CHAPTER X

SCOPE AMBIGUITIES OF TENSE, ASPECT AND NEGATION

ABSTRACT

In this chapter verbal constructions with will, have, with negation, and with the past tense are considered. The meanings of these syntactic constructions are expressed by semantic operators. These operators have a certain scope, and differences in scope give rise to semantic ambiguities. These scope ambiguities are investigated, and a grammar dealing with these phenomena is presented. In this grammar features and queries are used, and the grammar produces labeled bracketings.
1. INTRODUCTION

Verbal constructions with will, have, with negation, or with the past tense, give rise to semantic operators: negation, tense operators and aspect operators. The syntactic counterparts of such operators I will call 'verb-modifiers'. So a basic verb modifier consists sometimes of a single word (will, have), sometimes of two words (do not), and sometimes of a verb affix (for the past). Compound verb modifiers are combinations of basic modifiers; they may consist of several words (will not have).

The semantic operators which correspond with basic verb modifiers have a certain scope, and a sentence can be ambiguous with respect to the scope of such an operator. The aim of the present chapter is to present a treatment of scope phenomena involving terms and verb modifiers. Examples of such ambiguities are provided by sentences (1) and (2). Both are ambiguous; each sentence may concern either the present president or the future president.

(1) The president will talk

(2) John will hate the president.

It is not my aim to analyse in detail the semantic interpretation of operators corresponding with verb modifiers. I will not present proposals for the formal semantics of tense or aspect; there is, in my treatment, no semantic difference between past and perfect (there is a syntactic difference). It is my aim to investigate only scope phenomena of operators and not to consider the operators themselves.

The main conclusion concerning the treatment of scope will be that the introduction of verb modifiers has to be possible both on the level of verb phrases and on the level of sentences. Another conclusion will be that compound verb modifiers have to be introduced in a step by step process: each step introducing one semantical operator. The treatment that I will present does not deal with all scope phenomena correctly (see section 5).

2. THE PTQ APPROACH

2.1. Introduction


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syntactic and semantic aspects of that proposal and compare these with related aspects of my approach.

2.2. Syntax of PTQ

The grammar of PTQ has six operations for the treatment of verb modifiers: rules for present, perfect and future, and for the negated variants of these tenses. Some examples:

F14 \((\text{John}, \text{walk}) = \text{John has walked}\)

F15 \((\text{John}, \text{walk}) = \text{John has not walked}\)

F11 \((\text{John}, \text{walk}) = \text{John does not walk}\).

These operations are completely independent. The operation 'make a sentence in the perfect tense' is independent of the operation 'make a sentence in the negative perfect tense'. One would like to have here another situation.

My treatment aims at a so-called 'orthogonal' syntax: each phenomenon will be treated by its own collection of rules (e.g. 'negating' will be treated by means of a rules which just deal with negation), and all such collections of rules will have the same structure as much as possible.

The PTQ rules do not treat conjoined verb phrases correctly since only the first verb is conjugated. So the PTQ syntax produces (3) instead of (4).

(3) \(\text{John has walked and talk}\)

(4) \(\text{John has walked and talked}\)

FRIEDMAN (1979) has given a treatment of this kind of error, and the treatment in this chapter of these problems will be about the same as hers.

The rules of PTQ deal with only three verb-modifiers: future, perfect and negation. Compound modifiers such as past perfect (in \(\text{had walked}\)) are not treated, nor the simple past (\(\text{walked}\)). These modifiers will be incorporated in the fragment of the present chapter. Furthermore, compound verb phrases will be incorporated of which the conjuncts (disjuncts) may be modified in different ways (\(\text{has walked and will talk}\)).

2.3. Ambiguities

The grammar of PTQ deals with several scope ambiguities. I will recall two of them because variants of them will return in the discussion. The most famous example is (5). This sentence has a de-re reading (6) and a de-dicto reading (7).
(5) John seeks a unicorn

(6) $\exists u [\text{unicorn}_x(u) \land \text{seek}_x(john, u)]$

(7) $\text{seek}(\overset{\wedge}{john}, \lambda x \exists u [\text{unicorn}_x(u) \land \forall p(u)])$.

Another example is the scope ambiguity in (8); this sentence has readings (9) and (10).

