning. From that, future can be derived as a special case. I think this is correct, though in some examples the meaning is clearly epistemic (or 'modal'), and in others it is clearly also 'future'. This is demonstrated in Ehrich 1987ms by the following examples:

Hans wird das Problem längst gelöst haben (EPISTEMIC PERFECT)
'John probably has solved the problem already'
Hans wird das Problem bald gelöst haben (FUTURE PERFECT)
'John soon will have solved the problem'

The second sentence also has an epistemic taste to it. This would be less so if a sentence is about first person and about an action about which no serious doubt can arise, as in the example given by Ehrich (1987ms): *Ich werde gleich meine Sachen packen* 'I shall pack my things immediatly'.

The use of *werden* in combination with adjectives that describe a state is aspectual: *krank werden* means to be in the process of becoming ill, i.e. be involved in a process that leads to the state of being ill. Likewise *werden* in PASSIVE constructions, like *geschlagen werden* 'get beaten', means to be involved in a process that leads to the state of being a beaten one, which is expressed by the STATE PASSIVE *geschlagen sein* 'be beaten'. The use of *werden* to express future events is related to these aspectual relationships expressed by the auxiliary verb *werden*, as well as to the epistemic use of *werden* as a modal verb. The aspectual meaning of *werden* is generally 'posteriority of the event with respect to a reference situation (reference time)'. This posteriority of the event can be expressed formally by

$$\text{werden}(\alpha) : \lambda s_i [s] \ s_i < s \ \& \ \alpha(s)$$

This concept is a process or state concept, [+dur,-res]; it is true of the process or state before the realization of α , but not of its resulting state described by α , nor of the whole consisting of process + result. This is what the notation '<)' is designed to express: 'up to the border, without including the border'. As a process or state concept it is also true at each part of its maximal region. We can apply PRES to it in order to fix the reference time as the time of speech, which must be a part of the maximal region of WERDEN(α) . This results into the formal representation of the ANALYTIC FUTURE:

$$\text{FUT}(\alpha) = \text{PRES}(\text{werden}(\alpha)) : (\lambda P([s_j] P(s_j) \ \& \ s_j \text{ AT } s_0))(\lambda s_i [s] \ \alpha(s) \ \& \ s_i < s) = [s_j] [s] \ \alpha(s) \ \& \ s_j < s \ \& \ s_j \text{ AT } s_0$$

Because of systematic reasons, we should also be able to apply PAST to *werden*(α) which would result in expressions like *Er wurde kommen*, and with respect to a past reference time from which on, for example, two hours are measured, *Er wurde zwei Stunden später kommen* 'He would come two hours later'. Both sentences are not grammatical in German, where instead one has to say *Er sollte zwei Stunden später kommen*, and in Dutch *Hij zou twee uur later komen*. Sentences of this form can have the temporal meaning PAST(POST(α)), i.e. 'posteriority with respect to a past reference situation', as well as a modal counterfactual meaning that permits a continuation 'But he didn't come'.

By the way, the analysis of FUT(α) as being composed of PRESENT TENSE and POSTERIORITY ASPECT (i.e. *WERDEN*-ASPECT) explains nicely, why it is not strange to iterate FUTURE TENSE in German, which for a real tense would not be possible at all. What in fact happens is not that FUT as a whole is iterated, rather the internal POST-relationship is iterated, while PRES, of course, cannot be iterated because it is a tense, and tenses are determiners. In analogy with *Hans wird krank werden* 'John will become ill', *Hans wird geschlagen werden* 'John will get beaten', we can also form *Hans wird kommen werden* which has no informational value above *Hans wird kommen*, and is therefore not very acceptable. But logically as well as morphologically these forms are possible, logically as PRES(POST(POST(α))), and morphologically because the German infinitive is marked, which makes possible *werden wird*, contrary to the parallel English 'will will', which is ungrammatical.

There is a common modal basis for both uses of ' α werden', namely that from all information available at the speech situation it follows that α has to be true.¹⁶ This epistemic modality can, in principle, be treated in Data Semantics (Veltman 1985): ' α werden' is true at a situation if and only if all possible extensions of this situation that are according to our expectations grow out into extensions at which α is true. The interesting fact now is that there are two kinds of extensions, one defining the strictly epistemic meaning and one defining the future meaning (with more or less 'epistemic flavour'). There are the kind of extensions that keep fixed the space time region of s and merely are possible refinements in conceptualization which are such that they are compatible not only with what we know, but also with what we expect. This means that the additional conceptual information about the situation that makes up these extensions is about an already existing situation: the expected situations are weakly identical with it. In this case we speak of an 'epistemic' interpretation. In the other case, the extensions are of a different nature: the time and possibly also the location are changed; there are courses of events, i.e. connected path of situations that grow out of the situation s in the course of time. They are temporal and spatial continuations of the situation s on which we have based our predictions about future development, according to our expectations. For us, reality is restricted to presence, and in some weaker sense to the past, but future is not a part of reality, though we know that it will be reality at some time. Future cannot be other than inferential, based on what we know about past and present and what we expect about the future. Belief about the future is epistemically based expectation.¹⁷

Before leaving the topic of FUTURE TENSE, I want to address the question whether the morphologically analytic construction of FUT with its corresponding semantics of "event time > reference time; reference time AT speech time" still is semantically productive, i.e. whether FUT is compositionally constructed according to this semantics, or whether FUT is just a simple FUT, symmetrical with simple PAST, such that we just have "event time = reference time > speech time", as we have "event time = reference time < speech time" for simple PAST, according to Reichenbach (1947).

If we take Ehrlich's position that PRESENT TENSE is prototypically analyzed following Reichenbach by

¹⁶ The term 'inferentialis' used by Vennemann (1987: 237) for this modal category seems very suitable to express this property. Vater (1975: 110 ff.) uses the term 'inferentielle Verwendung' of *werden* and 'inferentielle Modaliteit'.

¹⁷ This is what the interpretation of *werden* has in common with the semantics of expressions that express default reasoning, like *Tigers are dangerous*, as treated by Veltman in a lecture at the ITLI-colloquium in 1987.

"speech time = reference time = event time", and that historical PAST and FUTURE interpretations are just based on dislocations of the reference time from the speech time, we get the semantics of SIMPLE PAST and SIMPLE FUTURE, as characterized above. Simple FUT then would be morphologically expressed by morphological PRESENT TENSE in German, and this simple FUTURE is symmetrical with SIMPLE PAST. If this is so, we should be able to find a difference between the use of SIMPLE FUTURE and the use of the analytic future construction PRES(WERDEN(α)). This difference should show up, like differences show up between PAST(α) and PRES(PERF(α)). The following examples point to such differences.

Simple PAST: *Als Fred herein kam, hustete Hans.*

'When Fred came in, John coughed'

PRES PERF: * *Als Fred herein gekommen ist, hustete Hans.*

lit. 'When Fred has come in, John coughed'

But: ? *Als Fred herein gekommen ist, hat Hans gehustet.* (Southern dialect) lit. 'When Fred has come in, John has coughed'

Note however that the last two sentences are acceptable with *nachdem* 'after' instead of *als* 'when'. For the contrast of SIMPLE FUTURE and ANALYTIC FUTURE assume the following situation:

We are supposed to wait with having coffee:

Simple FUT: *Wenn Fred kommt, trinken wir Kaffee*

lit. 'When Fred comes we have coffee',

i.e.: 'When Fred will come, we shall have coffee'

analytic FUT: * *Wenn Fred kommen wird, trinken wir Kaffee.*

lit. 'When Fred will come, we have coffee'

* *Wenn Fred kommen wird, werden wir Kaffee trinken.*

'When Fred will have come, we shall have coffee'

The last two sentences are not acceptable in German, except in a conditional reading, which expresses that we are not sure whether he will come: "In case Fred will come, we shall have coffee". This is therefore an epistemic use of the analytic expression PRES(WERDEN(α)), and not an expression of FUT(α).

The FUT-interpretation can be forced upon those sentences, if we replace *wenn* 'when' by *sobald* 'as soon as'. But even then the sentences are not quite acceptable. The expression *kommt*, like simple Past *kam* refers to the closed event of Fred's coming, which can serve as a referent to which the temporal ordering relationship "ALS" can apply in one of its two arguments, and accordingly "WENN" with respect to future events. But the same is not true of *kommen wird* which refers to some state before Fred's coming. This state cannot serve as a referent for a temporal relationship of sequential order, because this would mean that we will have coffee within this state in which Fred is not yet here. Therefore only an interpretation as a conditional is possible. If we use "SOBALD" instead of "WENN", we refer to a pointlike event, which can only be the closure point of the maximal state that is characterized by the concept "KOMMEN WERDEN", namely the end point of this state, which is the beginning of the event characterized by KOMMEN, and this situation or point is temporally well defined by this concept and can therefore serve as an argument in a temporal relationship of sequential order. That *Sobald Fred kommen wird* is not quite acceptable can be explained by stressing that this distinguished point is not really part of the maximal situation of the verb *kommen werden*. In German one has to say *Sobald Fred kommt* in order to express a future event. A similar consideration holds for the use of "ALS" and "SOBALD" with respect to PRESENT PERFECT, where the first is not usable with the PERFECT while the second is: "SOBALD" refers to the distinguished point of the Perfective state, namely its begin point, which is the end point of the event under the scope of PERF. "SOBALD" establishes a temporal sequential order between a point like situation and any other situation, while "ALS" and "WENN" establish a temporal sequential order only between two closed situations, with the feature [+Past] and [+Fut], respectively. Otherwise it establishes

an overlap, and especially an inclusion.

The same difference shows up in the construction of FUT PERF, where FUT is expressed by PRES(*Werden*) and in the one where FUT is expressed by morphological PRESENT TENSE:

Simple FUT: Wenn Fred angekommen ist, werden wir essen.
 lit. 'When John has arrived, we shall eat'
 i.e. 'When John will have arrived, we shall eat'
 Analytic FUT: ?* Wenn Fred angekommen sein wird, werden wir essen.
 'When Fred will have arrived, we shall eat'

Note that the last sentence which is odd in German, is fine, if we replace *wenn* by *sobald*. This is due to the difference between WENN 'when' and SOBALD 'as soon as'. 'WHEN' refers to the reference situation of the first clause, which according to the analytic construction by "HABEN" or "SEIN", can be any state before the resulting state that comes about by John's arrival, i.e. it can be any part of the maximal state that precedes John's arrival in the analytic construction by "WERDEN". This would mean that we can eat any time before Fred has arrived, which is not at all what we mean. On the other hand, "SOBALD" restricts this reference situation to the distinguished part of the state, i.e. to the closure point of ANGEKOMMEN SEIN WERDEN, which is the starting point of the event of John's having arrived. Since "ARRIVE" is a pointlike event, this point collapses with John's arrival. This is a well defined reference situation.

6. The analytic past expression: TENSE(*HABEN* (α PERF PART))

I shall first discuss the use of PRESENT PERFECT in German and then provide a formal representation. The representation will, of course, be compositional and special attention will be given to the scopes of its two parts, TENSE and PERFECT.

In German, the PRESENT PERFECT can be used very well together with adverbials that indicate a past time in relation with the time of speech, probably due to the feature of 'present relevance', which Combric (1976: 60) took to be central for the distinction between PRESENT PERFECT and SIMPLE PAST.

Dieser Junge hat seine Schulaufgaben gestern gemacht, darum kann er heute spielen.
 lit. 'This boy has done his homework yesterday; therefore he may play today.'

The interesting question, of course, is what establishes present relevance, or more correctly, relevance at the anaphoric or deictic reference situation. There are at least the following points of relevance at a reference situation: 1. the result of the event described by α in PERF(α) holds at the reference situation and is made part of its conceptualization, 2. a further long term consequence of this event is at issue in the reference situation, 3. the event immediately precedes the reference situation such that it calls for a reaction in the reference situation. Furthermore, expressions referring to locations or participants of the event described by α are evaluated at the reference situation. In our example there are two things that are presently relevant: that we refer to a boy in the speech situation, and that a certain state or possible action in the speech situation is due to the state that is expressed in the form of PRESENT PERFECT.

In our example, *yesterday* should have small scope because it cannot have the anaphoric/deictic reference time (here: speech time) in its scope, and it even should not have PERF(α) in its scope, but just α , because it is the making of his homework that took place yesterday. *Yesterday* may not apply to that part of the resulting state that is reached by making the home work and which includes speech time ("he has made his homework" is true at the speech situation). It is this part of the resulting state to which the main situational discourse referent of the sentence refers. This means that this reference situation, characterizable by "PERF(*yesterday*(α))", is fixed temporally by TENSE, here PRESENT TENSE, which says that we refer to a part of the resulting state of doing his homework yesterday that is at speech situation. This part is

the reference situation which the whole sentence *dieser Junge hat gestern seine Hausaufgaben gemacht* refers to.

The situational concept 'PERF(α)' characterizes the maximal resulting state reached by or after realizing α , as well as any part of the maximal state, and this state or any part of it can be a potential reference situation, and its time projection a potential reference time.¹⁸ Tensing, often further restricted by a temporal clause or time adverbial, picks out the reference situation or reference time from these potential ones by introducing a situational discourse referent. The scope assignment for the above sentence is:

PRES(dieser Junge(PERF(gestern(seine Hausarbeiten machen))))

or

dieser Junge(PRES(PERF(gestern(seine Hausaufgaben machen)))).

If a phrase is not in the scope of TENSE it is just interpreted at speech time or at an other available anaphoric reference time. Therefore the scope difference for TENSE does not matter in our example. The time adverbial *gestern* is deictically fixed to the speech time and therefore it is stable under the scope of whatever TENSE operator (i.e. its interpretation does not depend on a TENSE operator). Compare the above sentence with the following, in which PAST tense is used.

In der letzten Zeit gab es einige Vorfälle in der Schule. Gestern beleidigte ein Junge seinen Lehrer. Er wurde darum nach hause geschickt. 'Recently several incidents happened at school. Yesterday a boy offended his teacher. He was sent home because of that.'

Here the scope of *yesterday* does not make much of a difference, but it would matter if the sentence contained a universal quantifier phrase like *every pupil*, because it then would be either every pupil who was in school yesterday, or every pupil at speech time, and these might partly be different pupils. Likewise, scope would make a difference, if *yesterday* would be replaced by *ten years ago*. With broad scope of this adverbial, the sentence would refer to someone who was a boy ten years ago, with small scope such that *a boy* would not be included, *a boy* would have to be interpreted with respect to speech time, and that could be inappropriate in referring to the offender then, who today may be a grown up man. We can use also PRESENT PERFECT in this German text. But then the text would sound a little childish, maybe because we would have to interpret the PRESENT TENSE as a historical present, which would be rather unmotivated, except if we create present relevance by coreference with someone in the speech situation, as in:

Vor zehn Jahren hat ein Junge seine Tante beleidigt. Es ist dieser Mann, und sie ist noch stets böse auf ihn.
lit. 'Ten years ago a boy has offended his aunt. He is this man, and she is still angry at him.'

In order to interpret *ein Junge* such that it can be coreferential with *dieser Mann*, we need either a broad scope for the time adverbial, or for the PERFECT operator, that would include *ein Junge*. Since this text is in PRESENT TENSE, the time adverbial has to be within the scope of the PERFECT operator, because otherwise the reference time which is the time after that event, namely the time in which the aunt feels offended would be restricted to ten years ago. Only if the text was in PAST TENSE, could a broad scope for this time adverbial give the right result.

Vor zehn Jahren hatte ein Junge seine Tante beleidigt. Sie wurde sehr böse. Es ist dieser Mann. Sie kann ihn noch stets nicht leiden. 'Ten years ago a boy had offended his aunt. She got very angry. He is this man. She still does not like him.'

Here, the reference situation of the second sentence is temporally and conceptually part of the maximal one that is the resulting state of the offence. It is the situation at which the aunt gets angry, and it is in the past. The difference of this treatment with the one of Reichenbach (1947) is the following: Instead of a

¹⁸ Venneman (1987) calls this time interval "Nachzeitigkeit", and it is what the Perfect-expression refers to, rather than the event described by the verb within its scope.

reference point I have a reference situation introduced by TENSE (PAST in this example, because the sentence is in PAST PERFECT) of which the concept $\text{PERF}(\alpha)$ is true. This is the reference situation of the first sentence. It comprises (temporally, and often also locally and conceptually) the event described in SIMPLE PAST (PRESENT, or FUTURE) by the verb β in the following sentence, or in the preceding or following main clause if $\text{PAST}(\text{PERF}(\alpha))$ is a subordinate clause introduced by *als* 'when'. The time of this event is Reichenbach's reference time for the first sentence, and it means that $\text{PERF}(\alpha)$ is true at this time, which is characterized by β in the following sentence.

The way Reichenbach uses the notion 'reference time' leads to complications in cases like the one above because the reference time of the first sentence is not provided before but after it, in the second sentence.¹⁹ In our approach, where each sentence defines its own situational reference situation, which is linked to the reference situation of the preceding sentence by "AT", no problem arises: If the reference situation of the first sentence, s' , is a state and the second, s , an event, "AT(s, s')" amounts to the inclusion of s by s' . If s' has to be interpreted as a closed state, the relationship amounts to immediate precedence with a common border, i.e. " $s' <| s$ ", like in *It was dark. John turned on the light.*

If we use SIMPLE PAST instead of PAST PERFECT, we have to assume a narrative structure of consecution of events, in order to get the temporal sequence right. Since the maximal situation described by $\text{PERF}(\alpha)$, as well as any part of it, always is a state, the action or event that is at it has to be within it and not after it, as it would be in a succession of events represented in SIMPLE PAST, where we refer to the act of offence itself and not to a part of the resulting state thereafter, as we do when using the PERFECT. But in both constructions, the event of getting angry (β) follows the first act (α).

A boy offended his aunt. She got very angry.

As a whole the difference between PAST PERFECT and PAST is as follows: Let A be the offence, B the part of the resulting state referred to by $\text{PAST}(\text{PERF}(\textit{offend his aunt}))$, and C the event of getting angry. The combination *A boy had offended his aunt. She got very angry* means that C occurs at B, which, since B is a state, amounts to B including C, while the combination *A boy offended his aunt. She got very angry* means that C follows A. The final result of both constructions is the same.

The fact that we take $\text{TENSE}(\text{PERF}(\alpha))$ to refer to a state that results from the realization of α , i.e. a situation of which $\text{PERF}(\alpha)$ is true, forces us to have within the scope of PERF all the modifiers and complements of the basic verb that have to be interpreted at the event which is the realization of the basic verb. α then is a complex verb that includes all these modifiers. *John has eaten a cake* requires that *a cake* is within the scope of PERF . If it were not, we would consider a situation that results from John's eating, the reference situation, in which there still would be something that is the cake, because *a cake* would have to be interpreted at the speech situation. Likewise, *a mile* has to be within the scope of PERF in the sentence *John has run a mile*. The same is also true of *fortwo hours* in *John has run for two hours*, and for *until now* in *John has run until now*. If we would not incorporate *until now* within the scope of PERF , the state that is the result of running would last until now; but this is trivial and is not meant in our example. Likewise *since two hours* has to be under the scope of PERF in *John has run since two hours*, if we mean that his running took two hours. Otherwise the state that is the result of his running would now last for two hours, which would mean that he stopped running two hours ago. In German, this second interpretation sometimes is the preferred one, for example in *Du kannst das Auto abholen. Es ist seit zwei Stunden repariert*. 'You may pick up the car. It has been repaired since two hours', or in *Fritz kann jetzt schwimmen. Er hat seit zwei Stunden gegessen* 'Fred may swim now. He has eaten since two hours'. The other interpretation, which is improbable in the context of being allowed to swim, would be 'Fred may swim now. He has been eating for two hours now.' The topic, mostly the subject term, has either to be interpreted at the reference situation at which $\text{PERF}(\alpha)$ is true, and not at the situation at which α is true, or at the speech situation, which can amount to the same. This means, the topic may or may not

¹⁹ This problem is inherited by Hinrichs (1986) and by Partee (1984) for those compound sentences where a subordinate clause introduced by *before* precedes the main clause.

be under the scope of TENSE.

It is interesting to note that this approach makes it unnecessary, and even wrong, to say that sometimes the perfect phrase refers to the time of the act that has been closed and sometimes to the time after that; it always refers to the time after that. Compare the following sentences:

Ich habe in Hannover gewohnt. 'I have lived in Hannover'
 Ich habe zwei Jahre lang in Hannover gewohnt. 'I have lived in Hannover for two years'
 Ich habe bereits zwei Jahre in Hannover gewohnt. 'I have already / once / lived in Hannover for two years'
 Ich habe bereits zwei Jahre in Hannover gewohnt und bleibe da auch wohnen. lit. 'I have lived in Hannover already for two years, and I shall stay there', or better: 'I have been living in Hannover for two years, and I shall stay here.'

In these three sentences we have the following respective scopes for PERF: PERF(in Hannover wohnen), PERF(zwei Jahre in Hannover wohnen), PERF(zwei Jahre in Hannover wohnen). The last two sentences may have the same scope for PERF: it does not matter when the state begins that is the result of living in Hannover for two years. I could have lived in Hannover from 1970 to 1972, which means that I am now already for 16 years in the state of having lived in Hannover for two years once in my life, or I could have moved to Hannover just two years ago. Then, no matter whether I continue staying there or not, I would now be in the state of having lived in Hannover for two years.