(8) Every man loves a woman

(9) $\forall u [\text{man}_x(u) \rightarrow \exists v [\text{woman}_x(v) \land \text{love}_x(u, v)]]$

(10) $\exists v [\text{woman}_x(v) \land \forall u [\text{man}_x(u) \rightarrow \text{love}_x(u, v)]]$.

The readings of (8) have a remarkable property. Reading (10) logically implies (9). This means that there is no situation in which (10) is true, while (9) is false. For this reason one might doubt whether this scope ambiguity is an ambiguity we have to account for: reading (9) seems to be always acceptable. I will give two arguments explaining why (8) is considered ambiguous. Both arguments are due to Martin Stokhof (personal communication); see also chapter 4, section 6.

The first argument is that for slight variants of (8) the two readings are logically independent. Consider sentence (11), in which we understand one as precisely one.

(11) Every man loves one woman.

This sentence has readings (12) and (13), where neither (12) follows from (13), nor (13) from (12).

(12) $\forall u [\text{man}_x(u) \rightarrow \exists v [\text{woman}_x(v) \land \text{love}_x(u, v)]]$

(13) $\exists v [\text{woman}_x(v) \land \forall u [\text{man}_x(u) \rightarrow \text{love}_x(u, v)]]$.

A more well-known variant of the scope ambiguities of (8) and (11) is sentence (14). Also here the two readings are independent.

(14) Every man in this room speaks two languages.

These considerations show that sentences closely resembling (8) exhibit independent ambiguities.

The second argument is that in certain contexts the weaker reading of (8) is required. Consider (15) or (16).

(15) It is not the case that every man loves a woman

(16) John does not believe that every man loves a woman.
Sentence (15) can be used in situations in which it means (17), as well as in situations where it means (18).

\[ \neg [\forall u (\text{man}_u (u) \rightarrow \exists v (\text{woman}_v (v) \land \text{love}_v (u, v))] \]

\[ \forall v (\text{woman}_v (v) \land \forall u (\text{man}_u (u) \rightarrow \text{love}_v (u, v))] \]

Here the implication goes in the other direction: reading (17) implies (18). So if we prefered to have only one reading for (15), it would have to be (18). It is very likely that (15) is obtained by building (8), and next negating it. This construction requires that reading (18) of (15) be produced from reading (10) of (8). So sentences like (15) require that reading (10) is available. Hence (8) should get both reading (9) and (10).

2.4. Model

In several recent proposals arguments are put forward in favor of another model for time than the one used in PTQ. Such proposals are based upon a model with an interval semantics for time, rather than one with time point semantics (DOWTY 1979b, many contributions in ROHRER 1980). I will not incorporate these innovations, but follow the PTQ logic and semantics since it was not my aim to improve the PTQ interpretation of modifiers. This means that the logic does not provide for the tools to discriminate semantically between simple past and perfect, and therefore I will assign the same meanings to them. The use of the PTQ model has as a consequence that, formally spoken, I only deal with a limited use of tense: the reportive use (see BENNETT 1977).

Using such a 'primitive' semantics is, for the present purposes, not a great drawback. The scope phenomena under discussion will arise within any semantic treatment of tenses, no matter what kind of a model is used. I expect that my treatment can be adopted for another model (by taking the same derivational history, but changing the translations or their interpretations).

3. BASIC VERB MODIFIERS

In this section sentences will be considered which contain basic verb modifiers. First such sentences will be considered from a syntactic point of view. The PTQ rules produce such modifiers in few contexts only, but there are more situations in which they may occur. Next we will consider
such sentences from a semantic point of view and investigate their scope ambiguities. Finally we will consider which kind of rules might be used to produce such sentences and to obtain the desired meanings.

The first kind of situation we will consider are the complements of verbs like try, assert and regret. The rules of PTQ allow for unmodified verb phrases as complement. An example is (19).

(19) John tries to run.

PTQ does not allow for negated verbs as complement. Such complements are possible as is pointed out by BENNETT (1976); see example (20). The sentence is intended in the reading that what John tries, is not to run.

(20) John tries not to run.

As sentence (21) shows, complements in the perfect are also possible (unlike the PTQ predictions).

(21) John hopes to have finished.

Future is not possible in these complements (but in Dutch it is possible).

The second kind of situations where the PTQ rules are inadequate is provided by sentences with conjoined verb phrases. The PTQ syntax states that the first verb has to be conjugated. If we assume that the rule is changed to mark all relevant verbs, then sentences like (22) are produced.

(22) John has walked and talked.

In the PTQ approach it is not possible to obtain differently modified verbs in the conjuncts to the verb phrase; yet it was noticed by BACH (1980) and JANSSEN (1980b) that they can be combined freely. Some examples, due to Bach (op. cit.) are (23) and (24).

(23) Harry left at three and is here now.

(24) John lives in New York and has always lived there.

These examples can easily be adapted for other verb modifiers. In (25) negation occurs and in (26) future.

(25) Harry left at three but is not here now.

(26) John has always lived in New York and will always stay there.

So the PTQ syntax has to be extended for complements and conjuncts.

Now we come to the semantic aspect. Sentences which contain a modifier exhibit scope ambiguities with respect to the corresponding operator. An
example is (27).

(27) The president will talk.

This sentence has a reading which says that the present president will speak at a moment in the future (maybe after his presidency). It also has a reading which says that on a future moment the then president will speak. So sentence (27) has readings (28) and (29).

(28) \( \exists u [ \text{president}_*(v) \leftrightarrow u = v ] \land \text{talk}_*(u) ] \)

(29) \( \forall u [ \text{president}_*(v) \leftrightarrow u = v ] \land \text{talk}_*(u) ] \).

Notice that I consider president a predicate which may apply for different reference points to different persons. In some cases an index independent interpretation of an in principle index-dependent noun seems to be required. The American hostages in Iran will probably always be called hostages although they are no longer hostages. This means that this noun in sentence (30) is used with an index independent interpretation.

(30) The hostages were received by the president.

I assume that even the president can be used in an index independent way; in a biography about Eisenhower one might say

(31) The president studied at West-Point.

With an index independent interpretation of president formulas (28) and (29) are equivalent. An example of a term for which only an index-dependent interpretation is possible is 70-year-old-man. Sentence (32) only has readings (33) and (34).

(32) A 70 years old man will visit China.

(33) \( \exists u [ \text{70-year}_*(u) \land \text{man}_*(u) \land \text{visit}_*(u, \text{China}) ] \)

(34) \( \exists u [ \text{70-year}_*(u) \land \text{man}_*(u) \land \forall \text{visit}_*(u, \text{China}) ] \).

For past tense and for negation ambiguities arise which are related to the ambiguities for future discussed above. For perfect the opinions vary. Some native speakers have claimed that perfect can only have narrow scope, whereas others have no problems with two readings for sentence (35).

(35) The president has talked.

The grammar I will present, assigns two readings to (35), but a slight modification would give only one reading.
For sentences with differently modified verb phrases there is no scope ambiguity. Sentence (36) only has reading (37), see Bach 1980.

(36) A woman has walked and will run

(37) \exists u [\text{woman}_x(u) \land \text{walk}_x(u) \land \text{run}_x(u)].

The above examples concerning embeddings and conjunctions suggest that it is useful to have rules which produce modified verb phrases. This is the approach that will be followed in this article. But the examples do not prove that it is impossible to design a system in which only sentences with verb modifiers are produced, and no modified verb phrases. I will sketch below some problematical aspects of such approaches.

One might think of introducing the perfect on the level of sentences, thus obtaining (39) from (38). Combination with (40) then yields (41).

(38) Harry leaves at three

(39) Harry has left at three

(40) Harry is here now

(41) Harry has left at three and Harry is here now.

From (41) we obtain (42) by means of a deletion rule.

(42) Harry has left at three and is here now.

For these sentences there arise no problems with this approach. But for (43) it is problematic since (43) does not have the same meaning as (44).

(43) A man left at three and is here now

(44) A man left at three and a man is here now.

Our framework requires that there be a semantic operation which corresponds with the rule that produces (42) from (41) and (43) from (44). I do not know of a semantic operator which has the desired effect, and therefore it is questionable whether this approach can be followed.

A variant of this method, due to Van Benthem (personal communication) is to produce (42) from (45).