The last sentence can also have the scopes "(zwei Jahre(PERF(in Hannover wohnen)))", or in English "for two years(PERF(PROG(live in Hannover)))". This reading is the most probable one because of the presupposition of *bleiben* 'stay' in the following clause, which implies that the state previously mentioned holds at the time at which *bleiben* is interpreted. This is the speech time.

A third possibility of interpretation is suggested in the following context: To be eligible for a certain office I need to have been a citizen of Hannover for at least two years. Even if I have lived there or have been living there already for many more years I can say: *I have (already) lived in Hannover for two years; therefore I am eligible*. No matter of how much longer I have lived there, I have reached the state of already having lived there at least for two years. The scope assignment PERF(*live in Hannover for two years*) includes this possibility of interpretation.

The above considerations show that we have assigned a meaning to PERF that is consistent with the use of several kinds of adverbials with variable scope, such that PERF, TENSE, and time adverbials can be dealt with together in a compositional fashion.

In order to illustrate the difference between PRESENT PERFECT and PAST some more, I shall describe the interpretation of a couple of examples, which Eisenberg (1986) uses to explain the difference.

Es schneite. 'It snowed'

This sentence refers to an open or closed state in the past, which possibly is related to other past events, according to a context. Since it is a state it will include them.²⁰ If it is closed then, even if it is a state, other events may follow, for example with the following sentence *Dann klarte es auf* 'Then it cleared up'.

Es hat geschneit. 'It has snowed'

This sentence can be used when looking outside and seeing the earth covered white. The first sentence would not be adequate to comment on this fact. The second sentence refers to some part of the situation that is the result of snowing, such that speech time is included in it. Note that it is not required that snow is still on the ground; we can say *Es hat dieses Jahr schon geschneit* when snow is long gone. We are then, more

²⁰ These are the basic relationships according to Kamp and Rohrer (1983), Hinrichs (1986) and Partee (1984).

specifically, in the situation that it has already snowed this year, rather than in the situation that it has snowed. Without further specification we assume that the result is still perceivable or at least relevant at speech time, but the basic meaning of the perfect phrase does not exclude that the result is no more actual at speech time: *Es hat geschneit. Aber der Schnee ist schon wieder weggetaut.* 'It has snowed. But the snow has already melted'

Es schneite gestern fünf Stunden lang. Der Verkehr brach zusammen.
lit. 'Yesterday it snowed for five hours. The traffic broke down'

The sentence refers to the event of five hours snow fall which took place yesterday. This snow fall itself is the reference situation of the first sentence and the anaphoric reference situation of the second sentence, to which its reference situation is connected by the relationship "AT". On the other hand the corresponding sentence in PRESENT PERFECT, which is fine in German, refers to some part of the situation after the snow fall that took place for five hours yesterday. The speech situation fixes this reference situation as being a present situation:

Es hat gestern fünf Stunden lang geschneit. Darum ist auch jetzt noch der Verkehr behindert. lit.
'Yesterday it has snowed for five hours. Therefore also now the traffic is still impaired.'

The maximal interval of the state concept PERF(gestern(schneien)) as well as of the state concept PERF(gestern(fünf Stunden(schneien))) is the whole of today. The reference time that will be fixed by PRESENT TENSE has to be part of today and to include the speech situation. If the reference time would be part of the time indicated by *yesterday*, we would use PAST PERFECT instead of PRESENT PERFECT.

Es hatte gestern fünf Stunden lang geschneit. Der Verkehr war zusammengebrochen. 'Yesterday it had snowed for five hours. The traffic broke down.'

The first sentence refers to a situation that is part of the state that is the result of five hours snow fall. The sentence does not refer to the snow fall itself, though it relates its reference situation to this event. This event and the part of its result that is the situation referred to by PAST(PERF(*snow for five hours*)) are within the time restricted by *yesterday*. Within this part of the resulting state of snowing, the traffic broke down. The last sentence refers to the event of traffic break down. Here reference situation and event situation are identical, like in Reichenbach's analysis where simple PAST means that event time and reference time collap. Our last example shows how reference time of PRESENT PERFECT phrases, although it began the day before, can extend up to the next day:

Gestern hat es den ganzen Tag geschneit, und heute schneit es noch.
'Yesterday it has been snowing all day, and today it still is snowing.'

The sentence refers to a part of the resulting state of yesterdays snowing all day, such that this part is fixed as reference situation by the speech situation. It does not refer directly to yesterdays snowing, though it relates the reference situation to this event, as being part of the event's resulting state. The fact that we are in a part of the resulting state of yesterday's snowing (reference situation of the first sentence) does not preclude at all that snowing continues into the present day; in fact the second sentence refers to the situation of continued snowing, that takes place today, includes speech time and is contained in the reference situation of the preceding clause, which also comprises the speech situation.

The perfect phrase is constructed by means of the perfect participle of the head verb and an auxiliary verb, which can be either *haben* or *sein* in German. A rough rule, which refers to the distinction '[+transitive], [- transitive]', and the distinction of aktionsart [- durative] and [+ durative] (including the combination of durative with having a completion or result as an endpoint) reads as follows:²¹ Intransitive non-durative verbs take *sein* 'be', and intransitive durative verbs, as well as transitive verbs, take *haben*'have' as the auxiliary verb in order to form a Perfect Verb Phrase on the basis of their Perfect Participle. This formation

²¹ Cf. Eisenberg (1986).

of a morphological verb is a prerequisite for marking Tense morphologically. The morphological formation is as follows:

For basic verbs α the Perfect Participle of α is the Perfect of the verb α : $\text{PERF}(\alpha) = \text{PERF PART}(\alpha)$

For compound verbs $\alpha := X \beta$, the perfect of the compound is formed by
 $\text{PERF}(X \beta) = X \text{PART PERF}(\beta)$

The formal representation of $\text{PERF}(\alpha)$ is: $\lambda s_1 [s] \alpha(s) \ \& \ s_1 \triangleright s$;

the complex sign \triangleright means 'at or after the boundary'.

The maximal situation starts with the border and extends endlessly, if α does not contain a deictic or anaphoric temporal adverbial, i.e. if α is not something like '*gestern* β ' or '*den Tag davor* β ' 'the day before β '. Such an adverbial cuts out the part of the maximal situation of $\text{PERF}(\beta)$ that fulfills the adverbially expressed deictic or anaphoric relationship with the event characterized by β :

The representation of $\text{PERF}(\text{gestern}(\alpha))$ is:

$\lambda s_1 [s] \text{yesterday includes } s \ \& \ \alpha(s) \ \& \ s_1 \triangleright s \ \& \ s_1 \triangleright \text{yesterday}$

The representation of $\text{PRES}(\text{PERF}(\text{gestern}(\alpha)))$ is:

$[s_1] [s] s_1 \text{ AT } s_0 \ \& \ \text{yesterday includes } s \ \& \ \alpha(s) \ \& \ s_1 \triangleright s \ \& \ s_1 \triangleright \text{yesterday}$

This only can be made true by a situation s_1 that is at the speechsituation, is part of today, i.e. part of the day of the speechsituation, and is such that the day before, there is a situation of snowing. Only such a restricted interval has the property that the concept ' $\text{PERF}(\text{gestern}(\text{schneien}))$ ' is true on all its parts. This means that PERFECTIVE has to be applied with respect to all the situational concepts within its scope, also "yesterday" is such a concept, namely: λs "s" is the day before the day of s_0 . Application of the PERFECTIVE operator to this concept creates a concept that is true of every situation within the day following the end of the day s". The complete analysis is:

$[s_1] [s] s_1 \text{ AT } s_0 \ \& \ [s'] \text{ day}(s'') \ \& \ [s'] \text{ day} \ \& \ s' \triangleright s_0 \ \& \ s'' \triangleright s' \ \& \ s' \triangleright s \ \& \ \alpha(s) \ \& \ s_1 \triangleright s \ \& \ s_1 \triangleright s''$

If α is not restricted by deictic or anaphoric adverbs, the choice of a possible reference situation s_1 is free: it can be any situation that either starts at the end of the event s or is after it. A distinguished reference situation of which the concept $\text{PERF}(\alpha)$ holds is the final border of s , i.e. the situation on which the result of s has come about. This situation is a pointlike event. We therefore say that PERF is a closure operation, but this has to be understood right: *geschneit* 'snowed' characterizes the whole (maximal) situation that is the result of snowing as well as any part of it: it is true of the closing boundary of the event α , which is at the same time the beginning boundary of the resulting state $\text{PERF}(\alpha)$, and it is also true of all other parts of the resulting state. If the concept α is a restricted one, for example *zwei Stunden geschneit* 'snowed for two hours', at least in German, it does not preclude that snowing is going on further. The Perfect Participle Phrase *zwei Stunden lang geschneit* 'snowed for two hours' refers to a situation that is the result of snowing for two hours; it does not preclude that it continues snowing: *Nachdem es zwei Stunden lang geschneit hat, bricht der Verkehr zusammen. Es schneit noch weiter.* 'After it has been snowing for two hours the traffic collapses. It goes on snowing.' English here makes a distinction by systematic use of the Progressive form " $\text{PERF}(\text{for two hours}(\text{PROG}(\alpha)))$ ", which has to be used if snowing continues at the reference situation. In our example, both is true of the reference situation: " $\text{PERF}(\text{for two$

hours(PROG(α))", and also "Snowing".

This means that relational temporal adverbials, to which I reckon also the deictic and anaphoric ones, as well as the non-relational ones, e.g. the durative adverbs, are all temporal concepts to which the PERFECTIVE operator applies when they are in its scope. This is possible, because they are just situational, especially temporal, concepts. To such concepts PERF can apply by characterizing the time after their maximal interval. Thus, the maximal interval of the concept PERF(yesterday) is today, i.e. the time after yesterday such that it is at speech time. PERF(the day before) is the time after the day before such that it is at the anaphoric reference time. Thus

Fred came. The day before John had come

is interpreted as follows: The first sentence introduces a reference time, which because of SIMPLE PAST is its event time. This reference time is used in the second sentence anaphorically: Within the day before there was the event of John's coming. The PERFECTIVE now has as its maximal interval a time that is after John's coming and is after that day. The application of PAST to the second sentence picks out a reference time of that maximal time characterized by 'PERF(the day before(John come))', such that this reference time of the second sentence is at the anaphoric reference time, which means it is at the reference time of the first sentence. Here "AT" means that the reference time of the second sentence comprises the one of the first sentence. - In Reichenbach's terminology the event time of the first sentence, which is identical with its reference time, would be the reference time for the second sentence, such that the event time of the second sentence was on the day before it. The event time of the second sentence is the time at which John came, which is within the day before the reference time of the second sentence. - Our analysis requires the following scope for the second sentence:

PAST(PERF(the day before(John come))),

whereby the subject phrase can also have other scope possibilities. But note that, if the sentence would have been *The day before every man had come*, a small scope or broad scope for *every man* makes a semantic difference.

Generally, the the reference situation of a sentence is fixed by TENSE, and restricted by further temporal relationships, for example by the anaphorically bound relationship "AT". The concept PERF(α) is applied to the reference situation fixed by TENSE of its own sentence or clause. But this reference situation is related by the unmarked relationship "AT" or by another expressed relationship to the anaphoric reference situation, i.e. the reference situation of the preceding sentence or clause. The reference situation introduced by TENSE of a PERFECTIVE clause can be the distinguished point at which PERF(α) is true, namely the begin point of the resulting state of the event described by α , which is at the same time the final boundary of this event:

Zwei Stunden nachdem Hans gegessen hatte, war er wieder hungrig
'Two hours after he had eaten John was hungry again'

Here the beginning of the resulting state, or the closure of John's eating, is the reference time of the preceding subordinate clause and it is likewise the anaphoric reference time of the following main clause. The temporal relationship 'two hours after' says that the reference time of the main clause (starting with the beginning of John's being hungry) is two hours after the anaphoric reference time (i.e. the reference time of the preceding clause). Likewise we have:

Hans hatte das Licht ausgemacht. Es war stockdunkel 'John had turned of the light. It was pitch dark'

The reference situation of the second sentence, a state, is AT the resulting state of turning off the light. Hinrichs (1986) points out, for examples like

Hans machte das Licht aus. Es war stock dunkel 'John turned off the light. It was pitch dark',

that the state referred to in the second sentence does not incorporate the event referred to in the first. He uses this fact as one of his arguments for introducing an extra reference point right after the first event, at which then the state would hold. This, in fact, is unnecessary in our approach because the relationship "AT(s,s)" permits $s' < s$ also if s is a state, if that state is closed at its beginning. Likewise we have the other way around

Es war stockdunkel. Hans machte das Licht an. 'It was pitch dark. John turned on the light'

Here "AT(s,s)" amounts to $s' < s$, since the state s' is closed at its end.

The auxiliary verb *haben* or *sein* is semantically empty, it just has the morphological function of making a verb from the participle, which can be tensed and take congruence features. It can formally be represented by ' $\lambda P.P$ ', where P is a variable for (stative) situational concepts. Thus,

$$\text{AUX}(\text{PERF}(\alpha)): (\lambda P.P)(\lambda s_i [s] \alpha(s) \ \& \ s_i \mid > s) = \lambda s_i [s] \alpha(s) \ \& \ s_i \mid > s.$$

The PERFECT operator can have a broad scope, but it always has a smaller scope than TENSE, because TENSE is going to bind the concept in s_i to a discourse referent which then is the situation referred to by the sentence. PERF, though, does not include the topic of a sentence within its scope, which rather is bound to the reference situation, and specifically the speech situation in the standard use of PRESENT PERFECT. The following example can show this:

Dieser Mann hat als Junge gestohlen
This man, as a boy, has stolen.

Here *this man* has to be evaluated at speech situation and not at the time of stealing, while *as a boy* has to be evaluated at the time of stealing and therefore must be within the scope of PERF, such that it can be bound together with the event situation.

TENSE(PERF(α)) is built up compositionally by functional application:

If $\lambda P[s_j] P(s_j) \ \& \ \beta_{s_j}$ is the TENSE representation, whereby β is the temporal concept that relates the reference situation to the speech situation or to an anaphoric situation, then

$$\text{TENSE}(\text{PERF}(\alpha)) = (\lambda P[s_j] P(s_j) \ \& \ \beta_{s_j})(\lambda s_i [s] \alpha(s) \ \& \ s_i \mid > s) = [s_j][s] \alpha(s) \ \& \ s_j \mid > s \ \& \ \beta_{s_j}.$$

For PRES, PAST, and FUT we have $\beta_{s_j} : = s_j \text{ AT } s_0$, $= s_j < s_0$, and $= s_j > s_0$, respectively. For PRES there are, besides "actuality", which is listed here, also the other time concepts mentioned above.

Note that it follows from this analysis, that the following sentence can be interpreted in a meaningful way with two different scope assignments:

Gestern hatte es geschneit

has, for the scope PAST(PERF(*gestern(schneien)*)), the representation:

$$[s_j][s] \text{ yesterday includes } s \ \& \ \text{schneien}(s) \ \& \ s_j \mid > s \ \& \ s_j \mid > \text{yesterday} \ \& \ s_j < s_0$$

and for the scope PAST(*gestern*(PERF(*schneien*))) the representation:

$$[s_j][s] \text{ yesterday includes } s_j \ \& \ \text{schneien}(s) \ \& \ s_j \triangleright s \ \& \ s_j < s_0$$

The difference is that with the small scope for the temporal adverbial the sentence can be made true by each time interval before speechtime at which it is true that it has snowed and the snowing was the day before the day of speech time, while in the second scope distribution the sentence can be made true only by intervals which belong to yesterday and at which it is true that it has snowed before. This means that "Yesterday(PERF(snow))" is a concept which has as its maximal region only that part of the resulting state of snowing that is within yesterday. The PAST tense picks out some part of this restricted region as the reference situation of the sentence. This can be used further as an anaphoric reference situation by the following sentence. For example:

Gestern hatte es geschneit. Die Bahn fuhr nicht.
'Yesterday it had snowed. The train didn't run.'

The state characterized by the second sentence, especially the time of this state, is at the reference time of the preceding sentence, which must be yesterday after it had been snowing. Note that if the second sentence would be in present tense, we would be forced to a HISTORICAL PRESENT interpretation:

Gestern hatte es geschneit: Die Bahn fährt nicht. Die Straßen sind blockiert...
'Yesterday it had snowed. The train does not run. The streets are blocked....'

On the other hand, if the first sentence is not in PAST but in PRESENT tense, the present tense in the second sentence would be an ACTUAL PRESENT:

Gestern hat es geschneit. Die Bahn fährt nicht. Die Straßen sind blockiert
'Yesterday it has snowed. The train does not run. The streets are blocked...'

Though the acceptability of the the first sentence is doubtful according to schoolbook English, the sentence is fine in German. Present relevance is evident.

According to the treatment of PERFECT presented here, the two verb phrases

gestern geschneit haben 'have snowed yesterday'
gestern ein Gewitter gegeben haben 'have had a thunderstorm yesterday'

have the same maximal temporal extension, namely the whole of today: today we have the state of it having snowed yesterday and we have the state of having had a thunderstorm yesterday. But both states are not the same, they are merely temporally the same. These states, or situations, themselves are intentional entities that share the same region. The intension of the sentence can serve for restricting the intentional content, i.e. the conceptualization of the region as a certain situation. With respect to temporal or local predications only the region matters, but in causal or concessive statements it is the situation or state as a whole, not only its region. This we see in examples like:

Die Bahn fährt nicht, weil es gestern geschneit hat
Die Bahn fährt nicht, weil es gestern ein Gewitter gegeben hat.

What matters here, are the "conceptualized regions", i.e. "interpreted" parts of the world, where "interpreted" means: perceived and recognized by means of applying concepts to what occurs at a region. The region is partly "conceptualized" by a certain concept, if and only if the concept is fulfilled, i.e. is true, at the region. It can even be that yesterday's thunderstorm and the snowfall took place at the same time and location. Then

not only the regions of the two resultant states are the same, but also the regions of the two events. These can be comprised in one more complex event, but for our example it matters to distinguish these events, because it makes a difference whether the train does not go because a lightning struck the wires, or because there are masses of snow on the rails. The same holds for concessive connectives, like *obwohl*, *obgleich*, *trotz* 'although'.

7. The Participles

In the Perfect construction, use is made of the PAST PARTICIPLE, which is also used in the Passive construction. The logical representation of it will show why the same form can be used for both purposes. Further the PAST PARTICIPLE occurs within nominal terms as an adnominal, or positionally to a nominal term as an adterminal phrase. Likewise the PRESENT PARTICIPLE can be used in both these ways.

The traditional terminology suggests that PRESENT PARTICIPLE is always interpreted as referring to a present event and PAST PARTICIPLE to a past event. That is not true: the event represented in the Present Participle is located at a reference time provided anaphorically or deictically, or by TENSE of the sentence the participle is part of, and the event expressed within the Past Participle is located before this reference time. They are relative to whatever reference time is fixed. Only in special cases will the reference time be a present or a past one. Therefore it is more appropriate to change the terminology and speak of the 'imperfective' or 'progressive' or 'open' participle and the 'perfective' or 'closed' participle. I choose the terms 'PERFECTIVE PARTICIPLE' for what has been called 'Past Participle' and 'IMPERFECTIVE PARTICIPLE' for what has been called 'Present participle'. These names for the participles express what they are, namely forms that express aspectual properties.

The IMPERFECTIVE PARTICIPLE is morphologically *stam+end* in German, and *stam+ing* in English: *laufend*, *tanzend*, ..., 'running', dancing', ...

The situation described by this kind of participle is open with respect to the concept expressed by the verb of which the participle is formed.²² This means that in the following sentence it is not expressed that the letter gets completed in the situation referred to:

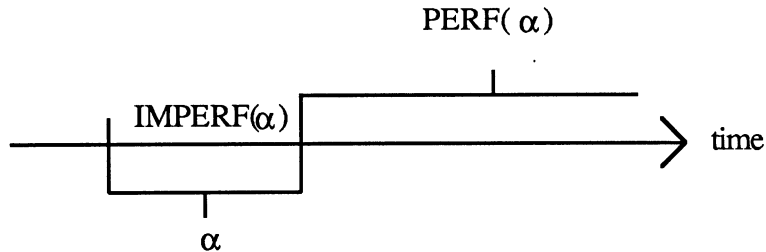
Ein einen Brief schreibender Mann saß am Tisch
'A man writing a letter sat at the table'

This means that the situation represented by the participle is represented without its borders at which the result of the action would be accomplished. The Imperfective Participle refers merely to the activity of writing a letter, but not to the action expressed by 'write a letter', which would include the accomplishment of the result. An action concept characterizes the interior together with the boundaries of the action, [+dur, +res], by an imperfective action, activity or state concept the boundaries are not included, [+dur, -res]. An imperfective situation concept maximally characterizes the interior, i.e. has as its maximal region the interior of the maximal region of the corresponding non-imperfective concept. Note that an imperfective concept is contrary to a perfective concept, but it is not its negation: A non-imperfective concept is not identical with a perfective concept. Rather we have three things, an unmarked or simple concept α , a concept IMPERF(α), and a concept PERF(α). The maximal region of a non-marked α consists of an interior together with a boundary, which means that the maximal region of α is closed with respect to α . The concept α is true of the maximal region as a whole, and it depends on the aktionsart of α , whether it is also true of every part of the maximal region. The concept IMPERF(α) is only true of the interior of the maximal region of α , and of any part of the interior. The interior is the maximal region of IMPERF(α). The concept PERF(α) characterizes the resulting state of α ; this means its maximal region consists of the end-boundary of α and all the time after that: PERF(α) is true on the end-boundary of α and on any stretch

²² These notions are treated in Bartsch 1986 with respect to the aspectual properties of Gerunds and other nominalisations in German and Dutch. They also apply to the English progressive.

of time that follows it. The maximal region of $\text{PERF}(\alpha)$ is closed with respect to $\text{PERF}(\alpha)$ at the beginning and open-ended, and is thus, from a certain time on, the region of a permanent state. The following drawing depicts the relationship between α , $\text{IMPERF}(\alpha)$, and $\text{PERF}(\alpha)$:

Schema 1:



The IMPERFECTIVE PARTICIPLE is also used predicatively in the PROGRESSIVE construction. Thus "writing a letter" is the activity included as the inner part in an action expressed by *write a letter*. An inner part can exist, even if the action is never completed; in such a case the boundaries of the action α are never reached (i.e. *has written a letter* is never true); instead, of course, and end has come to writing a letter, but then the situation is merely closed with respect to the activity concept "writing a letter" and not with respect to the action concept "write a letter". The action concept "write a letter", in fact, consist of the activity concept $\text{IMPERF}(\alpha)$, "writing a letter", and the beginning of the resultant state $\text{PERF}(\alpha)$, "have written a letter". The openness or closedness of a situation with respect to the characterizing concept is marked in the formal representation by the superscript 'o' for 'open' and 'c' for 'closed'. A [+res] concept α is only true of s if s is closed with respect to α . Thus $\alpha(s)^o$ cannot mean that α is true on s , but merely that on s it is true without its result. A [+dur,-res] concept β , for example $\beta = \text{IMPERF}(\alpha)$, is true of an β -closed as well as a β -open interval. Note that 'Write a letter(s)^o' = 'Writing a letter(s)^o', but 'Write a letter(s)^c' \neq 'Writing a letter(s)^c', i.e. closure with respect to α is different from the closure with respect to $\text{IMPERF}(\alpha)$, except for [+dur,-res] concepts. That there is no imperfective concept for [-dur] concepts follows from the definition of the operation IMPERF.

The logical representation of the IMPERFECTIVE PARTICIPLE is:

$$\text{IMPERF PART}(\alpha): \lambda x s_1 [s] R_1(x,s) \ \& \ \alpha(s)^o \ \& \ s \supset s_1, \quad \text{with 'o' = 'open'}$$

This formula implies that s_1 may be open or closed with respect to $\text{IMPERF}(\alpha)$, but must be open with respect to α . This is an important fact, because it gives a proper semantics to sentences like:

John was writing a letter, when he was struck down

The letter writing was closed the very moment he was struck down. At this closure point the IMPERFECTIVE(α) is still true, as long as it is not the closure of α . The same is true of the following sentence, where the first part can express a closed state.

It was pitch dark, when John turned on the lights.

If we want the first part to express an open state, we have to formulate:

It remained pitch dark when John turned on the lights.

Here it stays dark; the reference situation of the second clause, i.e. the event of turning on the lights, is

properly included within the maximal time interval of the state expressed in the first clause.

Note that from " $\text{Open}(s, \alpha) \ \& \ s \supset s_i$ " it follows that " $\text{Open}(s_i, \alpha)$ ". The imperfective concept is true of the interior of the maximal region of α , and of any part of this interior. The s_i will be bound by TENSE. As already mentioned, it is important to notice that ' $\alpha(s)$ ' does not in general imply that α is true of s ; this is only so for [+dur,-res] concepts. An [+dur,+res] concept is true on s if and only if s is closed with respect to the concept. Therefore, the unmarked notation $\alpha(s)$, meaning ' α is true on s ' implies for [+res] concepts α that s is closed with respect to α .

The present participle occurring in or with a nominal term is interpreted at the reference time of the verb phrase to which the nominal term is a complement. If TENSE has broad scope, this means that with a verb phrase in simple PAST TENSE, the participle is interpreted at the event time, because this is identical with the reference time. It is not interpreted at the event time with a verb phrase in PRESENT PERFECT; there the reference time comprises the speech time, and the participle has to be interpreted there, like in *the singing man has entered the house*. But consider:

A singing man entered the house.
 A man, singing the national entym, entered.
 The man , singing the national entym, entered.

In these sentences in simple PAST, the subject nominal term refers to someone who at the event time is a man and is singing. The above sentences cannot be used in referring to someone who was a boy at event time and is a man now, at speech time. There has to be an overlap between the singing, being a man, and the entering, whereby the tense that is marked on the verb *enter* determines the reference time which is in the case of PAST TENSE identical with the event time, i.e. the time for entering, and the nominal terms are interpreted at that time. This also means that PAST here has broad scope. In case the verb expresses an event that still has significance in the speech time, PAST TENSE can have a small scope and then the participle can be interpreted at speech time, as in the following sentences which can refer to a man sitting in the waiting room of a doctor and smoking:

Der stark rauchende Mann hatte vor zwei Jahren einen Herzinfarkt
 'The heavily smoking man had a hart infarct two years ago'

Such an event creates a situation that is still important for a patient, it is a kind of 'standing' fact about him. In such a case, the PRESENT PERFECT is preferred, because it explicitly refers to the resulting state or 'standing' fact that is created by the event. In the PRESENT PERFECT the participle is interpreted also at reference time, which is at speech time:

Der stark rauchende Mann hat vor zwei Jahren einen Herzinfarkt gehabt.
 lit.'The heavily smoking man has had a hard infarct two years ago.'

Also the PERFECT PARTICIPLE is bound by the reference time, introduced by TENSE:

Der beleidigte Mann bleibt/blieb ruhig
 'The offended man remains/remained calm'

Before the reference time the offence took place, and at reference time the resultant state holds. The concept that characterizes the state resulting from α is:

$$\text{PERFECT}(\alpha) = \lambda s_i [s] \alpha(s) \ \& \ s < s_i$$

This concept is true on every time point or interval that follows the event. This means it characterizes the maximal period of the Perfect Participle, which is unlimited to the right, and any part of it. Parts of this maximal reference period are the possible reference times, which are fixed by context or speech situation,

and, of course, the concept $\text{PERF}(\alpha)$ is true on these reference times s_i ; before or at s_i the event s has taken place.

The PERFECTIVE PARTICIPLE can occur as ACTIVE or as PASSIVE participle:

$$\begin{aligned}\text{PERF ACT}(\alpha) &= \lambda x s_i[s] R_1(x,s) \ \& \ \alpha(s) \ \& \ s <| s_i, \quad \text{with '<|': before/at} \\ \text{PERF PASS}(\alpha) &= \lambda x s_i[s] R_2(x,s) \ \& \ \alpha(s) \ \& \ s <| s_i\end{aligned}$$

The PERFECT PASSIVE PARTICIPLE is used predicatively to characterize the resultant passive state, the 'state passive', for example in *John is beaten*. Analogously to the 'state passive' *be beaten* we can speak of *have beaten* as characterizing the resultant active state, the 'state active': both are states that are the result of an action, one is the state of the actor participant, i.e. the R_1 -participant, the other is the state the passive participant, i.e. the R_2 -participant.

In German, state passive and state active are likewise expressed by α *sein* and α *haben*, respectively. But other than in English, *sein* is also used with Perfect Participles of intransitive [-dur,+res] verbs to express the state of the R_1 -participant that resulted from the realization of α . These are *fallen*, *ankommen*, *explode* 'fall', 'arrive', 'explode', etc.²³. These [-dur,+res] verbs characterize punctual events with a result, and by them no activity is reported that has led to the result. It is apparently an activity, which requires the auxiliary *haben* in the representation of the 'active state' instead of *sein*, and which is absent in achievements or punctual events. According to this point of view I classify iteratives like *tröpfeln*, *räuspurn*, *husten'drip*, 'clear one's throat', cough' basically as activities, i.e. [+dur,-res], though discontinuous ones. A discontinuous [+dur,-res] concept is true of its whole maximal time interval and of all its parts that contain at least one instance of a minimal realization of the concept.

The PROCESS PASSIVE is formed on the basis of the STATE PASSIVE, as can also be seen from its historical origin in German: *geschlagen sein* 'be beaten' has been *geschlagener sein* 'be a beaten one', and the process passive *geschlagen werden* 'get beaten' is *ein geschlagener werden* 'become a beaten one'. Here, the aspectual verb *werden* 'become' says that the situation referred to is such that it will end with a resultant state which is described by the State Passive:

x wird geschlagen 'x gets beaten' is true on s if and only if s has a closure on which *x ist geschlagen* 'x is beaten' is true.

The verb *werden*(α) characterizes a situation that develops such that the result α will be achieved at its closure.

$$\begin{aligned}\text{PROC PASS}(\alpha)(x) &= \lambda x s_i [s] \ s_i <| s \ \& \ \text{PERF PASS}(\alpha)(x)(s) \\ &= \lambda x s_i [s] \ s_i <| s \ \& \ [s'] R_2(x,s') \ \& \ \alpha(s') \ \& \ s' <| s\end{aligned}$$

Since s is the result of both, s' and s_i , and $s_i \supset s'$, the finite process s' singles out a substate from the maximal state of which the above concept is true. This means that these parts of the WERDEN-concept, that has an open beginning, are singled out as the parts at which the process α is taking place. Therefore the above reduces to: $= \lambda x s_i \cdot s_i = s' \ \& \ [s'] R_2(x,s') \ \& \ \alpha(s')$.

This is equivalent with the concept: $\lambda x s_i \cdot R_2(x,s_i) \ \& \ \alpha(s_i)$.

²³ Vendler's (1967) achievement verbs.

Thus we have derived that the PROCESS PASSIVE concept is equivalent with the concept α in conjunction with its passive participant relationship. This is a nice result that shows how the PERFECT PARTICIPLE can be used compositionally in expressing the passive voice as well as the perfective aspect.

The participles that can be combined with German *sein* can also be used adnominally, like in *der zu spät gekommene Junge mußte warten* 'the boy who came to late had to wait', or *der geschlagene Junge weinte* 'the boy who was beaten cried'.

Finally, I want to mention that parallelly with the iteration of the analytic Future expression WERDEN in German, there is also an iteration of the PERFECT :

Hans hatte schon gegessen gehabt, als Peter kam.
lit. John had already had eaten when Peter came.

The fact that PERFECT is an aspect and thus not fixed to the speech time by itself but rather relates to some reference time, makes iteration possible by again relating the reference time at which PERF(α) is true to a reference time at which PERF PERF(α) is true, which in our example is in the past. There is a PRES+PERF+PERF possible in German, like there is a PRES+WERDEN+WERDEN. Of course, semantically they come down to just PRES+PERF and PRES+WERDEN, respectively, and are thus mere redundancies.

Tenses are quantifiers (one-place determiners), and can, as such, not be iterated.²⁴ This is due to the fact that tenses introduce a referent and relate it to the time of speech. Aspects are much weaker: they are not determiners but rather temporal concepts which modify a situational concept by relating its instantiations to other undetermined situations such that we get a temporally complex situational concept that characterizes these yet undetermined situations. At least one out of these undetermined situations which form the extension of the complex concept later gets determined, i.e. singled out, by TENSE. In this way, aspects are modifiers on a situation concept expressed by a verb, and thus are like adverbials, analogously with a certain subclass of adnominal modifiers on a concept expressed by a noun. These nominal modifiers are fairly artificial modifiers, like "part of" that can be applied to a noun, e.g. *house*, in order to express the concept "part of a house". The indefinite determiner is required in English and German, but it would not be expressed in languages which have a partitive case, like Finnish. The indefinite determiner, of course, corresponds to the event discourse referent introduced in PERF(α). The aspects, and also these adnominals, do not preserve the head variable of the construction they are applied to as the head variable of the compound construction, but rather form a concept in another variable that is the new head variable, which will be tensed or bound by a nominal determiner, respectively. Other adverbials and adnominals preserve the head variable: they are merely further conditions on this variable. Aspects and adnominals like "part of" define a transgression to a new head variable, while the old one is bound by an existential quantifier. As far as the head variable goes, they are therefore not endocentric, but exocentric constructions. As far as categorial grammar and types go, they all are endocentric, i.e. preserve the category of the head as the category of the whole complex expression.

²⁴ Note, that *many*, *few*, and the numerals are basically not quantifiers or determiners, they are rather adjectives, and especially adnominals. In *four men come* we have an indefinite determiner which is morphologically not realized, but can be expressed by *some*, like in *some four men come*. The numerals are analyzable as adnominals, but alternatively, they can also be analyzed as modifiers on determiners, by which we get complex determiners: *the four*, *the many*, and *(some) four*, *the four*, *all four*. Categorial grammar, in principle, allows for both views: these adjectives can be used as noun modifiers or as determiner modifiers. The semantic result, finally, is the same.

8. An overview of Tenses and Aspects

The main four uses of PRESENT TENSE in German, in accordance with its meaning 'not marked for Past', are the following:

1. NEUTRAL: There is an event time, without any temporal specification, i.e. just tautological specification, given by TENSE.

PRES(1)(α) : [s] TRUTH(s) & α (s); or shorter: [s] α (s)

2. PRESENT: speech time at event time

PRES(2)(α) : [s'] AT(s', s₀) & α (s')

3. SIMPLE FUTURE: speech time < event time

PRES(3)(α) : [s'] s₀ < s' & α (s')

4. NARRATIVE : anaphoric reference time at event time

PRES(4)(α) : [s'] AT(s', s) & α (s'); historic if s' < s₀, live report if s'=s₀, narrative planning if s' > s₀

A special case of PRES(4) is that s' is in the past, 'historical present', another special case is that s' is in the present, 'live report', and a third is that s' is in the future, 'narrative planning'. s' is the anaphoric reference situation of a sentence, introduced by TENSE in the preceding sentence as its own reference situation, and s'' is the reference situation introduced by TENSE of the analyzed sentence itself. We thus have an anaphoric reference time (back reference) and the reference time of the sentence itself. In the unmarked case, these two are related by 'AT', if not specified otherwise. The discourse referent s'' is the variable newly introduced by TENSE. The temporal relation 'AT' is a weak relationship : it permits temporal overlap, inclusion, identity and immediate precedence between s' and s''. If one of them is [+dur] and the other [-dur], then the [-dur] situation is temporally included in the [+dur] situation, if it is open. If the [+dur] situation s' can be interpreted as finally closed then s'' can immediately follow s' such that it has a common border with s''. For example: *It was dark. John turned on the light.* If s' is punctual and s'' [+dur] and can be interpreted as initially closed, then s'' follows s' such that they have a common border. For example: *John shut off the light. It was dark.* If both are punctual events/acts, i.e. [-dur], then s'' follows s', if both are [+dur] there is an overlap. If both are [+dur,+res] also a succession is possible.

I do not follow Partee 1984, and Hinrichs 1986 in assuming that a sentence provides a reference time for the event described in the following sentences. Partee (1984:254) follows Hinrichs: "Hinrichs proposes that each new past-tense event sentence is specified to occur within the then-current reference time, and it subsequently causes the reference time to be shifted to a new reference time which *follows* the just introduced event." Against this, I rather have TENSE in each sentence introduce the main situational referent of this sentence (in case of the simple tenses this is the referent characterized by the basic verb, in Reichenbach's terminology 'the event'). The main situational referent of a preceding sentence, i.e. the one introduced by TENSE there, provides the anaphoric reference situation or time for a following sentence. If TENSE is under the scope of some universal quantifier, i.e. is part of a conditional the situational referent introduced by it is not a discourse referent on the main text level. It is not accessible anaphorically by a sentence that is simply conjoined. For a following, simply conjoined sentence, the closest available situational discourse referent can function for anaphoric binding, or the sentence has to be interpreted as an explication of the conditional, being part of the conditional consequence, like the examples of 'modal subordination' by Roberts (1987). In the 'hyperdynamic' semantics of Groenendijk and Stokhof (1988) anaphoric binding into a following sentence is possible in cases like these in a compositional manner by using the dynamic interpretation of the universal quantifier or conditional.

The NEUTRAL PRESENT TENSE also serves for general statements like

The earth circles around the sun
A dog has two ears

Here the neutral TENSE concept 'Truth(s)' is not used in a conjunction but in a conditional, i.e. like a universal quantifier:

[s] Truth(s) & α (s) = [s] α (s) for the existential neutral tense
[s] Truth(s) \rightarrow α (s) for the universal neutral tense.

Accordingly, we have *always in the past* and *always in the future*. In general we can state that, with 'Q' as the variable for the untensed verb or clause, and TEMP for the temporal concept involved in the respective tense, the existential and the universal tense is a verb modifier with the two respective representations:

$\lambda Q_{((s,t),t)}$ [s] TEMP(s) & Q(s) in existentially tensed sentences
 $\lambda Q_{((s,t),t)}$ [s] TEMP(s) \rightarrow Q(s) in universally tensed sentences.

Note that English has an obligatory opposition between simple TENSE and TENSE IMPERFECTIVE, in all the tenses. This distinction is obligatory if α is a concept that in principle permits closure of a situation with respect to it¹, and if the sentence represents the situation s' at a certain reference time s' which is properly included in s". Then s' is, of course, α -open. If a sentence does not contain a previously provided reference time at which the α -event s takes place, but rather states the fact that s takes place, TENSE IMPERFECTIVE is not used, except if it is stressed explicitly that the situation s does not have an α -closure. Note, that such a fact-statement is not about s but about the world. A tensed sentence is about the world, an untensed sentence or situational concept is about a situation. If an untensed sentence α is about s then, with respect to α (s), it is morphologically marked by the progressive form (IMPERFECTIVE) that s is α -open. Thus, in the neutral PRESENT, which does not refer back to a reference time there is no IMPERFECTIVE: *Hans spricht Chinesisch* 'John speaks Chinese'. A previously provided reference time will be anaphorically bound by a referent introduced in the preceding text. We need the reference point only in narrative texts, for example in texts with historical present. The use of PRESENT TENSE for future events need not be narrative, it can just be a report of a fact. Therefore I included a representation without anaphoric reference time, namely PRES(3).

The use of PAST TENSE can be simply reporting a past event as a fact, or can be anaphorically related to previous events in a narrative text. The anaphoric reference situation s' is bound by the previous text.

PAST(α) : speech time > reference time at event time

NARRATIVE PAST: [s"] s₀> s" & AT(s",s') & α (s")

NEUTRAL PAST: [s] s₀> s & α (s), or: [s] s₀> s \rightarrow α (s)

for the existential and universal past specifications *sometimes in the past*, and *always in the past*.

The analytic future in German is built up compositionally from the aspect WERDEN and the PRESENT TENSE.

WERDEN(α) : $\lambda s'[s] s'< s$ & α (s)

The sign '<)' means that s' does not contain its closure, which is the beginning of s, on which α is true.

PRES(WERDEN(α)) : speech time at reference time <) event time (= ANALYTIC FUTURE)

PRES(WERDEN(α)): [s"][s] AT(s",s₀) & s"<) s & α (s)

¹ This excludes permanent states.

The difference between this representation of ANALYTIC FUTURE and the one of SIMPLE FUTURE, i.e. $[s''] s_0 < s' \ \& \ AT(s'', s') \ \& \ \alpha(s'')$ or, without anaphoric reference time, $[s''] s_0 < s'' \ \& \ \alpha(s'')$, expressed by PRESENT TENSE in German, is that the main reference time s'' is different. In ANALYTIC FUTURE, the main reference time is at speech time, and, in fact, introduced by PRES. In Simple Future it is at the future event. Therefore, ANALYTIC FUTURE cannot be used in a narrative text about a future happening, for example, in a text planning a series of actions. For such a kind of text, Simple or narrative Future, i.e. PRES(3) or PRES(4) with a future anaphoric referent, can be used with the anaphoric reference time being at the event time. The relationship between speech time and event time amounts to the same in both, in SIMPLE or ANALYTIC FUTURE. The difference between the two FUTURE TENSES will therefore not show with respect to isolated sentences, but with respect to texts, where the anaphoric reference time plays a role.

The IMPERFECTIVE is, like WERDEN and PERFECTIVE, an aspect that can be combined with TENSE.

IMPERF(α): $\lambda s' [s] s \supseteq s' \ \& \ \alpha(s)^0$, or: $\lambda s' [s] s \supset s' \ \& \ \alpha(s)$

Both representations amount to the same, except that the second presupposes that there is an α -closure. Anyhow, every s' is α -open, and it is due to this that in English progressive form is used. In German, expressions for the IMPERFECTIVE are not included in the aspectual system of the verb, though there is the IMPERFECTIVE PARTICIPLE, which is hardly used in verbal position, and there are as expressions of the IMPERFECTIVE the partitive constructions and infinitive-nominalisations². Further there is the use of a SIMPLE TENSE with *gerade* 'just' by which German can express that at the reference point indicated by *gerade* the concept α is open, as in:

Hans war am Schreiben des Briefes, als der Ofen ausging. (*am* 'at', partitive with respect to the action expressed by the nominalisation) 'John was writing a letter when the heater turned off'
 Hans schrieb an dem Brief, als der Ofen ausging. (*an* 'at', partitive with respect to the direct (resulting) object)
 Hans war dabei, den Brief zu schreiben, als der Ofen ausging. (*dabei* 'at it', partitive with respect to the performed action)
 Hans schrieb gerade den Brief, als der Ofen ausging. (*gerade* 'just', focussing on a point or interval within the action, which is, of course, open with respect to the action concept.)