(45) He has left at three and is here now.

Sentence (45) is produced in the way sketched above, so obtained from (46) by means of a deletion rule.

(46) He has left at three and he is here now.
The semantic problem mentioned above does not arise because (45) and (46) are equivalent. I expect that an approach like this will require rules which are far more complex than the rules which produce modified verb phrases in this chapter.

If we have rules introducing verb modifiers at the level of verb phrases do we then still need rules introducing them at the level of sentences? The answer of Bach (1980) seems to be that only rules for verb phrases are needed. He presents a new translation rule corresponding with the syntactic rule which produces a sentence from a term and a verb phrase. His translation rule has the effect that in the translation of the sentence the operator in the IV-translation gets wider scope than the subject. So the basic situation is that subjects obtain narrow scope, and subjects can obtain wide scope by quantifying in. In this way the two readings of (47) are obtained.

(47) The president will walk.

An exception to this pattern is the conjunction (disjunction) of differently modified verb phrases. As we observed above, the subject can only have wide scope. Recall (36)

(36) A woman has walked and will run.

In order to deal with such constructions, Bach presents translation rules for conjunction and disjunction of verb phrases which have the effect that for such constructions the subject gets wide scope.

Bach's approach is insufficient because there are examples where one wishes to quantify a term in, but where nevertheless this term should be within the scope of the tense operator. I will give three examples. Each exhibits in the future tense a phenomenon for which quantification rules are commonly used in the present tense. The first example concerns scope ambiguity of quantifiers: sentence (48) with reading (49).

(48) Every catholic will follow a man

(49) ∀∀u[man∗(u) ∧ ∃v[catholic∗(v) → follow∗(v,u)]]

In order to obtain reading (49) one wishes to quantify a man into Every catholic follows him and only after that, assign the tense. The second example concerns the de-dicto/de-re ambiguity: sentence (50) with reading (51).

(50) Every catholic is following a man
(50) John will seek a unicorn

(51) $\exists u [\text{unicorn}_s(u) \land \text{seek}_s(john, u)]$.

Here John seeks a future 'de-re unicorn'. Again one wishes to quantify in, and then assign tense. The third example concerns coreferentiality of terms inside the scope of the tense operator: sentence (52) with reading (53).

(52) The president will love a woman who kisses him

(53) $\exists v [\text{president}_s(v) \leftrightarrow u = v] \land \exists w [\text{woman}_s(w) \land \text{kiss}_s(w, u) \land \text{love}_s(u, w)]$.

This translation represents the reading in which the loving and kissing happen on the same moment in the future. Again one wishes to produce this sentence by means of first quantifying in at the sentence level, followed by tense assignment on that level. Related examples can be given for other tenses and aspects.

For the introduction of negation on the sentence level related examples can be given: situations where one wished to quantify in, but where negation has wide scope. Examples are the wide quantifier scope in (54), the de-re reading of (55) and the coreferentiality in (56).

(54) Every woman does not love a man

(55) John does not seek a unicorn

(56) The president does not love the woman who kisses him.

The main conclusion of this section is that rules are needed which introduce modifiers on the level of verb phrases, but that also rules are needed which do so on the level of sentences. This aspect constitutes the fundamental difference between the present approach and the approach of Bach (1980). Notice that an important part of the argumentation is based upon the fact that phenomena like scope of terms, de-dicto/de-re ambiguity and coreferentiality, are dealt with by means of quantification rules.

The last part of this section consists of two examples of sentences which are produced according to the ideas I have just sketched. The details of the rules will not be given here, but the sequence of stages of the process (and the respective translations) are the same as the ones obtained by using the rules of the grammar from section 7.

The first example is sentence (57), with reading (58).

(57) John will seek a unicorn
(58) \[ \exists u [ \text{unicorn} \_u \land \text{seek} \_u (\text{john}, u) ] \].

First sentence (59) is produced, it has (60) as translation.

(59) \text{John seeks him} \_1
(60) \text{seek}(\^\text{john} \_1, \^\lambda x \^F P(x)_1).

The next step is to quantify in the term a unicorn. Then sentence (61) is obtained, with translation (62).

(61) \text{John seeks a unicorn}
(62) \exists u [ \text{unicorn} \_u \land \text{seek} \_u (\text{john}, u) ].