TENSE(IMPERF(α)) is compositionally built up, whereby the IMPERFECTIVE-concept is applied to the situational discourse referent introduced by TENSE. For example PAST(IMPERF(α)), as in the narrative version of it:

NARRATIVE PAST(IMPERF(α)): $[s''] AT(s'', s') \ \& \ IMPERF(\alpha)(s'')$
 $= [s''] AT(s'', s') \ \& \ [s] s \supseteq s'' \ \& \ \alpha(s)^0$, whereby $s_0 > s'$;
 and with the presupposition of an α -closure,
 $= [s'] AT(s', s'') \ \& \ [s] s \supset s' \ \& \ \alpha(s)$, whereby $s_0 > s''$;

PERFECTIVE is the third aspect, which can also be composed with all tenses and with the aspects IMPERFECTIVE and WERDEN, the last only if the WERDEN-concept characterizes not just a state, but a process.

PERF(α): $\lambda s' [s] s < s' \ \& \ \alpha(s)$.

The sign '<' means that s is before s' and that s' may incorporate the boundary of s . In special cases, the concept WERDEN(α) characterizes not just a state, as it does in the analytic future tense, but a process, for

² Cf. Bartsch 1986 about aspectual properties of nominalizations.

example in: *rot werden* 'to become red', *Lehrer werden* 'to become a teacher', or *geschlagen werden* 'to get beaten'. In these cases, a PERFECTIVE-operation is possible on a WERDEN-concept, for example: PRES(PERF(WERDEN(α)): *Hans ist rot geworden, Hans ist Lehrer geworden, Hans ist geschlagen worden.*

TENSE(PERF(α)) can be formed compositionally with any TENSE-representation, for example with each of the three last meanings of PRESENT. For example,

$$\text{PRES(2)(PERF}(\alpha)) : [s''] \text{ AT}(s'', s_0) \ \& \ \text{PERF}(\alpha)(s'') = [s''] \text{ AT}(s'', s_0) \ \& \ [s] \ s <| \ s'' \ \& \ \alpha(s).$$

Accordingly, we get from PRES(3) and PRES(4) the Simple Future Present Perfect, and its narrative version, the narrative Present Perfect, especially the historical Present Perfect. For example, NARRATIVE PRES (PERF(α)) in its historical version:

$$\text{PRES(4)(PERF}(\alpha)) : [s'] \text{ AT}(s', s') \ \& \ \text{PERF}(\alpha)(s'') = [s''] \text{ AT}(s'', s') \ \& \ [s] \ s <| \ s'' \ \& \ \alpha(s), \text{ whereby } s' < s_0$$

I think that it is this HISTORICAL PRESENT PERFECT that is used as a stylistic variant in narratives in Southern German dialects. It is not PRES(2)PERF, which would have present relevance, which the historical version does not have: it has not relevance at speech time, but at the anaphorically bound narrative reference time.

The difference between on the one hand PRES(4)(PERF(α)), PRES(2)(PERF(α)) and on the other PAST(α), in the version of NARRATIVE PAST: $[s''] \ s_0 > s' \ \& \ \text{AT}(s'', s') \ \& \ \alpha(s'')$, or of NEUTRAL PAST: $[s''] \ s_0 > s'' \ \& \ \alpha(s'')$, is a difference with respect to the main reference situation of the sentence. In SIMPLE PAST it is the event situation, in PRES PERF it is some part of the resulting state of the event situation. Its location is defined deictically by being at the speech time in PRES(2)PERF, or by being at an anaphoric reference situation in PRES(4)PERF. This difference is the reason why the temporal connective *als* 'when' can be used with PAST TENSE, but not with PRESENT PERFECT.

Likewise, PAST(PERF(α)) and FUTURE(PERF(α)) can be formed compositionally, as well as PRES (WERDEN(PERF(α))).

Note that the aspect-composition $\text{PERF}(\text{IMPERF}(\alpha)) \neq \alpha$. The PERFECTIVE-operation forms a concept that characterizes the resulting state of a situation with respect to the characterizing concept of this situation. This means that $\text{PERF}(\text{IMPERF}(\alpha))$ characterizes the state that follows a situation characterized by $\text{IMPERF}(\alpha)$ and not the state that follows a situation characterized by α , which would be characterized by $\text{PERF}(\alpha)$. As far as $\text{PERF}(\text{IMPERF}(\alpha))$ is concerned, the result or closure of α might not have been reached, i.e. 'John had been writing a book' does not imply that the book is finished: 'John had been writing a book when an illness struck him down. So he never finished'. And likewise 'John had been eating, when Fred entered' does not imply 'John had eaten, when Fred entered'. The form PERF IMPERF is compositional.

$$\text{PERF}(\text{IMPERF}(\alpha)): \lambda s' [s] \ s <| \ s' \ \& \ \text{IMPERF}(\alpha)(s) = \lambda s' [s] \ s <| \ s' \ \& \ [s'] \ s' \supseteq s \ \& \ \alpha(s')^0$$

The special case where there exists a closure with respect to α :

$$\text{PERF}(\text{IMPERF}(\alpha)): \lambda s' [s] \ s <| \ s' \ \& \ [s'] \ s' \supset s \ \& \ \alpha(s')$$

Even then, $\text{PERF}(\text{IMPERF}(\alpha))$ does not characterizes this closure, i.e. s' itself, nor the resulting state that follows s' , which would be characterized by $\text{PERF}(\alpha)$, but rather a state that is the result of having performed a part of the activity involved in the whole activity or action characterized by α .

9. Temporal hypotactic and paratactic constructions

In the traditional grammar of German, temporal subordinate clauses are treated as adverbials to the verb of the main clause. Temporal connectedness by reference times proceeds via main clauses (Partee 1984: 257f, and also Hinrichs 1981). This is claimed to be so if the main clause is an event clause, which provides a new reference time for the following sentence. But if the untensed main clause is an IMPERFECTIVE-concept, or a state concept, it cannot provide a new temporal discourse referent for the following sentence, though it transmits an old one. In such a case the subordinate clause will provide this referent if it is able to define such a referent, i.e. if it is a closed concept with respect to its maximal region. For example:

Als Fritz kam, war Peter am Essen. Hans war draußen. 'When Fred came, Peter was eating dinner. John was outside.'

According to Hinrichs (1986), the event time characterized by the subordinate clause is the reference time for the main clause, and further for the following sentence. If also the untensed subordinate clause is an IMPERFECTIVE or STATE concept it transmits a reference time from a previous sentence. The same phenomenon we find in the paratactic parallel of the previous example:

Fritz kam. Peter war gerade am Essen. Hans war draußen. 'Fred came. Peter was just eating dinner. John was outside.'

This text does not move on temporally. The reference time for the second, as well as the third sentence seems to be provided by the first sentence. This transmittance becomes very apparent in the simplifications of the representations, which we get if we do not predicate over situations, but rather use evaluation times for sentences (see next chapter). But then it also shows that this picture of reference time transmittance is not quite correct. In the next chapter, I shall give an example of a narrative text that requires also non-event clauses (i.e. those expressing STATE- or IMPERFECTIVE concepts) to introduce their own reference situations or times, which are anaphoric reference situations or times for the sentences to follow. Therefore the most general procedure is to have the main situational referent of a sentence bind a situational anaphoric variable of the next sentence which stands in the unmarked relationship "AT" with the situational referent of that sentence. The facts mentioned about the proceeding of narrative time with events and its standing still with states follow from this general procedure as special cases. In the example above, the reference time, here also the event time, of the preceding subordinate clause is the anaphoric reference time for the main imperfective clause, and further on for the following sentence. How this follows from the general procedure will be shown below (see the analysis of *während* 'while').

In order to illustrate the difference with Hinrichs (1986) I briefly shall discuss one of his examples (p. 69), which he uses as an argument that temporal reference times have to be introduced separately in order to guarantee the identity of reference time for all the sentences that make up the following text :

Jaime was building another boat. He sang happily as he worked, the muscles of his brown arms rippled in the sun, and crispy wood shavings made a carpet between his bare feet.

His argument (1986: 72) is that if there were merely the times of the states described by these sentence and an overlap between successors is the appropriate relationship it is not secured that they have a common overlap, rather they could also form a chain of overlaps which would mean that, for example, the first and the last sentence have no time in common. But this, actually, will not happen if we take into account that all the following sentences are a scenic explication of the situation described in the first sentence: the first situation comprises all the others. This we know from its contents in relationship with the contents of the following sentences. As far as the temporal relationships go that are expressed by TENSE and the AKTIONSTYPEN and ASPECTUAL PROPERTIES not more information is given than that there is an overlap between the successors. It leads to identity is a special case, but with another content it could be a chain of states and activities. The special textsort, namely elaboration of a scene referred to in the first sentence, which is at issue in the example, makes that the overlap is one that is such that all the states and activities overlap with each other in order to be part of one scene. The subordinated clause *as he worked* introduces a situational referent that is part of the state or activity of boat building. This follows from the

lexical information: building is working. The situational referent of *he worked* bears the relationship WHILE, expressed by *as*, with all the situational referents of the other clauses of the compound sentence. This relationship expressed by *as* holds this referent together with all the other situational referents of the clauses that form the compound sentence. This consideration shows that no separate reference time needs to be introduced next to the states or activities or events that are referred to by the tensed clauses. The whole text is true on a certain region, the common overlap of the regions of all the states and activities mentioned. I don't see any advantage in considering this to be an instance of time as Hinrichs (p. 72) does, though there is, of course, at least one instance that is characterizable by the text. But this is a reduction of what the text describes, which is without use and gives a wrong impression. The temporal and spatial quality of the content of the text is such that by it a lasting, peaceful scene is presented, which has nothing in common with an instance of time which in this case could really be a point, because only states and activities are involved, which are true at each subinterval or point of their maximal region. To get the result of time identity for the whole text, even if no WHILE relationship is made explicit, we can specify the "AT" for scenic descriptions that consist of states and activities: Let the narrative PAST be [s] s" AT s' & α (s") where α is a [+dur,-res] concept, i.e. a state or activity concept. Then the relationship "AT" is specified as $s' \supset s''$. This guarantees that the main referent s' of such a sentence is always part of the main previous referent, and with that identity of time is secured. We do not need to introduce any special reference times. The anaphoric reference time is always the main reference times from the previous sentence.

Generally, the interpretation of "AT" as inclusion in the case of situational referents which are open with respect to their characterizing concepts is too strong, compared to the weaker requirement of overlap. But for scenic elaborations, a special text soort, this is just appropriate. Note that, except for [+res] concepts, i.e. actions, telic events, and punctual events, the situational discourse referent introduced by TENSE is not a maximal region of the respective concept, but just a part of it. By the preceding context only a part of a maximal region is cut out as the main situational referent. Whether a text moves on temporally or not, each sentence individually defines its reference situation, though restricted by the "AT"-relationship which it bears to an anaphoric situational referent. This makes it possible to refer to internal parts of situations which are closed as well as to the internal parts of those that are open with respect to the concepts true on them.

The treatment of temporal subordinate clause constructions, i.e. compound sentences with hypotactical temporal constructions, requires TENSE to have broad scope over subordinate and main clause, if we want to guarantee the identity of TENSE in main and subordinate clause, and with this the consecutio temporum as a special case.

The hypotactic connectives in German are *als* 'when' with obligatory PAST tense, *wenn* 'when' with obligatory FUTURE tense, *wenn (immer)* 'when(ever)' with obligatory NEUTRAL tense, *nachdem* 'after' with obligatory PERFECTIVE aspect³, *während* 'while' with IMPERFECTIVE aspect for the subordinated clause, *vor* 'before', and *sobald* 'as soon as', *seit* 'since', and *bis* 'until' with an INCHOATIVE aspect, especially an INCHOATIVE PERFECTIVE aspect. The respective basic meanings are represented as follows: *als/wenn*: $\lambda s' \lambda s'' \text{AT}(s', s'')$, *nachdem*: $\lambda s' \lambda s'' \supset (s', s'')$ with PERFECTIVE s', *während*: $\lambda s' \lambda s'' \supset (s', s'')$ with IMPERFECTIVE s', *bevor*: $\lambda s' \lambda s'' > (s', s'')$, *sobald*: $\lambda s' \lambda s'' | < (s', s'')$, *bis*: $\lambda s' \lambda s'' < | (s', s'')$, *seit*: $\lambda s' \lambda s'' | < (s', s'')$ & AT(s', s''), whereby s is deictically or anaphorically bound. The subordinated clause has the situational referent s' and the main clause has s''. For *sobald*, *bis*, *seit* the situational variable s' has to be characterized by an inchoative concept. The inchoative aspect mostly is not expressed in German or English, though it can be expressed in an analytic construction with the verb *beginnen* 'begin'. The inchoative aspect is never expressed when applied to a perfective verb. The complex concept INCHOATIVE(PERF(α)) characterizes the beginning of the perfective state, i.e. the beginning of the state that results from realizing α .

From these basic concepts the corresponding predicative, adnominal, or adverbial expressions can be formed by the semantically empty verb *geschehen* 'happen' in the predicative use, and by the form $\lambda \Sigma \lambda \Pi \lambda s' \lambda s''$

³ Partee (1984: 264) presents an example from colloquial English, where PAST is used instead of PAST PERFECT, but she points out that for systematic reasons also in English PAST PERFECT is required. In German it is obligatory.

$C(s',s'') \ \& \ \Sigma(s') \ \& \ \Pi(s'')$, where Σ and Π get filled by situational concepts based on verbs or nouns for the adverbial or adnominal use. The paratactic main-clause connectives *danach* 'thereafter', *davor* 'before', *unmittelbar danach* 'immediately after', *gleichzeitig* 'at the same time' are just the basic relationships, applied to an anaphoric pronoun in the first position. From these forms ' λs ' $C(s',s'')$ ' adverbials of the form $\lambda \Pi \lambda s$ ' $C(s',s'') \ \& \ \Pi(s'')$ ' are formed that apply to the second sentence. Note that the paratactic 'AT', corresponding with hypotactic *als/wenn* is morphologically zero, i.e. it is just realized by paratactic connection without any explicit connective expression. This is, in fact, the standard narrative paratactic connection, some effects of which have been observed in the previous literature on discourse semantics of tense, though this relationship has never been recognized as such. Instead of taking into account this standard unmarked relationships of text connectedness, separate reference points had been introduced by Hinrichs (1981 and 1986) in order to capture its effects. I now want to discuss the hypotactic temporal connectives.

Let α and β be two situational concepts and C the temporal conjunction, which introduces the subordinate clause. Let α be the situational concept of the subordinate clause. Then we have two options for providing broad scope for TENSE in the main clause, either $TENSE((C(TENSE(\alpha)))(\beta))$, which means that first the subordinate clause is applied as an adverb to the situational concept of the main clause. The TENSE of the main clause does not create any problems with respect to the subordinate clause, because the subordinate clause, as being already tensed, is stable with respect to the TENSE of the main clause, although it is in its scope. The disadvantage of this approach is, that it does not take into account the fact that TENSE in the subordinate and in the main clause have to be identical, which also guarantees the consecutio temporum of TENSE PERFECT and TENSE, where TENSE has to be identical. The following alternative approach takes care of the identity of TENSE in subordinate and main clause: C-TENSE(α, β). This relationship has to be analyzed as:

$$C-TENSE(\alpha, \beta): [s'] T(s') \ \& \ \alpha(s') \ \& \ [s''] T(s'') \ \& \ \beta(s'') \ \& \ C(s',s'')$$

Here, T is the basic temporal concept included in TENSE, which is := $\lambda s \ s_0=s$, $\lambda s \ s_0 > s$, and $\lambda s \ s_0 < s$ for TENSE:= PRES, PAST, and FUT (=PRES(3)), respectively.

This means that C-TENSE has the representation:

$$C-TENSE: \lambda S' \lambda S [s'] T(s') \ \& \ S'(s') \ \& \ [s''] T(s'') \ \& \ C(s',s'') \ \& \ S(s'')$$

This will later be constructed compositionally.

To take care of the temporal text connectedness, we may assume that TENSE also introduces into the main clause representation, i.e. with respect to s'' , an anaphoric situational referent being identical with the situational referent of the previous main sentence. This is taken care of by $\lambda s' \lambda S'' \dots AT(s'',s') \ \& \ S''(s'')$. The AT-relationship between s'' and s' can be specified as overlap, inclusion, or sequential order, according to the aspect and aktionsart of the situational concepts describing s' and s'' :

AT(s',s'') :

$O(s'',s')$, or $s'' > s'$, if s' and s both are durative and closed with respect to their respective concepts;
i.e. for: $[s'] +dur, [s''] +dur$.

$O(s'',s')$, or $s' \supset s''$, if s' and s both are durative and open with respect to their respective concepts;
i.e. for: $(s') +dur, (s'') +dur$.

$s' \supset s''$, if s' is open and s'' closed with respect to their respective concepts; $s'' \supset s'$ is possible if s'' is $[+dur]$; i.e. for: $(s'), [s'']$

$s'' \supset s'$, if s'' is open and s' closed with respect to their respective concepts; $s' \supset s''$ is possible if s' is $[+dur]$; i.e. for: $[s'], (s'')$

$s'' \supset s'$, if s'' is a resultant state (i.e. with a begin point and further open) and s' closed with respect to its concept; i.e. for: $[s''], [s']$

$s' \supset s''$, if s' is a resultant state (i.e. with a begin point and further open) and s'' closed with respect to its concept; i.e. for: $[s']$, $[s'']$

$s' < s''$, if s' is a punctual event and s'' is closed with respect to its concept (the last includes that s'' may also be a punctual event or a state/activity with an initial closure); i.e. : $[s']$ -dur, $[s'']$ or $[s'']$ +dur

$s'' < s'$, if s'' is a punctual event and s' is closed with respect to its concept (the last includes that s' may also be a punctual event or a state/activity with final closure); i.e. for: $[s'']$ -dur, $[s']$ or (s') +dur.

The stroke '|' says that s' and s'' may have a common boundary, which means that $s'' \supset s'$ says that s' is included right at the beginning of s'' , and $s' < s''$ says that s'' immediately follows s' such that they may have a common boundary. $s' < | s''$ says that s' immediately precedes s'' , it permits that they have a common boundary.

The temporal conjunction *als* 'when' with obligatory PAST is a function that maps the PAST-concept onto ALS-PAST. If $C=ALS$, the relationship $C(s',s)$ is $AT(s',s)$. The conjunction *wenn* 'when' has to be applied to PRES(3) (= SIMPLE FUTURE) or to PRES(1) (=NEUTRAL TENSE). If $C=WENN$, the relationship $C(s',s)$ is also $AT(s',s)$, which explains why both, *als* and *wenn*, translate into English 'when'. The English conjunction WHEN is applied to TENSE, with TENSE: PAST, FUT, or PRES(neutral).

The meaning of *wenn* (*immer*) 'when (ever)' requires NEUTRAL TENSE, for example NEUTRAL PRES or NEUTRAL PAST:

WENN(IMMER)-PRES(1): $\lambda S' \lambda S [s'] S'(s') \rightarrow [s] AT(s',s) \& S(s)$

WENN(IMMER)-PAST: $\lambda S' \lambda S [s'] s' < s_0 \& S'(s') \rightarrow [s] AT(s',s) \& S(s)$

If $C=$ *nachdem* 'after', the subordinate sentence has to be in PERFECT aspect, and TENSE may be PAST or PRES(3) (=simple FUTURE). This means that s' is characterized by the concept $PERF(\alpha)$. The relationship $C(s',s)$ is $\supset(s',s)$, which means that s is part of the resultant state of α , i.e. follows α .⁴ To achieve all this, NACHDEM is a function on TENSE with the following result:

NACHDEM-TENSE : $\lambda S' \lambda S [s'] T(s') \& PERF(S')(s') \& [s] T(s) \& \supset(s',s) \& S(s)$

NACHDEM-TENSE then has to be applied to the situational concept α under the scope of PERF, expressed by the subordinate clause, and then to the main clause situational concept β . We also could have:

NACHDEM-TENSE : $\lambda S' \lambda S [s'] T(s') \& S'(s') \& [s] T(s) \& \supset(s',s) \& S(s)$,

which would mean that we take for $S' \alpha$ as the whole PERFECTIVE situational concept. This gives the same result. The disadvantage is, that nowhere perfectivity is required for S' , which would render sentences without consecutio temporum, like the ones below, acceptable:

Nachdem Fritz kam, aßen wir. 'After Fred came, we ate'

Nachdem Fritz am Essen war, kam Hans. 'After Fred was eating, John came'

Nachdem Fritz ißt, kommt Hans. 'After Fred will eat, John will come'.

But the acceptability of these sentences is, at least, very doubtful.

The conjunction *sobald* 'as soon as' is like *nachdem*, but with $C(s',s): = | < (s',s)$. It can be used with s' characterized by PERFECT-concepts and means then that s takes place right at the beginning of the

⁴Partee (1984:264) presents an example in which it is required that the event described by β immediately follows the one described by α . For our representation this would mean $\supset(s',s)$.

PERFECT-state, and it can be used with other concepts and means then that *s* takes place right at the beginning of *s'*. With *s'* characterized by a PERFECT concept this amounts to

SOBALD-TENSE : $\lambda S' \lambda S [s'] T(s') \& S'(s') \& [s] T(s) \& \supset (s',s) \& S(s)$

We therefore have with the same meaning:

Nachdem er gegessen hat, legt er sich schlafen
 Sobald er gegessen hat, legt er sich schlafen
 'As soon/after as he has eaten he goes to bed'

and

Sobald er ißt, wird er schweigen
 Nachdem er mit Essen begonnen ist, wird er schweigen.
 'As soon as he is eating he will shut up'

The conjunction *während* 'while' expresses the overlap of two regions that are open with respect to their defining concepts. This means that, semantically speaking, this conjunction is restricted to IMPERFECTIVE-concepts: If α and β are two concepts, then $WÄHREND(\alpha, \beta)$ means that there is an overlap between the interiors of their respective regions, and these are characterized by the concepts $IMPERF(\alpha)$ and $IMPERF(\beta)$, respectively. The difference between main and subordinate clause amounts to taking as the main clause situational referent that part of the maximal region of its situational concept that is included in the situational referent of the subordinate clause. This means that an identical time referent exists for both clauses, namely s'' , which is the anaphoric referent for the sentence following the compound. Because of this, identity of time is secured in examples like the one of Hinrichs (1986: 72), discussed above.

WÄHREND-TENSE: $\lambda S' \lambda S [s''] T(s'') \& S'(s'')^O \& [s'''] T(s''') \& \supset (s'', s''') \& S(s''')^O$

For example:

Hans betrat die Küche. Während Fred das Essen kochte, las Maria Zeitung . Sie sah eine Anzeige und sagte zu Hans... 'John entered the kitchen. While Fred was preparing dinner Mary was reading the newspaper. She saw an advertisement and said to John...'

The first sentence in SIMPLE PAST has *s'* as its situational referent. With NARRATIVE PAST, *s'* becomes the anaphoric reference time for the following compound sentence. Since the newly introduced situations s'' and s''' are activities which are open with respect to their respective concepts, $AT(.,s')$ means that they temporally include *s'*. They themselves are related by the inclusion relationship expressed by *while*. The concept characterizing the main clause situational referent is an activity; we take for s''' that part of Mary's reading the newspaper that is in the overlap with s'' . This means that the main clause situational referent is included in the subordinate clause referent: $s'' \supset s'''$.

WÄHREND-PAST(β)(γ): $[s''] s_0 > s'' \& s'' \supset s' \& \beta(s'')^O \& [s'''] s_0 > s''' \& s''' \supset s' \& \supset (s'', s''') \& \gamma(s''')^O$

This is the same as:

WÄHREND-PAST(β)(γ): $[s''] s_0 > s'' \& s'' \supset s' \& IMPERF(\beta)(s'') \& [s'''] s_0 > s''' \& s''' \supset s' \& \supset (s'', s''') \& IMPERF(\gamma)(s''')$

The the referent s'''' of *she saw an advertisement* stands in the relationship $AT(s'''' , s''')$, which here means $s'''' \supset s'''$. But how is it secured that $s' < s''''$? This takes place by a reduction: Since s'' and s''' are both characterized by activity or states concepts [+dur, -res] these concepts are also true on each of their parts, for example on *s'*. We therefore can replace s'' and s''' by *s'*. This way *s'* is transmitted through the clauses with activity or state concepts and is the anaphoric referent for the third sentence: the situational referent s'''' of the third sentence stands in the relationship $AT(s'''' , s')$, which means $s' < s''''$ since both, *s'* and s'''' are

characterized by closed concepts. Likewise $s''' < s''''$. We get altogether the following temporal reduction for the above text:

$$[s'] s' < s_0 \ \& \ \alpha(s') \ \& \ \beta(s') \ \& \ \gamma(s') \ \& \ [s'''''] s' < s'''' \ \& \ \delta(s''''') \ \& \ [s'''''''] s'''' < s'''''' \ \& \ \gamma(s''''''')$$

These reductions will be the topic of the next section. I have chosen the above analysis of temporal hypotactic connectives in order to be able to regulate TENSE-identity between main and temporal subordinate clause. Otherwise one just could simply take the tensed subordinate clause as an adverbial to the situational concept of the main clause.

9. Simplifications and reductions from situations to times

If we do not use situations as a special sort of entities about which we can predicate concepts and between which we can establish all kinds of relationships, but just use times instead, we lose a lot of expressive power of the language. But the analysis of TENSE gets simplified. It might be due to this simplification that such an analysis of tenses and aspects never was quite satisfactory. Interesting differences, for example between PRES PERF and PAST, or between SIMPLE FUTURE and ANALYTIC FUTURE got lost.

Often whole situations or constellations of situations are passed through the text by way of anaphorical reference: not only with respect to temporal properties, but also with respect to local properties and relationships, and with respect to properties of entities and subsituations one has to be able to refer to situations. For example, it is with respect to a situation that somebody is a patient, and with respect to another situation that he is a teacher, and with respect to a third one that he is the father of two children, etc., though he may be all this at the same time. When John is teaching his class, we will say that the teacher is teaching his class, and not that the patient is teaching his class. If DR. M. says that his patient taught the class of his eldest son, 'patient' has to have wider scope than TENSE, which introduces the teaching situation., or at least, 'patient' has to be interpreted deictically or anaphorically, such that its predication about the person in question is not bound to the teaching situation.

Although situations cannot be dispensed with, it is instructive to see that from the relatively fine grained representations which involve predications over situations, the basic results follow that have been stated about tempora and temporal reference by Kamp (1979), Kamp and Rohrer (1983), Hinrichs(1981) and Partee(1984). But they only follow as special cases, and it is an advantage of the present approach that it also covers other cases which were not treated there, or have been noticed as "different", or "exceptional".

The reductions of situations to times are as follows:

PRES(1): $[t] \alpha(t)$

PRES(2): $[t] t \supset t_0 \ \& \ \alpha(t)$;

if α is a state, process or activity concept: $\alpha(t_0)$,

if α is a punctual event concept: $\alpha(t_0)$,

if α is a [+dur,+res] concept: IMPERF(α)(t_0)

In English, the obligatory expression is progressive form, if α is not a permanent state, a permanent process concept, or a punctual event concept. This shows that in English the time considered for evaluation is t_0 , which for all [+durative] concepts α is open with respect to α , and then, of course, progressive form is used if α is non-permanent. This means that strictly speaking, merely the IMPERFECTIVE(α) can be true at t_0 if α is a durative and closure defining concept, i.e. [+dur, +res]. The IMPERFECTIVE in English expresses this openness of t_0 with respect to α . German, apparently, evaluates α at an interval which is supposed to be closed with respect to α , whereby PRES(2) says that t_0 is included in it. If the activity is

not in focus, but rather the whole action including its result, then also in English no progressive form is used. For example, we see John writing a letter. Someone asks: "To whom does John write this letter". The answer will likely be in simple present tense: "John writes this letter to his mother". Here, the analysis must be like the one for German, namely that t_0 is included in the time of the whole act "write a letter to his mother", otherwise the answer should be "John is writing this letter to his mother". But this would put the activity itself into focus.

PRES(3): $[t] t_0 < t \ \& \ \alpha(t)$ (SIMPLE FUTURE)

PRES(4): $[t] AT(t,t') \ \& \ \alpha(t)$ (e.g., HISTORICAL PRESENT)

Here, $AT(t,t')$ is $t' < t$ if t' and t are characterized by a closure concept: $[-dur]$ or $[+res]$. It can be $t' < t$ if t' is finally closed with respect to a $[+dur]$ concept, or $t' < t$ if t is initially closed with respect to a $[+dur]$ concept. If the concept α is $[+dur,-res]$, we get $t \supset t'$, or also $t' \supset t$, if t' is characterized by a $[+dur]$ concept. If the concepts are $[+dur,+res]$, overlap, inclusion or succession is possible. If α is $[+dur,-res]$ $\alpha(t')$ follows from $t \supset t'$, which means that no new reference time is introduced for the following sentence. If t' is characterized by a concept that is open with respect to t' then $t' \supset t$ implies that that concept is also true on t , i.e. we can state $t'=t$. If t' is an interval defined by a concept that is closed with respect to it, we cannot reduce like this. For example,

Last month John wrote an article _{t'} , which will be published soon. He was working _{t} part of the time in his vacation house _{t''} .

This, actually, is a good example for the fact that also states or activities can provide an anaphoric reference time for the following sentence: we may continue with

There he did some fishing for recreation _{t'''} .

Note that $t'' \supset t'''$, where t'' is not the time of working in the vacation house, rather the stay there, which is a state. And we have also not just $t' \supset t'''$. It would even be wrong to take $t \supset t'$ or $t'' \supset t'$, which should be the case according to the tense theories of Kamp (1979), Kamp and Rohrer (1983), Hinrichs (1981, 1986) and Partee (1984), which claim that if a state or process/activity sentence follows an event/action sentence (in simple past) the first, being "pointlike" should be included in the second. This is not always the case. It has to be the case, though, if the first really is a punctual event, i.e. is $-durative$, but SIMPLE PAST does not make something durative become non-durative, it merely expresses that a concept α , no matter whether it is $[+dur,-res]$, $[+dur,+res]$, or $[punctual]$, especially $[-dur,+res]$, is fully realized in the past, i.e. is true on some interval or point there, this is opposition to the weaker statement that there is some interval or point in the past on which $IMPERFECTIVE(\alpha)$ is true. The claim that SIMPLE PAST represents an event as pointlike cannot be upheld, because, in general, we need an interval of a concept α as a reference time, within which we can place several processes, bounded states, activities, actions and events that might be introduced in the next sentences. This is so, even if α is a concept that involves a closure or result. It is an unnecessary complication to first take an instance or point as a time referent and then 'blow it up' to become an interval if needed for internal temporal reference. The problem is created by mixing up two different, but related, notions of 'pointlikeness', namely undivability with respect to a characterizing $[+dur,+res]$ concept (i.e. a concept that is true of its maximal region but not of its parts), and topological undivability, i.e. pointlikeness per se.

The last kind of pointlikeness, but not the first one, plays a role as a restriction on the formation of progressives: We cannot form a progressive from a $[-dur]$ concept, i.e. with respect to pointlike events. This is so because the maximal region of such a concept, i.e. a point, has no parts which are open with respect to the concept. By assuming an iterative interpretation of the concept instead of its $[-dur]$ interpretation we assume a maximal interval for the concept that has part which are open with respect to the iterative concept. Iterativity is a certain kind of durativity, namely discontinuous durativity. Therefore the progressive can be formed if we assume the iterative actionsart. Concepts that are of a $[+dur,+res]$ aktionsart always permit a

progressive form, although they are pointlike in the first sense of undividedness with respect to the [+dur,+res] concept. Here the progressive form selects the [+dur] aspect and eliminates the [+res] aspect. That the progressive is not used with [+permanent,+dur] concepts, which characterize permanent states or permanent processes, is just a matter of redundancy or tautology: One does not express that a state or process is still going on at a certain time if it is known anyhow that it holds or goes on.

PAST(α):

neutral: $[t] t < t_0 \ \& \ \alpha(t)$

narrative: $[t''] t' < t_0 \ \& \ AT(t'',t') \ \& \ \alpha(t'')$; this reduces to $\alpha(t')$, if $t'' = t'$

This identity can always be assumed if α is an IMPERFECTIVE- concept, expressed in English by the progressive form, or some other [+dur, -res] concept, e.g. a state-concept, or if α is a punctual concept.

Fritz kam herein. Hans schrieb einen Brief.
'Fred entered. John was writing a letter.'

Generally it holds: if $\alpha(t)$, then $\alpha(t')^0$ for every t' with $t \supset t'$. This means that if α is true of t then for every such t' , IMPERF(α) is true of t' . This leads to the special reduction IMPERF(α)(t').

No such reduction is possible if α is a [+dur,+res] concept, i.e. an event or action concept. For example, we need to interpret the concept expressed in the phrase *schrieb einen Brief* as [+dur,-res] which amounts to English progressive form, should the reduction be allowed to apply. But the concept "write a letter", [+dur,+res], could not be true at a pointlike t' . It only could be part of t' , if t' was a state, for example $t' \supset t''$ & $t' \supset t'''$ without any order between t'' and t''' :

It was a rainy day_t. John wrote a letter to his father. Mary did the laundry.

In such a text the narrative temporal connectedness is loosened between the second and the third sentence. It is a kind of state description which makes the situational referent t' dominate over t'' such that it is preferred above t'' as an anaphoric referent for the third sentence. It is a matter of distinguishing types of texts and of determining accordingly the preferred anaphoric relationships for the arguments of the relationship AT, which establishes narrative text-connectedness.

PRES(WERDEN(α)): $[t'] [t] AT(t',t_0) \ \& \ t' < t \ \& \ \alpha(t)$

From this follows: $[t] t_0 < t \ \& \ \alpha(t)$, since t' is characterized by a [+dur,-res] concept, i.e. WERDEN(α), this concept is also true on t_0 . This reduced form is no more distinguishable from SIMPLE FUTURE, and it is therefore not surprising that those who work merely with the reduced form, like Kamp (1979) and Kamp and Rohrer (1983), will not be able to explain differences of use between ANALYTIC and SIMPLE FUTURE.

IMPERF(α): $\lambda t' [t] t \supseteq t' \ \& \ \alpha(t)^0$, or: $\lambda t' [t] t \supset t' \ \& \ \alpha(t)$

PAST(IMPERF(α)): $[t''] t' < t_0 \ \& \ AT(t'',t') \ \& \ IMPERF(\alpha)(t'') = [t''] t' < t_0 \ \& \ AT(t'',t') \ \& \ (\alpha)(t'')^0$

From this, $(\alpha)(t')^0$, i.e. IMPERF(α)(t'), follows, because t'' is defined by a [+dur,-res] concept. If we apply this reduction, no new situational discourse referent is introduced.

PERF(α): $\lambda t' [t] t < t' \ \& \ \alpha(t)$

PRES(PERF(α)): $[t''] t'' \supset t_0 \ \& \ [t] t < t'' \ \& \ \alpha(t)$

From this it follows: $[t] t < t_0 \ \& \ \alpha(t)$, because t'' is defined by a state concept.

By performing this reduction, we have lost the difference between PAST and PRES PERF, except that the last permits that t_0 may be identical with the closure point of the situation characterized by α . PAST requires $t < t_0$.

PAST(PERF(α)): $[t''] t'' < t_0 \ \& \ AT(t'', t') \ \& \ [t] t < t'' \ \& \ \alpha(t)$

From this follows: $[t] t < t' \ \& \ \alpha(t)$, because t'' is defined by a state concept, whereby t' is the anaphoric reference time with $t' < t_0$. PAST PERF just reduces to pre-PAST.

According to these formulas, PRES PERF and PAST PERF introduce new situational referents, which are the event times and which will be the anaphoric reference times in the following sentences. This, in fact, is not adequate and it does not happen in the unreduced formulas, because there the event times in TENSE PERF sentences are not the main time referents. These are introduced by TENSE.

PERF(IMPERF(α)): $\lambda t' [t] t < t' \ \& \ IMPERF(\alpha)(t) = \lambda t' [t] t < t' \ \& \ [t''] t'' \supseteq t \ \& \ \alpha(t'')^0$

From this follows: $\lambda t' [t] t < t' \ \& \ \alpha(t)^0$, because t'' is open with respect to α , and the same is true of every part of it.

The $AT(t'', t')$ relationship reduces to either $t'' = t'$, or $t' < t''$, if we assume that sentences in simple tenses define instances as time referents rather than time intervals are closed with respect to their defining concepts. Those intervals may incorporate other open or closed intervals. Texts like the one presented at the beginning of this chapter require this possibility of inclusion. But if we do not take these into account, we arrive at Kamp's (1979) claim about French, namely that SIMPLE PAST sentences move the discourse time forward by introducing a new time referent ($t' < t''$), while IMPERFECT sentences do not introduce a new time referent ($t' = t''$), i.e. do not move the time further. But if we take into account that closed concepts define intervals and not something that behaves like a point in the time structure, we cannot uphold this alternative. Then we have also to consider that a 'closed' interval t' (e.g. SIMPLE PAST) can comprise an 'open' interval t'' (e.g. IMPERFECTIVE), and that the text can elaborate further on that. This also means that the narrative time does not move on further, and also in so far Kamp's claim is still valid, but it requires to take closed intervals for [+dur,+res] concepts instead of points and also to have tensed IMPERFECTIVE-concepts introduce new temporal discourse referents, which can also play a role as anaphoric reference times in the next sentences.

This is also true for compound sentences with the relationship AT between the situations characterized by the main and the subordinate clause, introduced by *when*. The relationship AT would reduce to either '=' or '<', if we would not keep track of intervals, which can be open or closed with respect to their characterizing concepts. The following examples show the three possibilities:

When Fred arrived t' , Mary was preparing dinner t'' .

Here: $AT(t'', t')$: $t'' = t'$ in the reduced version, such that we have 'Mary was preparing dinner at t' '. But instead of applying such a reduction, I would keep t'' , with $t'' \supset t'$, in order to be able to refer to the time of her cooking, for example by,

It took her longer than two hours and cost her a lot of effort.

In fact, because of the second predication we need a situational referent here, and not just a time referent.

Reduction to a time referent would be alright with respect to the first predicate but it cannot explain the use of the same *it* with respect to the second predicate. We therefore need situational referents. Time relationships between them are just relationships between their temporal projections.

When Fred entered t' , Mary left through the back door t'' .

Here: $AT(t'',t') : t' < t''$, in the reduced version. But $t'' = t'$ is also possible here, since we may continue: *Therefore she unfortunately did not see him*. This shows that also with pointlike events we need to be able to interpret $AT(t'',t')$ in both its possibilities, as overlap or as immediate succession.

When Fred wrote a book t' , Mary built a house t'' .

Here: $AT(t'',t') : t' < t''$ is required in Kamp's theory. But this is not quite correct: An overlap between the two times is possible as well. The simple tense form, other than imperfective form, lets the situational concepts of both sentences unimpaired, namely [+dur,+res]. The imperfective form would make them [+dur,-res]. Because of the simple tense form it is therefore not true that on the overlap both clauses are true. Therefore we cannot reduce the overlap between t' and t'' to a simple $t' = t''$. It would be possible, if both were in IMPERFECTIVE form:

While Fred was writing a book t' , Mary was building a house t''

Here, $t' = t''$ is perfectly correct, because on the overlap both sentences are true, although both actions may not take place precisely at the same time.

When Fred wrote his book t' , Mary was travelling in Europe t'' .

Here, $AT(t',t'') : t' \supset t''$, or $t'' \supset t'$. The position of Kamp and Rohrer 1983, and others following them, only takes care of the possibility $t'' \supset t'$, which reduces to $t'' = t'$ which means evaluating the IMPERFECTIVE sentence, here the main clause, at t' , the reference time provided by the subordinated clause in Simple Past. The first possibility is not included in that position, but it is necessary in order to be able to continue the above text in the following way:

She also made a short trip to China. When she came home, John was just on the point of sending the copy to the publisher.

All these events are still included in t' . Although these sentences are in Simple Past, they are not after t' , something that, for example, Kamp's (1979) claim for French would suggest, if we apply it to English. The question, of course, is whether in French or in English such a simple past subordinate clause like *When Fred wrote his book, ...* can correctly be used as antecedent clause of a text of the kind presented in the example, namely:

When Fred wrote his book, Mary was travelling in Europe. She also made a short trip to China. When she came home, John was just on the point of sending the copy to the publisher.

As it stands, the first sentence expresses a [+dur,+res] action, which means that it includes the information that the book was completed. The corresponding imperfective form would merely express the activity concept [+dur,-res], which does not imply that the result of writing is achieved. In German the sentence is interpreted as [+dur,+res], i.e. as implying the result. Otherwise, one would use a partive construction like *als Fred an seinem Buch schrieb* or a construction that expresses that the concept is open at the reference situation, like in *als Fred dabei war, sein Buch zu schreiben*, where *dabei* refers to the situational referent which is open with respect to the characterizing concept. This means, for German we need to treat the situations characterized by [+dur,+res] concepts temporally as intervals closed with respect to their characterizing concepts, and not as points. This also holds for English, provided a text like the one

considered above is correct.

10. Flexible grammars for handling scopes

Flexibility of grammar with respect to scope assignments for expressions in a sentence can be achieved in several ways: Expressions can be used in several categories with different scopes, or they can be used in fixed categories with a fixed position in the build-up of a sentence, but with flexible semantic types for each category. In what follows I assume that in German clauses the order of the nominal terms and adverbials naturally determines their relative scopes. With verb-end position this means that the closer such an expression is to the verb the smaller is its scope. Thus, the category in which an expression is used in a sentence is expressed by its position. Nominal terms, in whatever case, can be used in categories (V^n, V^{n-1}), i.e. they map n-place verbs on (n-1)-place verbs. This means they bind one free place of the verb, and therefore the complex verb consisting of the nominal term and the verb has one place less. Their position in a sentence makes clear in which category they are used. Although TENSE cannot appear at different positions in sentences, expressing its scope in this way, we can treat TENSE as a variable category, i.e. as appearing in categorial structures of sentences in different TENSE-categories which bring about different scopes. The other possibility is to take TENSE as a fixed category in the sense of having the same position in every sentence, but getting assigned different semantic types in order to achieve the same semantic results as different categorial scopes would provide. German naturally expresses scope by order of the nominal terms and adverbials with respect to the verb. But with each possible order there is, besides the natural scope assignment in accordance with the order, the possibility of less natural scope assignments by using the method of flexible type assignment additionally. I shall work this out only with respect to TENSE in the second type of grammar, the one with flexible types and fixed categories. But first I shall discuss a grammar with flexible categories, and then one with flexible types.