The last step is the introduction of future tense in (61). This gives us sentence (57), with (58) as translation.

The second example concerns the sentence \text{John tries not to run}. This sentence contains the verb phrase \textit{not to run}, and this raises the question which kind of translation we use for verb phrases. \textsc{bach} (1980) has given several arguments for considering verb phrases as functions operating on subject terms. This approach has as a consequence that a new, somewhat complex translation rule has to be used for S4 (the rule which combines a T and an IV to make an S). One of Bach's arguments in favor of considering verb phrases as functions was his treatment of tense and aspect. As we concluded, his proposal is in this respect not satisfactory. His other arguments in favor of verb phrases as functions, concern phenomena I do not deal with in this article (such as 'Montague phonology' and constructions like \textit{A unicorn seems to be approaching}). Since in our fragment we will not have any of the advantages of that approach, I will use the simpler PTQ translation. But no matter which translation is chosen, the conclusion that modifiers have to be introduced on two levels remains valid.

Let us return to the example, sentence (63) with translation (64).

(63) \text{John tries not to run}
(64) \text{try to}(\^\text{john}, \^\lambda x \exists [\text{run}(x) \_x]).

The first stage in the production of this sentence is to produce verb phrase (65). Its translation as explained above, is (66).

(65) \text{do not run}
(66) \^\lambda x \exists [\text{run} \_x (\_x)].
The next step is the addition of *try to*, yielding (67), with (68) as translation.

(67) *try not to run*

(68) *try to(λx,¬[run_x(y)])*.

Combination with the term *john* gives sentence (63), with translation (64).

4. COMPOUND VERB MODIFIERS

In this section I will consider sentences in which verbs occur which are accompanied by compound modifiers: constructions with *will not*, *will have*, *had*, *would*, etc. The sentences exhibit ambiguities which give us suggestions as to how to deal with compound modifiers.

The first example concerns the combination of negation and future. Sentence (69) has three readings, viz. (70), (71) and (72).

(69) *Every woman will not talk*

(70) ∀u[woman_u(u) → ∀W[talk_u(u)]]

(71) ∀Wu[woman_u(u) ∧ talk_u(u)]

(72) ∀Wu[woman_u(u) → W talk_u(u)].

Notice that in all readings negation has wider scope than future. The first two readings are the most likely ones. A situation in which the relative scope of the third reading seems to be intended arises in HOPKINS (1972, p.789). Hopkins argues that it is not necessary to always design elegant computer programs because

(73) *Every program will not be published. Many will be used only once.*

In the PTQ approach only readings (70) and (71) can be obtained. This is due to the fact that in PTQ tense and negation are treated as an indivisible unit which is introduced by one single step.

For sentence (74) related ambiguities arise. The sentence is three ways ambiguous.

(74) *The president will have talked.*

This sentence may concern

(i) An action of the present president (maybe after his presidency).

(ii) An action of some president during his presidency (maybe a future president).
(iii) An action of a future president (maybe before his presidency).

This readings are presented in (75), (76) and (77) respectively.

(75) $\exists u[v[president](v) \land u = v] \land \text{WH}[\text{talk}(u)]$

(76) $\forall u[v[president](v) \leftrightarrow u = v] \land \text{talk}(u)$

(77) $\forall u[v[president](v) \leftrightarrow u = v] \land \text{talk}(u)$.

I assume that (75) is the most likely reading cf (74). The relative scope of the tense operators and president as indicated in (76) is, however, the most likely reading of (78).

(78) (In 2000 the political situation will be different since)
A USA president will have visited Cuba.

The relative scope as indicated in (77) is the most likely reading of (79).

(79) The president will have learned Montague grammar at high school.

These examples show that the two tense operators corresponding with the compound modifier 'future perfect' may have different scope. For the other compound modifiers related examples can be given. I will give some examples of the reading in which the scope of the two operators is not the same.

Sentence (80) with reading (81) can be said about Eisenhower.

(80) The president had been a general. (Therefore he knew about the power of the military-industrial complex)

(81) $\exists u[v[president](v) \leftrightarrow u = v] \land \text{general}(u)$.

Sentence (82) gives information about the former Dutch queen Wilhelmina.