10.1. A FLEXIBLE CATEGORIAL GRAMMAR FOR TENSE

The grammar presented first is a categorial grammar version of traditional dependency grammar, where the verb is the head of a sentence and modifiers (adverbial expressions), specifiers (nominal terms with cases or pre/postpositions, and other verb complements), aspects, and one-place determiners (TENSES) are applied to it. This way, complex verbs are formed, and by way of tensing, a sentence is formed from a simple or complex verb.⁵ The order of application of modifiers, specifiers, aspects and determiners is free, and by this we get different scope possibilities for aspects, tenses, nominal terms and adverbial modifiers. I distinguish classes of linguistic phrases from their categorial uses. For each phrase class there is a basic semantic type defined that is the basic type of the most basic category in which the phrases of these class can be used. The types of their other uses, i.e. their use in other categories, are generated by one single mechanism of type lifting. This dependency grammar has a categorial build-up for each sentence. A category is not a phrase class but a specific syntactic use of linguistic expressions, and with it there corresponds a semantic type. The scope of an expression is indicated by the order of functional application in the sentence. This order is expressed in the 'free' constituent order in a German sentence in its verb-final form, used in infinitive constructions and subordinate clauses. We can also introduce an additional flexibility which can provide scopes different from the standard one that is expressed in the order of constituents. This can be done by additional type lifting such that for one category we can have additional semantic types.⁶ The grammar presented first is a combination of dependency grammar and categorial grammar. The verb with the appropriate case relationships is constructed in the following way: We construct an n-place verb with the respective case relationships as an n-place function. This construction is restricted by information from the

⁵ This kind of grammar is in principle the same as in Bartsch 1975 and other articles since, but enriched with situational variables like in Bartsch 1987, where different versions of this grammar are discussed and adapted to the purpose of discourse representation. The new formulation in the present paper is theoretically based on a mechanism of type shifting, which gives a principled foundation to this grammar..

⁶ This is done following the work of Hendriks (1987 and 1988) on a categorial Montague Grammar with flexible types, by which all scopes can be achieved with one single syntactic form and without Montague's rules of quantification.

lexicon. The nominal terms can then be applied in whatever order. In interpretation of a sentence the order is, of course, given in the sentence and the nominal terms and adverbs are applied to the verb in that order: the order 'X Y ZV' expresses the categorial form 'X(Y(Z(V)))'.

THE BASIC CATEGORIES AND THEIR TYPES

The basic semantic types are: e: entity, s: situation, t: truth value. The other semantic types are constructed from these.⁷

Verb phrases: (untensed) verbs and tensed verbs (=verbal terms)

The term 'verb phrase' is not a category name; rather it is a name for several kinds of expressions that have in common that they can be used in the verbal category groups VERB and VERBAL TERM. The category group VERB consists of its basic category $V^{S,0} = V^S$, i.e. the untensed verbs with no entity argument places, and a series of lifted verb-categories, $V^{S,n}$, i.e. the untensed n-entity place verbs. Further it comprises all modifications of untensed verbs by adverbs and aspects. That is: category group VERB comprises all untensed verb phrases. To those we can apply one-s-place determiners, i.e. the TENSES. TENSE is the category of verb determiners. If a tense is applied to a verb the result is a VERBAL TERM, VT. The category group VT comprises the categories V^n , $n:=0,1,2,3,\dots$, also written as V^K , with $|K| = n$. The V^0 is a sentence, i.e. $V^0 = S$.

Verbs:

basic category: V^S ; basic type: (s,t); basic representation: $\lambda s \alpha(s)$.

To these basic verbs, which are situational concepts, the specifying complements are attached. In the lexicon a frame is provided in which the kinds of complements of each verb are represented. Which of these complements are realized syntactically in a specific sentence is flexible, though German mostly requires at least a subject term, i.e. a nominal term in the nominative case, NT_1 , with which the verb agrees morphologically in person and number. The basic verb gets specified according to which verb complements (nominal terms with cases) occur as constituents of the sentence by attaching the case relationships (including pre/postpositional relationships) of these nominal terms onto the verb. This can be done by a simple rule of case attachment which copies the cases from the nominal terms onto the verb. In this way we get lifted verbs $V^{S,K}$ with the set of cases K, with their respective representations: If there are n nominal terms attached with their respective cases $i \in K$, a verb of the type (e^n, s, t) is constructed:

Type of $V^{S,K}$, with $|K|=n$: (e, \dots, e, s, t) , with n times e, in short: (e^n, s, t) .

Its representation is: $\lambda x^1, x^2, \dots, x^m, s \alpha(s) \& R_1(x^1, s) \& R_2(x^2, s) \& \dots \& R_m(x^m, s)$, with n variables x^j , $j \in K$, of type e.

The superscripts are markers for the respective case relationships R_i in which the variable stands with respect to s. The case relationships are specified for each verb in the lexical frame, for example for the verb *singen* 'to sing' we have in German R_1 : producer, R_2 : produced, R_3 : beneficiary, as for example in *der Wind singt mir ein Lied* 'the wind sings a song for me'. The verb can also occur with merely R_1 , as in *Fritz singt* 'Fred is singing', or with R_1 and R_2 , as in *Fritz singt ein bekanntes Lied* 'Fred is singing a well-known song'. The verb can also form a sentence without a case relationship, like in *Es singt und klingt* 'it is singing and ringing' with the empty unpersonal 'it', like in 'it is raining', which is no more than an auxiliary NT used to get the obligatory surface form of a sentence and to carry number and person

⁷ Post (1987) used types e, i (times), and t as basic types and, naturally, arrived at type assignments similar to those presented here.

for verb agreement. Or it can occur with merely R_3 , as in *Es singt mir im Ohr* lit. 'it rings in my ear', which would be $\lambda x^3 \text{ sing}(s) \ \& R_3(x^3, s)$, or with the prepositional phrase included: $\lambda x^3 x^4 \text{ sing}(s) \ \& R_3(x^3, s) \ \& \text{IN}(x^4, s)$.

For the above representation of an n-e-place untensed verb I shall often use the shorter notation of Davidson (1967) with n variables x^j , $j \in K$, of type e:

$$\lambda x^1, x^2, \dots, x^m, s \ \alpha(x^1, x^2, \dots, x^m, s)$$

Since I use case markers, the order of the arguments could be free, but if nothing else is said, I sometimes take a fixed order to express the case relationships, for example:

$$\lambda x, y, z, s \ \alpha(x, y, z, s) \text{ for a three-place verb with } R_1(x, s), R_2(y, s), R_3(z, s).$$

Since these are relations the order of the variables following λ is free. They are all bound by λ . The order of the arguments of the verb is fixed such that the order can serve as a short expression for the case relationships.

There are two major kinds of verb modifiers, adverbs and aspects. The first just adds further conditions to the verb concept, the second introduces a discourse referent for the verb and at the same time forms a new concept in another variable which is related to the referent of the verb by the temporal relationship characteristic of the aspect. Adverbs leave the region of the situation which is characterized by the verb the same; it is defined by the same verb, with or without adverbial modifier, but aspects define a new region that is related to the old one, and on it the verb is not true, except for [+dur,-res] verbs which are also true on the region of their IMPERFECTIVE concept. This new region is the region where the concept expressed by ASPECT(α) holds. It characterizes a new situation which is a state, process or activity related by the respective aspectual relationship to the situation described by the verb α .

Verb modifiers (1): Adverbs

Adverbial expressions and adnominal expressions are constructed from predicates over situations (processes, activities, events, etc.) and over entities.

The basic type of an adverb is $((s,t),(s,t))$. Its representation is: $\lambda Q \lambda s \ Q(s) \ \& \ \alpha(s)$, where α is the basic predicate. Manner adverbs, instrumental adverbs, directional adverbs are based on such properties of situations. All adverbs can be lifted to types $((e^n, s, t), (e^n, s, t))$ for $n = 1, 2, \dots$, and the construction of representations of these types is evident, namely:

$$\lambda Q^n, s \ \lambda X \ \delta(\lambda s \ Q^n, s(X)), \text{ whereby } \delta \text{ is the representation of the adverbial of basic type.}$$

A special class of adverbs are the relational adverbs, and among them those that express temporal relationships. Here, α is constructed from a temporal relation between two situations. Being such an adverbial α has the internal form:

$$\lambda s \ [s'] \ T(s') \ \& \ \gamma(s') \ \& \ \beta(s, s')$$

This is, for example, the representation of a temporal subordinate clause, where β is the temporal relationship expressed by the connective conjunction, γ is the situational concept expressed by the subordinate clause, and T is the characteristic temporal property of TENSE. The problem with this view on temporal subordinate clauses has been mentioned: it does not guarantee temporal agreement between subordinate and main clause, which is typical for temporal hypotaxis, though not for causal and concessive ('because', 'although') hypotactic constructions.

Verbal modifiers (2): Aspects:

basic category: (V^S, V^S) , basic type: $((s,t),(s,t))$,

basic representation: $\lambda P \lambda s' [s] A(s') \& P(s)$,

whereby 'A' is the respective aspectual property for the aspects WERDEN, IMPERFECTIVE, PERFECTIVE.

A: = $\lambda s'[s] s' < s$, for WERDEN
 = $\lambda s' s \supset s'$, for IMPERF
 = $\lambda s' s < | s'$, for PERF

Aspects can, furthermore, be used in the categories $(V^{S,n}, V^{S,n})$, with the respective lifted types: $((e^n, s, t), (e^n, s, t))$. The respective representations are:

If α is a basic aspect representation, then the lifted representation of type $((e^n, s, t), (e^n, s, t))$ is:

$\lambda Q^{n,s} \lambda X \alpha (\lambda s Q^{n,s}(X)); \quad X = \{x^i, s \mid i \in K, |K|=n\}$.

Often the nominal term has broader scope than the aspect. The nominal term might be under the scope of TENSE, or not. In any case, the aspect α would then have to be in the category $(V^{S,n}, V^{S,n})$, i.e. of type $((e^n, s, t), (e^n, s, t))$. For $n=1$, the representation is $\lambda Q^{1,s} \lambda x \alpha (\lambda s Q^{1,s}(x, s))$, which results in $\lambda Q^{1,s} \lambda x (\lambda P \lambda s' [s] A(s') \& P(s)) (\lambda s Q^{1,s}(x, s)) = \lambda Q^{1,s} \lambda x \lambda s' [s] A(s') \& Q^{1,s}(x, s)$. The variable $Q^{1,s}$ will be replaced by a concept of a 1e-place untensed verb, when the aspect is applied to the verb concept.

Verb determiners: Tenses

The basic category of TENSE as a one-place verb-determiner is (V^S, V) , its basic type $((s,t), t)$. This means, it is a "generalized quantifier" over situational concepts. Its basic representation is:

$\lambda P [s] \text{TEMP}(s) \& P(s)$ for existential,
 and
 $\lambda P [s] \text{TEMP}(s) \rightarrow P(s)$ for universal tense determination.

Here, $V^{S,0} (=V^S)$ is the untensed zero-place verb as far as entity variables go, i.e. $|K|=0$, which has one lambda-bound situational variable, and $V^0 (=V=S)$ is the tensed zero-place verb, which is a sentence. The situational variable is bound by TENSE, which means that there is no unbound situational variable available anymore. TEMP is the characteristic temporal concept and P the verb concept, i.e. the situational concept. The tenses are built of basic tense concepts that consist of a deictic and/or anaphoric relationship. These last are zero (i.e. the tautological temporal condition) in the neutral present tense, which merely introduces a situational referent for the verb. We have for the basic tense concept TEMP, type (s,t) , a representation of the form:

TEMP: = $\lambda s \text{Truth}(s)$, for neutral tense
 = $\lambda s s \text{AT } s_0$ (& $s \text{AT } s'$), for PRES
 = $\lambda s s \text{AT } s'$, for NARRATIVE PRES

$$= \lambda s \ s < s_0 \ (\& s \text{ AT } s'), \text{ for SIMPLE PAST}$$

$$= \lambda s \ s_0 < s \ (\& s \text{ AT } s'), \text{ for SIMPLE FUT}$$

Besides these simple tenses, compound tenses can be built from simple tenses and aspects. But I shall treat the aspects not as modifiers of tenses, as could easily be done, but as modifiers of simple or complex verbs. The mechanism of the grammar permits both options.

There are lifted tenses in the categories $(V^{S,n}, V^{S,n})$, with the types $((e^n, s, t), (e^n, t))$, and the respective representations constructed as follows: If β is a basic tense then the corresponding lifted tense has the representation:

$$\lambda Q^{n,s} \lambda \{X-\{s\}\} \beta (\lambda s Q^{n,s}(X)), \text{ with } s \text{ as the situational variable.}$$

This lifting makes it possible to apply TENSE to any untensed n-place verb, and thus takes care of all kinds of scopes. If TENSE appears in the syntactic form

$$(\beta_{\text{TENSE}}(\alpha_{V^{S,n}})_{V^n}), \beta \text{ gets a type lifted for the category } (V^{S,n}, V^n).$$

Noun phrases: nouns and nominal terms

The term 'noun phrase' is not a category symbol but a name for a class of expressions that can be used in the categories NOUN or NOMINAL TERM. The category NOUN comprises simple common nouns and modifications of these by adnominal modifiers. The category NOMINAL TERM comprises proper names and the results of the application of nominal determiners on nouns.

Nouns: The basic category is N, its type: (e, s, t) , its representation: $\lambda x, s \ \alpha(x, s)$ ⁸.

The translation into the logic language of a common noun α in its basic categorial use N, α_N , is of the form: $\lambda x, s \ \alpha'(x, s)$ ⁹. Nouns are relations between an entity and a situation, i.e. two-place functions, for example the noun *patient* expresses the property of being, in a certain situation, a patient: x has in s this property; it is a situation dependent property. Some nouns express properties which an entity has in all situations. These are of the same type, but stable with respect to whatever situation. The situational variable s can be bound deictically or anaphorically. The situationally bound noun is a derived noun, which has the type (e, t) .

Noun modifiers:

Noun modifiers, adnominal expressions, are based on concepts about entities or situations. Temporal adnominals belong to the last group. If α is a situational concept, i.e. of the type (s, t) , for example *gestern* in *Das war/geschah gestern* 'That was/happened yesterday', then its use as an adnominal is of type $((e, s, t), (e, s, t))$. Its relationship to the corresponding basic adverbial type $((s, t), (s, t))$ is just a lift by e .

If α is the representation of type (s, t) , then the representation of the corresponding adverbial is $\lambda P \lambda s'' \ P(s'')$ & $\alpha(s'')$, and of the corresponding adnominal it is:

$$\lambda P^{1,s} \lambda x, s'' \ P^{1,s}(x, s'') \ \& \ \alpha(s'')$$

⁸ I use the letter 's' for three purposes: to indicate that a verb has a situational variable, i.e. is untensed, as a name for the basic situational type in the semantics language, and also as a variable of that type in the logical language used for discourse representation.

⁹ I shall omit the accent ' which distinguishes the logical language lexical expressions from the ones of natural language.

Let us take, for example, the adnominal *gestrige* 'yesterday's', the predicative and the adverbial version of this concept being *gestern* 'yesterday'. The basic concept, used predicatively, is of type (s,t):

$$\lambda s'' \text{ yesterday}(s'') = \lambda s'' \text{ day}(s'') \ \& \ [s'] \text{ day}(s') \ \& \ s' \supset s_0 \ \& \ s'' \supset s'$$

The adverbial is of type ((s,t),(s,t)): $\lambda P \lambda s'' P(s'') \ \& \ \text{yesterday}(s'')$

The adnominal is of type ((e,s,t),(e,s,t)): $\lambda P^{1,S} \lambda x,s'' P^{1,S}(x, s'') \ \& \ \text{yesterday}(s'')$

An example would be *gestrige Besucher* 'yesterday's visitor'. Together with the definite nominal determiner this would be *der gestrige Besucher* 'yesterday's visitor', or with the indefinite determiner *ein gestriger Besucher*.¹⁰

Another type of adnominals are the ones that relate to the entity. They are based on concepts about entities, which are of type (e,s,t), as they are used predicatively. The type of the adnominal use of these is ((e,s,t),(e,s,t)). Only the expressions of this subgroup of adnominal modifiers can be used as predications over entities: From 'this is a red hat' follows 'this hat is red', but from 'this is yesterday's visitor' we cannot conclude 'this visitor is yesterday's'. Their representation is

$$\lambda P^{1,S} \lambda x,s'' P^{1,S}(x, s'') \ \& \ \alpha(x,s'')$$

If the concept α is situationally bound, i.e. is not dependent on a situational variable, it is of type (e,t), and accordingly the adnominal is of the same type as above, and in the representation we just have $\lambda P^{1,S} \lambda x,s'' P^{1,S}(x, s'') \ \& \ \alpha(x,s'')$, where s' is an anaphoric or deictic variable. In a stable property the s' can be bound by an universal quantifier.

Nominal determiners: basic category $D = (N,NT)$; basic type ((e,s,t),((e,s,t),(s,t)))

For example:

ein 'a': $\lambda Q^{1,S} \lambda P^{1,S} \lambda s [x] Q^{1,S}(x,s) \ \& \ P^{1,S}(x,s)$

jeder 'every': $\lambda Q^{1,S} \lambda P^{1,S} \lambda s [x] Q^{1,S}(x,s) \rightarrow P^{1,S}(x,s)$

der 'the': $\lambda Q^{1,S} \lambda P^{1,S} \lambda s Q^{1,S}(x_i,s) \ \& \ P^{1,S}(x_i,s)$, with x_i anaphoric

If the determiner relates two tensed concepts Q^1 and P^1 it is of type ((e,t),((e,t),t)). This is the case if both, the noun Q^1 and the verb P^1 are tensed. Other possibilities are that the determiner relates a tensed noun Q^1 with an untensed verb $P^{1,S}$, or an untensed noun with a tensed verb. The types are ((e,t),((e,s,t),t)) and ((e,s,t),((e,t),t)) respectively.

Nominal terms: basic category $NT = (V^{S,1}, V^S)$, basic type ((e,s,t),(s,t)) for application to untensed verbs; basic category (V^1, V) , basic type ((e,t),t) for application to tensed verbs.

For example for

$$\text{John: } \lambda P^{1,S} \lambda s P^{1,S}(j,s) \quad \text{or: } \lambda P^1 P^1(j)$$

¹⁰ Note that in English *yesterday's* is already a determiner, which includes the deictical situational concept 'yesterday'. This, of course, reminds us, that we also could analyze the expression *gestern* in this position as a modifier on the determiner: *ein gestriger, der gestrige*. The possibility of treating these expressions as addeterminal is parallel with the possibility of treating the corresponding adverbs not as adverbs but as addeterminal with respect to the TENSE operator, i.e. *gestern*(PAST).

er 'he': $\lambda P^{1,S} \lambda s P^{1,S}(x_i, s)$, or: $\lambda P^1 P^1(x_i)$, with x_i anaphoric.

But nominal terms can be used in different cases. The moment a nominal term is applied to a verb it must be clear in which case-relationship it is applied. This is morphologically marked at the nominal term or expressed by a pre/postposition or by its position in the sentence. If NT^i , i.e. NT with case i , is applied to a verb, this case must still be available in the verb representation and not already been bound by another NT. Further, an NT can be used in several categories, namely in the categories $(V^{S,n}, V^{S,n-1})$, and (V^n, V^{n-1}) , i.e. mapping an n -place verb onto an $(n-1)$ -place verb. A nominal term, when applied as a sentence constituent, is therefore of one of the categories $(V^{S,n}, V^{S,n-1})$, and (V^n, V^{n-1}) and in one of the cases i . These two functions can be combined in a new category marker: $(V^{S,n}, V^{S,n-1})^i$, and $(V^n, V^{n-1})^i$. For these categories, I shall also write $(V^{S,K}, V^{S,K-\{i\}})$, and $(V^K, V^{K-\{i\}})$. A special case is $(V^{S,1}, V^S)^i$, and $(V^1, V)^i$, which is the subject nominal term if $i=1$. But in German, also the other cases can be used with the category $(V^{S,1}, V^S)$ and (V^1, V) , which means that they can be topic of the sentences if not stressed, and focus if they are stressed.

The derived lifted NT-categories $(V^{S,n}, V^{S,n-1})^i$ and $(V^n, V^{n-1})^i$ are of type $((e^n, s, t), (e^{n-1}, s, t))$ and $((e^n, t), (e^{n-1}, t))$, respectively.

Their representations can be constructed from the basic representation in the following way:

If β is the basic NT-representation, then the lifted representations are:

$\lambda Q^{n,S} \lambda \{X-\{x^i\}\} \beta (\lambda x^i Q^{n,S}(X))$, with X as the sequence of variables of an $(n-e)-(1-s)$ -place verb,
 $X = \{x^j, s \mid j \in K\}$, e.g. x^1, x^2, \dots, x^n, s ,

or

$\lambda Q^n \lambda \{X-\{x^i\}\} \beta (\lambda x^i Q^n(X))$, with X as the sequence of the $(n-e)$ -place verb, $X = \{x^j \mid j \in K\}$, e.g.
 x^1, x^2, \dots, x^n .

If such a term is applied to an n -place verb with the available case i , the verb replaces $Q^{n,S}$ or Q^n , which is a variable for the concepts of n -place untensed or tensed verbs. If a nominal term β is used in the categorial form $(\beta_{NT,i}(\alpha_{V^S,K})_{V^S,K-\{i\}})$, with $|K|=n$, it gets a type lifted for an n -place verb with the suitable case relationship. After the application of the term in case i the variable x^i is no more available for further term application and the verb is then an $(n-1)$ -place verb without a variable marked by i , as shown in the formula. If the verb is already tensed, i.e. $(\beta_{NT,i}(\alpha_{V^n,K})_{V^n,K-\{i\}})$, the sequence X of variables does not contain a situational variable, i.e. $X = \{x^j \mid j \in K\}$, $x^i \in X$. This will always be the case if TENSE has small scope with respect to one or more nominal terms.

The syntax which is already implicit in the categories and types discussed is very simple:

$(\alpha_{ADN}(\beta_N)N)$
 $(\alpha_D(\beta_N)NT)$
 If $i \in K$, $|K|=n$, $(\alpha_{NT}(\beta_{V^S,n})_{V^S,n-1})^i$, $(\alpha_{NT,i}(\beta_{V^n})_{V^n-1})^i$
 $(\alpha_{ADV}(\beta_{V^S,n})_{V^S,n})$
 $(\alpha_{ASPECT}(\beta_{V^S,n})_{V^S,n})$, $n:= 0,1,2,\dots$
 $(\alpha_{TENSE}(\beta_{V^S,n})_{V^n})$
 $V^0 = V = S$

The translations into the representation language, dynamic predicate logic, is straight forward, following the

representations of the basic type assignments for the respective categories and the derived representations of the assignments of the derived categories, as presented in the grammar.

Temporal agreement:

Temporal agreement in temporal hypotactical constructions makes it appropriate to either combine TENSE with the temporal connective first and then apply the result to the two situational concepts of the clauses to be connected, or to first combine the connective with the two situational concepts and then apply TENSE to the result. For both options it is necessary to lift TENSE such that it can be applied to temporal relationships and not just to temporal 1s-place relationships, namely situational concepts. This means, we lift TENSE from the basic type $((s,t),t)$ to the type $((s,s,t),t)$.

If $TENSE^1 (= TENSE)$ is the basic type, $TENSE^2$ is the raised type $((s,s,t),t)$, which applies to 2s-place situational concepts, then the representation of $TENSE^2$ is:

$$TENSE^2: \lambda P^2 TENSE (\lambda s (TENSE (\lambda s' P^2(s,s'))))$$

If β is a basic tense representation then we have:

$$\beta^2: \lambda P^2 \beta (\lambda s (\beta (\lambda s' P^2(s,s'))))$$

For any temporal connective α , we now can form $TENSE^2(\alpha) = TENSE (\lambda s (TENSE (\lambda s' \alpha(s,s'))))$. If we take the general basic tense representation $\lambda P [s] T(s) \& P(s)$, where T is the temporal property characteristic for the specific tense, 'C' the connective expressing the two-place concept C, we get:

$$TENSE^2(C) = [s] T(s) \& [s'] T(s') \& C(s,s')$$

This expression is of type t and it has to be lifted to $((s,t),(s,t),t)$ in order to be able to be applied to the pair of situational concepts of the subordinate and the main clause. Its representation is the one used in the chapter on hypotactic temporal constructions:

$$\lambda Q \lambda P [s] T(s) \& [s'] T(s') \& C(s,s') \& P(s) \& Q(s')$$

This representation is, in its last step, not constructed compositionally in the traditional sense, but it is semantically compositional with respect to the possibilities which Dynamic Predicate Logic (Groenendijk and Stokhof 1987) provides: the s and s' in 'P(s)' and 'Q(s)' are anaphorically bound to the preceding representation in this conjunction.

The other route is compositional in the traditional sense. We first apply the temporal connective to the two situational concepts, and then apply $TENSE^2$ to the result:

The basic type of a temporal connective C is (s,s,t) , and it is of the form $\lambda ss' C(s,s')$.

It has to be lifted to type $((s,t),(s,t),(s,s,t))$, in order to be applicable to a pair of situational concepts. If γ is of type (s,s,t) , then the lifted γ^2 of type $((s,t),(s,t),(s,s,t))$ has the representation: $\lambda Q,P,s,s'(Q(s) \& P(s') \& \gamma(s,s'))$. This gives us:

$$C-2: \lambda Q,P,s,s'(Q(s) \& P(s') \& C(s,s'))$$

If α and β are the situational concepts expressed in the two untensed clauses, we apply C-2 to the two concepts and get:

$$\lambda s,s'(\alpha(s) \& \beta(s') \& C(s,s'))$$

To this two-place situational concept we apply TENSE² and we get:

$$\begin{aligned} & \text{TENSE}^2(\lambda s, s'(\alpha(s) \ \& \ \beta(s') \ \& \ C(s, s'))) \\ & = \text{TENSE}(\lambda s(\text{TENSE}(\lambda s'(\alpha(s) \ \& \ \beta(s') \ \& \ C(s, s'))))) \\ & = [s] \text{T}(s) \ \& \ [s'] \text{T}(s') \ \& \ \alpha(s) \ \& \ \beta(s') \ \& \ C(s, s') \end{aligned}$$

We could also first apply it to one clause, let's say the subordinate clause, and in this way construct the temporal adverbial clause, which then this will be applied to the main clause. This stepwise procedure is useful, if we don't want to apply the subordinate clause to the whole main clause, as it happens when it precedes the main clause, but merely to a verb within the main clause, which will be a reasonable analysis if the main clause precedes. Then the temporal adverbial clause has a smaller scope, it has just the respective n-place verb in its scope. This operation requires again some lifting on the adverbial, which is straight forward: ((s,t),(s,t)) has to be lifted to ((eⁿ,s,t),(eⁿ,s,t)).

Let us now consider a simple example to illustrate scope difference of TENSE.

Example: *Every man drinks* TENSE(*every man(drink)*)

Following the rules above we get, for this categorial structure, the broad scope representation for TENSE:

$$[s] \text{TEMP}(s) \ \& \ ([y] \text{man}(y, s) \rightarrow \text{drink}(y) \ \& \ R_1(y, s))$$

Here, TEMP is the characteristic temporal concept of the tense in question. If TENSE is NEUTRAL PRESENT, we just get

$$[s] ([y] \text{man}(y, s) \rightarrow \text{drink}(y) \ \& \ R_1(y, s)).$$

This means that there is (somewhere in space and time) a situation s of which it is true that for every man it is a drinking situation, i.e. he drinks in it. This is a huge drinking event for all men together: each man is involved in this drinking occasion as an actor, since R₁ for the verb *drink* is the actor relationship.

Note that the parentheses that give the scope of [s] are very important. They indicate that [s] is an existential quantifier which in this position is not identical with the universal one. It is important to distinguish

$$[s][y] \alpha(y, s) \rightarrow \beta(y, s) \quad \text{from} \quad [s]([y] \alpha(y, s) \rightarrow \beta(y, s))$$

The first is equivalent with the predicate logic $\forall s \forall y (\alpha(y, s) \rightarrow \beta(y, s))$, but the second is equivalent with the predicate logic $\exists s (\forall y \alpha(y, s) \rightarrow \beta(y, s))$. Only the latter introduces a discourse referent in the text. By the above sentence a discourse referent is introduced, with the condition that it is for every man a drinking event.

If we take TENSE: = NARRATIVE PRESENT, the situation s will be connected anaphorically to another situation, for example a party at which the drinking event for all the men occurs:

$$[s] \text{AT}(s, s_i) \ \& \ ([y] \text{man}(y, s) \rightarrow \text{drink}(y) \ \& \ R_1(y, s)).$$

Compare with this the following categorial analysis:

Every man drinks with: (*every man*(TENSE(*drink*)))

The sentence with this categorial structure results into the broad scope reading for *every man*, which is the small scope reading for TENSE. Here, we combine the nominal term with a tensed verb. The result for an anaphorically bound nominal term is:

$$[x] \text{man}(x, s_i) \rightarrow [s] \text{TEMP}(s) \ \& \ \text{drink}(s) \ \& \ R_1(x, s)$$

If TENSE is simply NEUTRAL PRESENT we get:

$$[x] \text{man}(x, s_i) \rightarrow [s] \text{drink}(s) \ \& \ R_1(x, s)$$

Here, for every man in a situation s_i there is a drinking situation. This can be a different one for each man, but it can also be anaphorically linked to s_i ; if we take, e.g. NARRATIVE PRESENT:

$$[x] \text{man}(x, s_i) \rightarrow [s] \text{AT}(s, s_i) \ \& \ \text{drink}(s) \ \& \ R_1(x, s).$$

If s_i refers to the party, then here every man has his own drinking event. It is not expressed that they drink all together.

Instead of having besides the basic category (V^S, V) , with type $((s, t), t)$, a number of lifted ones of types $((e^n, s, t), (e^n, t))$, we could have TENSE fixed to just the basic category. This category, in fact leaves both options open, TENSE can be applied with smallest scope, or with broadest scope, i.e. before the n-place verb is constructed, or after all nominal terms have been applied to the n-place verb. In both events the verb is of type V^S .

If TENSE is applied before the n-place verb is constructed from the basic verb, the construction of the n-place verb has to take place on the basis of a tensed verb. The cases can be added according to the applied case-marked nominal terms, for example:

$$\beta_{NT,1}(\gamma_{NT,3}(\delta_{NT,2}(\text{TENSE}(\alpha_{Vs})V))) \text{ becomes}$$

$$\beta_{NT,1}(\gamma_{NT,3}(\delta_{NT,2}(\text{TENSE}(\alpha_{Vs})V_{1,2,3})))$$

The representation of the three-place tensed verb is:

$$\lambda x^1, x^2, x^3 [s] T(s) \ \& \ \alpha(s) \ \& \ R_1(x^1, s) \ \& \ R_2(x^2, s) \ \& \ R_3(x^3, s)$$

In Dynamic Predicate Logic we are allowed to add the case-relationships with an anaphorically bound s , in a normal predicate logic this would not be possible in a compositional way. Here, the composition is just conjunction together with abstraction. Although the basic category for TENSE allows for smallest and broadest scope, it does not allow TENSE to have scopes in between. For that we need the lifted categories for TENSE. But we can dispense with lifted categories of TENSE altogether if we use type lifting. Then just one single category for TENSE is sufficient. This is illustrated in the second version of flexibility, the type flexibility. But before introducing that version of grammar I want to discuss two modifications of the grammar just presented. One modification is that we have n-place verbs in a functional build-up, like in Montague grammar, but without the fixed order of nominal terms with respect to the verb, which is not so bad for English, but inappropriate for German. Instead we have for each sentence with a different order of nominal terms a verb with a different, but appropriate functional build-up. This functional build up is constructed by a simple method which will be presented below. The other modification is that we take the case-relationships as being part of the nominal terms instead of having them incorporated within the representation of the verb. In this version the untensed verb, whether simple or complex, always has the type (s, t) .

In the first approach, which is somewhat different from the one elaborated above, the verb is not an n-place function but is built up of higher order functions with a fixed order of λ -application with respect to the nominal terms. This order of λ -application is incorporated in the constructed structure of the verb. This grammar is, in fact, a typical Montague Grammar, except that the verb is constructed according to the order of the case-marked nominal terms which are sentence constituents, and that the nominal terms are all applied to the verb, and not just the subject term, as it is done in Montague Grammar. But the last is not essential in this context. We could as well have the verb be applied to the object phrases, though this would not correspond with verb-final constituent order. The construction of the verb is appropriate to the free constituent order in German and other languages with a rich case-system.

If a sentence in its verb-final form has the order of nominal terms $\alpha \beta \gamma \delta$ with respect to the verb δ , then its categorial form is $(\alpha (\beta (\gamma (\delta))))$.

The global information about the cases and the order of terms with respect to the verb can be expressed in combination according to the following schema of re-analysis of a sentence in categorial form:

$$\begin{aligned} &(\alpha_{T,i}(\beta_{T,j}(\gamma_{T,k}(\delta_V)))) = \\ &(\alpha_{T,i}(\beta_{T,j}(\gamma_{T,k}(\delta_{V,k})))) = \\ &(\alpha_{T,i}(\beta_{T,j}(\gamma_{T,k}(\delta_{V_{k,j}})))) = \\ &(\alpha_{T,i}(\beta_{T,j}(\gamma_{T,k}(\delta_{V_{k,j,i}})))) \end{aligned}$$

Let α' , β' , γ' , δ' be the representations of the respective terms and the verb. The representation of an untensed sentence of the above categorial form then is:

$$\lambda s(\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z \delta'(s) \& R_k(z,s) \& R_j(y,s) \& R_i(x,s))))))$$

For this we also write shorter:

$$\lambda s(\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z \delta'(x^i, y^j, z^k, s))))),$$

with i, j, k for the standard order of argument places for the respective verb, or

$$\lambda s(\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z \delta'(z^k)(y^j)(x^i)(s))))))$$

If the verb δ is tensed first, we have:

$$\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z [s] \delta'(s) \& R_k(z,s) \& R_j(y,s) \& R_i(x,s))))$$

For this we write shorter:

$$\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z [s] \delta'(x,y,z,s))))),$$

with standard order of the argument places of the verb, or also:

$$\alpha'(\lambda x \beta'(\lambda y \gamma'(\lambda z [s] \delta'(s)(z)(y)(x))))$$

In fact, in accordance with the basic type of TENSE, also all in-between positions are available for TENSE: $[s]$ may stand just before α' , or before β' , or before γ' , or before the verb δ' . This means that in this grammar the scopes of TENSE are to be handled in a very simple way: No matter where in the categorial structure TENSE appears with respect to the nominal terms and adverbials, it always has the same type, namely its basic type $((s,t),t)$. Likewise all the representations of the nominal terms have the same type, namely the basic type $((e,t),t)$.

But if we want to build up the structure compositionally, starting with the untensed constructed verb with broadest scope for TENSE, $\lambda z \lambda y \lambda x \lambda s \delta'(s) \& R_k(z,s) \& R_j(y,s) \& R_i(x,s)$, the nominal terms have to be in the appropriate types: An NT has the type $((e,(e,(e,(s,t))), (e,(e,(s,t))))$, if it applies to an untensed three-place verb, and the type $((e,(e,(e,t))), (e,(e,t)))$ if it applies to a tensed three-place verb. Generally, an NT in

category (V^n, V^{n-1}) has the respective types $(e^{n>}, (s,t)), (e^{n-1>}, (s,t))$ and $((e^{n>}, t), (e^{n-1>}, t))$, which here are short expressions for the functional forms with n entity expressions. Also TENSE has to have appropriately raised types in the different categories $(V^{n,s}, V^n)$, but then built up in a functional form. The representations corresponding to the raised types are straight forward, similar to the ones derived before, but with a functional build-up expressed in the order of λ -abstracted variables.

Latest developments in Dynamic Predicate Logic, Groenendijk and Stokhof (1988), make it possible to give a compositional semantics to expressions with anaphoric variables which follow negative expressions, disjunctions or conditionals and form a conjunction with them, whereby the anaphoric variables are bound by a discourse referent within the preceding negation, disjunction or conditional. This makes it possible to define dynamic counterparts of the stable negation, disjunction, conditional and specially the stable universal quantifier which do not bind anaphoric variables outside their scope. With this semantics of "Hyperdynamic Predicate Logic" we can, considerably, simplify our categorial grammar with cases by treating the cases categorially and semantically as parts of the nominal terms, where they anyhow are situated morphologically, and use the simplest form of the verb without any case markings. Here, any simple or complex untensed verb phrase is of the same type: (s,t) . A nominal term in a case maps the verb of type (s,t) on a new complex verb of type (s,t) . The lexicon has to restrict the use of cases with respect to a verb. When a nominal term in a certain case has been used with respect to a verb, another term in the same case can be use with the same verb only in an appositional conjunction, for example:

Ein Junge kam, und ein Mädchen , ein Hund und ein Esel.
'A boy came, and a girl, a dog, and a donkey'

The representation will be:

$[s][x]$ boy (x,s) & $R_1(x,s)$ & come (s) & $[y]$ girl (y,s) & $R_1(y,s)$ & $[z]$ dog (x,s) & $R_1(z,s)$ &
 $[w]$ donkey (w) & $R_1(w,s)$

In this way, iteration of a case is possible. But this iteration is not possible in the same position, there a conjoined term would have to be constructed which is a plural term:

Ein Junge, ein Mädchen, ein Hund und ein Esel kamen.
'A boy, a girl, a dog and a donkey came'

Cases are two-place concepts of the form $\lambda x, s R_i(x,s)$, with the first variable as a participant variable and the second as a situational variable. The determiners *ein* 'a', *jed-* 'every' have the respective representations:

$\lambda S \lambda Q \lambda P \lambda x \lambda s S(x,s) \ \& \ Q(x,s) \ \& \ P(s)$
 $\lambda S \lambda Q \lambda P \lambda x \lambda s S(x,s) \ \rightarrow Q(x,s) \ \& \ P(s)$

The variable S will be filled by the noun representation and the variable Q by the case-representation. In this functional form, the determiner is first applied to the noun and then to the case. The result, the nominal term in a case, is of type $((s,t), (s,t))$, i.e. it will be applied to a simple or complex verb. Its representation will replace the variable P . At last, TENSE will be applied, and thus TENSE will have broadest scope. To receive the other scope interpretations for TENSE we would need to also formulate a rule for the application of nominal terms in cases to tensed verbs. Hereby we would need to make use of anaphoric binding of the situational variable of the case relationship by the situational referent of the verb that has already been introduced by TENSE. This means we would have to take into account information about the representational structure when building up the complex representation from those of the nominal term with its case and of the tensed verb. This is, from a syntactic point of view, not fully compositional in the same way as choosing an anaphoric pronoun in a text is not fully compositional. Nevertheless, the resulting representations can be interpreted in a compositional semantics, following Groenendijk and Stokhof (1988).

In this grammar, the nominal terms and the aspects are of the same semantic type, namely $((s,t), (s,t))$. The main difference between both is that the nominal terms introduce new entity variables to which the

situational variable of the verb is related by the case relationships, and the aspects introduce new situational variables that are related to the situational variable of the verb by aspectual relationships. The new entity variables do not change the type of the complex verb because they are bound by the determiners of the respective nominal terms. The categorial position of ASPECT is in principle free, but it has to have a smaller scope than TENSE. If ASPECT is within the scope of a nominal term we have to take care that the case relationship of the later applied nominal term gets anaphorically connected with the event variable of the basic verb and not with the situational variable introduced by ASPECT. For this we have to look into the verb-phrase representation, and this is syntactically not fully compositional. Once a representation is constructed its interpretation is done by a compositional semantics. To use syntactically not fully compositional procedures within a sentence, which otherwise are used only in texts, is the disadvantage of not having the case relationships incorporated in the verb. This 'disadvantage' occurs only in small scope interpretations of ASPECT and TENSE, i.e. if they are within the scope of nominal terms which are sentence constituents. This kind of relating nominal terms anaphorically to the situation characterized by the verb by using its situational referent anaphorically in the case-relationship reflects the following fact about the small scope readings of TENSE: the situational referent of the verb cannot be interpreted independently of the nominal terms in the scope of which the tensed verb occurs.

We conclude that this grammar is only syntactically fully compositional if we take TENSE to have broadest scope and ASPECT second broadest scope. But then we would miss the other scope interpretations. The other scopes require the use of anaphoric pronouns like they are used in texts. The semantics is compositional in any event.

10.2. A FLEXIBLE TYPE GRAMMAR FOR TENSE

Other than the nominal terms and the adverbs in German, which may occur in free order as constituents of a sentences, thus making order, together with intonation, available for expressing topic and focus distribution, and for expressing scope in a natural manner, TENSE cannot occur freely. It is always bound morphologically to the finite verb. The question therefore arises, whether we should not also give TENSE a fixed position in the categorial structure. If we do this there are two possibilities: it can have smallest scope, or it can have broadest scope. Whatever we decide, the other scope possibilities have then to be handled by type shifting, especially by t-argument raising of the verb arguments, following Hendriks 1987.¹¹ The same question has to be raised with respect to ASPECT. I shall now investigate broadest categorial scope for TENSE.

The grammar we present now has a fixed categorial position of TENSE. We shall explore whether it makes any difference whether we assign categorially a fixed broadest scope to TENSE or a fixed smallest scope.

Such a fixed order with broadest scope for TENSE and functional application according to this order would, for example, be:

$$\text{TENSE}(\text{ASPECT}(\text{NT}_i(\text{NT}_j(\text{NT}_k(\text{V}^{s,3})))))),$$

i.e. categories:

$V^0=S$, TENSE: $(V^{s,0}, V^0)$, ASPECT: $(V^{s,1}, V^{s,1})$, and the NT's according to position as $(V^{s,n}, V^{s,n-1})$ for $n:= 1,2,3$

and the types accordingly:

S: t, TENSE: $((s,t),t)$, ASPECT: $((s,t),(s,t))$, NT: $((e,(s,t)),(s,t))$, $((e,(e,(s,t))),e,(s,t))$, $((e,(e,(e,(s,t))),e,(e,(s,t))))$ for the respective NT-categories, or short: $((e^{n>},(s,t)),(e^{n-1>},(s,t)))$.

¹¹ From the discussion of the question of whether smallest or broadest scope is adequate, we can conclude that broad scope is necessary as well as smallest scope. Bach (1980, 1983) argues that TENSE should be part of the verb phrase, while Siegel (1987) argues that wide scope is needed, even such that it can comprise compound sentences.

Let us again treat the simple example. But now we have a fixed categorial position of TENSE, first the position with broadest scope. With that position we can naturally get a broad scope interpretation, and a small scope interpretation by type-lifting.

Example: *Every man (drink+Temp, num,pers);*
the categorial form: $\text{TENSE}(\text{every man}_{\text{NT1}}(\text{drink}_{\text{VS},1})_{\text{VS},0})$

Broad scope interpretation for TENSE:

Its representation is straight forward:

$$\begin{aligned} & (\lambda P[s] \text{TEMP}(s) \ \& \ P(s))(\lambda Q^{1,s} \lambda s'([y] \text{man}(y)(s) \rightarrow Q^{1,s}(y)(s)))(\text{drink}) \\ & = \lambda P[s] \text{TEMP}(s) \ \& \ P(s)(\lambda s'([y] \text{man}(y)(s) \rightarrow \text{drink}(y)(s))) \\ & = [s] \text{TEMP}(s) \ \& \ [y] \text{man}(y)(s) \rightarrow \text{drink}(y)(s) \end{aligned}$$

TEMP is the temporal concept characteristic for the respective tense.

Small scope interpretation for TENSE:

We keep the same categorial form as above: $\text{TENSE}(\text{every man}(\text{drink}))$. In order to get, nevertheless, a small scope interpretation for TENSE, we have to lift the verb *drink* from the basic:¹²

$$\lambda x \lambda s \text{drink}(x)(s), \text{ of type } (e,(s,t)),$$

to higher type $((e,t),((s,t),t))$ by, first, t-argument raising with respect to the situational variable *s*, and then t-argument raising with respect to the entity variable *x*.

t-argument raising *s*: $\lambda T \lambda x . T \lambda s \text{drink}(x)(s)$; here, *T* is of type $((s,t),t)$;

t-argument raising *x*: $\lambda T' \lambda T . T' \lambda x . T \lambda s \text{drink}(x)(s)$; here, *T'* is of type $((e,t),t)$.

The variable *T* will be replaced by the TENSE-representation and is therefore of the type $((s,t),t)$. Note, that we have to take into account that the verb is already bound by TENSE when we apply the nominal term *T'*, which means that the nominal term has to be of type $((e,t),t)$.

t-value raising¹³ *every man*: $\lambda T . T(\lambda Q \lambda s([y] \text{man}(x)(s) \rightarrow Q(y)))$; here, *T* is of type $((((e,t),t),t),t)$.

every man(drink):

$$\begin{aligned} & (\lambda T . T(\lambda Q \lambda s([y] \text{man}(x)(s) \rightarrow Q(y))))(\lambda T' \lambda T . T' \lambda x . T \lambda s' \text{drink}(x)(s')) \\ & = (\lambda T' \lambda T . T' \lambda x . T \lambda s' \text{drink}(x)(s'))(\lambda Q \lambda s([y] \text{man}(x)(s) \rightarrow Q(y))) \\ & = \lambda T (\lambda Q \lambda s([y] \text{man}(x)(s) \rightarrow Q(y)))(\lambda x (T(\lambda s' \text{drink}(x)(s')))) \\ & = \lambda T \lambda s([y] \text{man}(x)(s) \rightarrow (\lambda x (T(\lambda s' \text{drink}(x)(s')))(y))) \\ & = \lambda T \lambda s([y] \text{man}(x)(s) \rightarrow (T(\lambda s' \text{drink}(y)(s')))) \end{aligned}$$

t-value raising TENSE: $\lambda T . T(\lambda P[s'] \text{TEMP}(s') \ \& \ P(s'))$; here, *T* is of type $((((s,t),t),t),t)$.

TENSE(*every man(drink)*):

¹² For the general theory cf. Hendriks (1987); t-raising of some type *a* means: $a \rightarrow ((a,t),t)$.

¹³ We can dispense here with t-value raising, if we do not fix the function-argument order within a constituent. This means that it does not matter whether we apply the nominal term to the verb, or the verb to the nominal term.

$$\begin{aligned}
 & (\lambda T.T(\lambda P [s''] \text{TEMP}(s'') \ \& \ P(s''))) (\lambda T \lambda s ([y] \text{man}(x)(s) \rightarrow T(\lambda s' \text{drink}(y)(s')))) \\
 & = (\lambda T \lambda s ([y] \text{man}(x)(s) \rightarrow T(\lambda s' \text{drink}(y)(s')))) (\lambda P [s''] \text{TEMP}(s'') \ \& \ P(s'')) \\
 & = \lambda s ([y] \text{man}(x)(s) \rightarrow (\lambda P [s''] (\text{TEMP}(s'') \ \& \ P(s'')) (\lambda s' \text{drink}(y)(s')))) \\
 & = \lambda s ([y] \text{man}(x)(s) \rightarrow ([s''] \text{TEMP}(s'') \ \& \ (\lambda s' \text{drink}(y)(s'))(s'))) \\
 & = \lambda s ([y] \text{man}(x)(s) \rightarrow ([s''] \text{TEMP}(s'') \ \& \ \text{drink}(y)(s')))
 \end{aligned}$$

The s can be bound anaphorically to the preceding sentence or deictically to the speech situation. We could have started with a deictically or anaphorically tense bound NT; then the result would be:

$$[y] \text{man}(x)(s) \rightarrow ([s''] \text{TEMP}(s'') \ \& \ \text{drink}(y)(s'))$$

We have received a small scope representation for TENSE, and a small scope interpretation accordingly, although TENSE has broad scope in the assumed categorial structure.

The other possibility is to start out with categorially small scope for TENSE, and accordingly for ASPECT. This is suggested by the fact that the tense marking is attached to the verb, or to the auxiliary verb in a construction where TENSE is applied to ASPECT-VERB. An example of such a categorial order is:

$$\text{NTi}(\text{NTj}(\text{NTk}(\text{TENSE}(\text{ASPECT}(\text{V}^{s,3}))))))$$

This would mean that we either need to have lifted ASPECT and TENSE categories, according to how many places the verb has, or we have to add the case relationships to the verb after ASPECT and TENSE have applied. In the second case, we have to take care of the fact, that the cases have not to be associated with the situational variable of the ASPECTUAL concept, but rather with the basic verb concept, i.e. with the event variable. This variable has to be the anaphoric variable for the case relationships. This selection of the right variable is, of course, not fully compositional under a syntactic point of view: we have to look into the structure to pick the right anaphoric variable for the case relationships. But the semantics is fully compositional for the representation constructed. The interpretation is done in dynamic predicate logic following Groenendijk and Stokhof (1987/1988).

I now shall show how the grammar works if we take a fixed small categorial scope for TENSE. We shall see that then only nominal terms of type $((e^n, t), (e^{n-1}, t))$ can be used, i.e. they have to be bound in their situational variable. But this means that a nominal term cannot be bound by the situational variable introduced in its accompanying verb, even if we get the wide scope interpretation for TENSE by type-shifting the verb by means of t-argument raising. This will be shown presently.

Consider the categorial structure $((\beta_{\text{NT}}(\text{TENSE}(\alpha_{\text{V}} s)_{\text{V}})_{\text{V}})_{\text{O}} = s)$, first with basic type assignment, and then with argument raised type of the verb, in order to achieve a broad scope TENSE interpretation. The example will be again *Every man drinks*, but now in the fixed categorial form $(\text{Every man}(\text{TENSE}(\text{drink}))$.

1. Using just basic type assignment for the categories this results, naturally, into a small scope interpretation for TENSE:

$$\begin{aligned}
 & (\lambda P [x] \text{man}(x, s') \rightarrow P(x)) (\lambda x (\lambda Q [s] \text{TEMP}(s) \ \& \ Q(s)) (\lambda s \text{drink}(x, s))) \\
 & = [x] \text{man}(x, s') \rightarrow [s] \text{TEMP}(s) \ \& \ \text{drink}(x, s)
 \end{aligned}$$

The situational variable s' is anaphoric with respect to a situational discourse referent of the preceding text, or to the speech situation.

2. We now use raised types with the same categorial structure in order to receive a broad scope interpretation for TENSE:

t-argument raising of the verb ' $\lambda s \lambda x \text{drink}(x,s)$ ' first in x : $\lambda T_{((e,t),t)} \lambda s T \lambda x \text{drink}(x,s)$

t-argument raising of the verb in s : $\lambda T'_{((s,t),t)} \lambda T_{((e,t),t)} T' \lambda s T \lambda x \text{drink}(x,s)$

To cut short, we dispense with t-value raising. Instead of t-value raising the TENSE-representation in order to be able to apply it to this raised verb representation, we simply apply this verb representation to the TENSE-representation, as it is: instead of 'TENSE(α)' we have ' α (TENSE)'.

$$\begin{aligned} & (\lambda T'_{((s,t),t)} \lambda T_{((e,t),t)} T' \lambda s T \lambda x \text{drink}(x,s)) (\lambda Q [s] \text{TEMP}(s) \ \& \ Q(s)) \\ & = \lambda T_{((e,t),t)} (\lambda Q [s] \text{TEMP}(s) \ \& \ Q(s)) (\lambda s T \lambda x \text{drink}(x,s)) \\ & = \lambda T_{((e,t),t)} [s] \text{TEMP}(s) \ \& \ T \lambda x \text{drink}(x,s) \end{aligned}$$

Instead of t-value raising the nominal term, I just let the application take place the other way around, apply the verb to nominal term; i.e. instead of $\beta_{NT}(\alpha)$ we have $\alpha(\beta_{NT})$:

$$\begin{aligned} & (\lambda T_{((e,t),t)} [s] \text{TEMP}(s) \ \& \ T \lambda x \text{drink}(x,s)) (\lambda P [x] \text{man}(x, s') \rightarrow P(x)) \\ & = [s] \text{TEMP}(s) \ \& \ (\lambda P [x] \text{man}(x, s') \rightarrow P(x)) (\lambda x \text{drink}(x,s)) \\ & = [s] \text{TEMP}(s) \ \& \ ([x] \text{man}(x, s') \rightarrow \text{drink}(x,s)) \end{aligned}$$

Since the nominal term has to be a tensed one when being applied to the verb (in order to fit with the type of the variable T), the situational variable of the verb does not bind the situational variable of the nominal term.

Let us see what would happen if the nominal term was of type $((e,t),(s,t))$, which means that it is itself not yet tensed and has the representation: $\lambda P \lambda s' [x] \text{man}(x, s') \rightarrow P(x)$. Then the end result would be: $[s] \text{TEMP}(s) \ \& \ (\lambda s' [x] \text{man}(x, s') \rightarrow \text{drink}(x,s))$. But this is not correct, because no situational variable is available to which the λ -bound expression can be applied. We would need to somehow introduce an anaphoric variable, possibly s , to which we can apply the λ -bound expression. But this is not a compositional procedure, and we therefore must conclude that the nominal term must be tense bound before we combine it with the tensed verb, also in the broad scope interpretation for TENSE. From this the non-desirable fact follows that sentences like

Ein singender Mann kam herein 'A singing man entered'

cannot, by this method, be interpreted with broad scope for TENSE, which means that *singing man* could not be evaluated at event time, i.e. at the time of entering, but has to be interpreted with respect to a situation anaphorically referred to. Therefore the conclusion is that TENSE should not be analyzed as having basically a category that gives it small scope. If TENSE is taken as basically having broad scope, we can get all other scope interpretations by verb argument lifting, following the theory of Hendriks (1987). In this model of grammar in which for every sentence the application of its constituents is fixed according to the construction of the verb in accordance with the order of these constituents, TENSE, which is morphologically located just in one position of the sentence, should therefore also be located only in one categorial position. But, unfortunately, this cannot be the categorial position that the fact that TENSE is part of the verb morphology suggests, namely the position closest to the verb. TENSE has to take categorially broadest scope, or it should not be fixed categorially at all at all. In the first case we have one single category for TENSE, but different types assigned to the verb by means of t-argument lifting, in the last we have flexible categories with, for each, one appropriately assigned type. In both cases, the derived types are all derived from one basic type, though in a different way. The semantic results are the same.

III. References

- Bach, E. 1980. Tenses and Aspects as Functions on Verb-Phrases. In: Rohrer, Ch. (ed.). *Time, Tense, and Quantifiers*. Tübingen: Niemeyer Verlag: 19-37.
- Bach, E. 1981. On Time, Tense and Aspect. An Essay in English Metaphysics. In: Cole, P. (ed.), *Radical Pragmatics*. New York: Academic Press: 63-81.
- Bach, E. 1983. Generalized Categorical Grammars and the English Auxiliary. In: Heny F. and Richards, B.(eds.). *Linguistic Categories: Auxiliaries and Related Puzzles. II*. Dordrecht: D. Reidel: 101-120.
- Ballweg, J. 1983. Praesentia non sunt multiplicanda praeter necessitatem. In Ballweg, J. and Stickel, G. (eds.), *Pragmatik in der Grammatik: Jahrbuch 1983 des Instituts für Deutsche Sprache*. Düsseldorf: Schwann Verlag.
- Bäuerle, R. 1979. *Temporale Deixis und temporale Frage*. Ergebnisse und Methoden moderner Sprachwissenschaft 5. Tübingen: Gunter Narr Verlag.
- Bartsch, R. 1975. The Role of Categorical Grammar in Grammatical Theory. In: Kasher, A. (ed.), *Language in Focus: Foundations, Methods, Systems. Essays in memoriam Y. Bar-Hillel*. Boston Studies in the Philosophy of Science, Vol. 43. Dordrecht-Boston; De Reidel: 503-540.
- Bartsch, R. 1981. Semantics and Syntax of Nominalizations. In: Groenendijk, J., Janssen Th., and Stokhof, M. (eds.), *Formal Methods in the Study of Language*. Mathematical Centre Tract 135. Amsterdam: CWI, Centrum for Mathematics and Computer Science: 1-28.
- Bartsch, R. 1986. On Aspectual Properties of Dutch and German Nominalizations. In: Lo Cascio, V. and Vet, C.(eds.), *Temporal Structure in Sentence and Discourse*. Dordrecht-Riverton: Foris Publications: 1-40.
- Bartsch, R. 1987. Frame Representations and Discourse Representations. ITLI Prepublication Series 87-02, University of Amsterdam. To appear in *Theoretical Linguistics*.
- Barwise J. and Perry J. 1983. *Situations and Attitudes*. Cambridge, Mass.: MIT Press.
- Comrie, B. 1976. *Aspect. An Introduction to the Study of Verbal Aspect and Related Problems*. Cambridge: University Press.
- Davidson, D. 1967. The Logical Form of Action Sentences. In: Resher, N. (ed.). *The Logic of Decision and Action*. Pittsburgh: The University of Pittsburgh Press. Also in: Davidson, D. 1982. *Essays on Actions and Events*. Oxford: Clarendon Press: 105-148.
- Ehrich, V. 1987 ms. Tempusbedeutung und temporale Referenz im Deutschen. Manuscript. Max Planck-Institute für Psycholinguistik. Nijmegen. The Netherlands.
- Eisenberg, P. 1986. *Grundriss der Deutschen Grammatik*. Stuttgart: J.B. Metzlersche Verlagsbuchhandlung.
- Fabricius-Hansen, C. 1986. *Tempus fugit: Über die Interpretation temporaler Strukturen im Deutschen*. Sprache der Gegenwart 64. Düsseldorf: Schwann Verlag.
- Groenendijk, J. and Stokhof, M. 1987. Dynamic Predicate Logic. Towards a compositional and non-representational discourse theory. Manuscript. ITLI, Department of Philosophy. University of Amsterdam.
- Groenendijk J. and Stokhof, M. 1988. Context and Information in Dynamic Semantics. Manuscript. ITLI/Department of Philosophy. University of Amsterdam.
- Helbig, G. and Buscha, J. 1974. *Deutsche Grammatik*. Ein Handbuch für den Ausländerunterricht. Leipzig: VEB Verlag Enzyklopädie.
- Hendriks, H. 1987. Type Change in Semantics: the Scope of Quantification and Coordination. In: Klein, E. and van Benthem, J. (eds.), *Categories, Polymorphism and Unification*. Centre for Cognitive Science, University of Edinburgh and Institute of Language, Logic, and Information, University of Amsterdam: 95-120.
- Hendriks, H. 1988. Flexibele Montague-Grammatica. To appear in: *GLOT*.
- Hinrichs, E. 1986. Temporal Anaphora in Discourses of English. In: *Linguistics and Philosophy* 9: 63-82.
- Janssen, Th. 1983. Scope ambiguities of Tense Operators in Montague Grammar. In: Heny F. and Richards, B.(eds.). *Linguistic Categories: Auxiliaries and Related Puzzles. II*. Dordrecht: D. Reidel: 55-99.

- Kamp, H. 1979. Events, Instants, and Temporal Reference. In: Bäuerle, R., Egli, U., and Stechow, A. von (eds.). *Semantics from Different Points of View*. Berlin-Heidelberg-New York: Springer Verlag: 376-417.
- Kamp, H. and Rohrer, Chr. 1983. Tense in Texts. In: Bäuerle, R., Schwarze, Ch., and Stechow, A. von (eds.). *Meaning, Use, and Interpretation of Language*. Berlin-New York: de Gruyter: 250-269.
- Kamp, H. 1984. A Theory of Truth and Semantic Representation. In: Groenendijk, J., Janssen, Th., and Stokhof, M. (eds.). *Truth, Interpretation, and Information*. Dordrecht-Riverton: Foris Publications: 1-42.
- Landman, A. 1986. *Towards a Theory of Information: The Status of partial objects in Semantics*. Dordrecht-Riverton: Foris Publications.
- Ludwig, O. 1971. Ein Vorschlag für die semantische Analyse des Präsens. *Linguistische Berichte* 14: 34-41.
- Partee, B. 1984. Nominal and Temporal Anaphora. In: *Linguistics and Philosophy* 17:243-286.
- Post, A. 1987. Temporal Predication. Semantics of Temporal Elements in Natural Language. Doctoraal Scriptie. Institute of General Linguistics. University of Utrecht.
- Reichenbach, H. 1947. *Elements of Symbolic Logic*. Toronto: The Macmillan Company.
- Roberts, C. 1987. Modal Subordination, Anaphora, and Distributivity. Dissertation. Department of Linguistics. University of Massachusetts. Amherst.
- Russell, B. 1921. Words and Meaning. In: Russell, B. *The Analysis of Mind*. First edition. New Edition 1961, London: Allen & Unwin.
- Siegel, M. 1987. Compositionality, Case, and the Scope of Auxiliaries. In: *Linguistics and Philosophy* 10: 53-75.
- Vater, H. 1975. WERDEN als Modalverb. In: Calbert, J.P. and Vater, H. *Aspekte der Modalität*. Tübingen: Gunter Narr Verlag: 71-148.
- Veltman, F. 1985. *Logics for Conditionals*. Dissertation. Department of Philosophy. University of Amsterdam.
- Vendler, Z. 1967. *Linguistics in Philosophy*. Ithaca, New York.
- Venneman, Th. 1987. Tempora und Zeitrelation im Standarddeutschen. In: *Sprachwissenschaft* 12, Heft 2:234-249.
- Whitehead, A. 1919. *The Concept of Nature*. Cambridge: University Press. First Paperback Edition 1964.
- Wunderlich, D. 1970. *Tempus und Zeitreferenz im Deutschen*. München: Max Hueber Verlag.

The ITLI Prepublication Series

1986

- 86-01 The Institute of Language , Logic and Information
86-02 Peter van Emde Boas A Semantical Model for Integration and Modularization of Rules
86-03 Johan van Benthem Categorical Grammar and Lambda Calculus
86-04 Reinhard Muskens A Relational Formulation of the Theory of Types
86-05 Kenneth Bowen, Dick de Jongh Some Complete Logics for Branched Time, Part I
86-06 Johan van Benthem Logical Syntax

1987

- 87-01 Jeroen Groenendijk, Martin Stokhof Type shifting Rules and the Semantics of Interrogatives
87-02 Renate Bartsch Frame Representations and Discourse Representations
87-03 Jan Willem Klop, Roel de Vrijer Unique Normal Forms for Lambda Calculus with Surjective Pairing
87-04 Johan van Benthem Polyadic quantifiers
87-05 Víctor Sánchez Valencia Traditional Logicians and de Morgan's Example
87-06 Eleonore Oversteegen Temporal Adverbials in the Two Track Theory of Time
87-07 Johan van Benthem Categorical Grammar and Type Theory
87-08 Renate Bartsch The Construction of Properties under Perspectives
87-09 Herman Hendriks Type Change in Semantics: The Scope of Quantification and Coordination

1988

Logic, Semantics and Philosophy of Language:

- LP-88-01 Michiel van Lambalgen Algorithmic Information Theory
LP-88-02 Yde Venema Expressiveness and Completeness of an Interval Tense Logic
LP-88-03 Year Report 1987
LP-88-04 Reinhard Muskens Going partial in Montague Grammar
LP-88-05 Johan van Benthem Logical Constants across Varying Types
LP-88-06 Johan van Benthem Semantic Parallels in Natural Language and Computation
LP-88-07 Renate Bartsch Tenses, Aspects, and their Scopes in Discourse

Mathematical Logic and Foundations:

- ML-88-01 Jaap van Oosten Lifschitz' Realizability
ML-88-02 M.D.G. Swaen The Arithmetical Fragment of Martin Löf's Type Theories with weak Σ -elimination

Computation and Complexity Theory:

- CT-88-01 Ming Li, Paul M.B. Vitanyi Two Decades of Applied Kolmogorov Complexity
CT-88-02 Michiel H.M. Smid General Lower Bounds for the Partitioning of Range Trees