(82) (In May 1940 Wilhelmina had to leave her country but) The queen would return to Holland.

(83) $\exists u[v[queen](v) \leftrightarrow u = v] \land \text{return}(u)$.

Notice that in sentence (82) would is used to indicate a certain temporal sequence. At the moment in the past under consideration, the return was still in the future. Also the construction would have can be used to describe a certain temporal sequence. The information about queen Wilhelmina given above can be extended by (84).

(84) At her departure she was just the queen, at the moment of her return she would have become a symbol of patriotism.
The use of *would* and *would have* described above is somewhat exceptional. More frequently they are used in constructions like (85) and (86).

(85) John *would* come, but he is not here.

(86) If John *had* come, we *would have* won the game.

I do not intend to deal with constructions like (85) and (86), but only with the 'temporal' constructions.

For simple modifiers ambiguities of the kind considered above do *not* arise: (87) does not have reading (88), which would express the fact that the action may take place after the presidency of a future president.

(87) The president will visit Holland

(88) $\forall u \forall v [\text{president}_u(v) \leftrightarrow u = v] \land \forall [\text{visit}_u(u, \text{Holland})]$. 

The ambiguities considered in this section suggest that the compound modifiers have, for semantic reasons, to be introduced in a process with several stages, each stage introducing one operator in the translation. For instance, a sentence containing *will have* is obtained by first introducing perfect and next introducing future. Analogously *had* is analyzed as past + perfect and *would* as past + future. The semantic ambiguities can easily be accounted for since for an operator we have the options of introducing it on the level of verb phrases and of introducing it on the level of sentences.

Besides the semantic arguments there is also syntactic evidence for the introduction of compound modifiers by means of a process with several stages. Some compound modifiers can be split up when they occur in connection with a conjoined verb phrase. An example is (89).

(89) The president *will* have talked and *have* walked.

In (89) the verb phrases *have talked* and *have walked* share the auxiliary verb *will*.

The main conclusion of this section is that compound modifiers have to be introduced by a process with several stages, each stage introducing a new operator in the translation. An example illustrating this process is sentence (90) with reading (91).

(90) The president *will* have talked

(91) $\exists u \forall v [\text{president}_u(v) \leftrightarrow u = v] \land \forall [\text{talk}_u(u)]$.

The first step is the production of the verb phrase (92), which has
translation (93).

(92) have talked

(93) \( \lambda x [\text{talk}_s(x)] \).

Next sentence (94) is formed with translation (95).

(94) The president has talked.

(95) \( \exists u [\forall v \text{president}_s(v) \leftrightarrow u = v] \land H[\text{talk}_s(u)] \).

The last step is the introduction of the future, this yields sentence (90) with translation (91).

5. COMPLEX CONSTRUCTIONS

5.1. Introduction

In the previous sections we considered scope phenomena of simple and of compound verb modifiers. In this section scope phenomena will be considered in connection with more complex constructions than considered before. The most important ones are conjoined and disjoined phrases and combinations of them. I will use the name conjoined phrases to cover such conjunctions and disjunctions except where the difference is relevant. This section has a somewhat different character than the previous two, because conjoined constructions give rise to phenomena which do not constitute a clear and simple pattern. The acceptability of the sentences or interpretations is sometimes marginal and the judgements may have to be changed in some cases. The present discussion is intended primarily to point out some interesting phenomena.

5.2. Conjoined verb phrases with positive verbs

Conjoined verb phrases which consist of unmodified verbs give rise to the same phenomena as single verbs. The conjoined phrases can be modified as if they were simple verbs and they exhibit the same ambiguities. An example is sentence (96), which has readings (97) and (98).

(96) The president will walk and talk

(97) \( \forall u [\forall v \text{president}_s(v) \leftrightarrow u = v] \land [\text{walk}_s(s) \land \text{talk}_s(u)] \).

(98) \( \exists u [\forall v \text{president}_s(v) \leftrightarrow u = v] \land [\text{walk}_s(s) \land \text{talk}_s(u)] \).

The formulas (97) and (98) present the possible readings as far as the
position of president with respect to the future operator is concerned. Both readings, however, say that on a moment on the future a certain person will both walk and talk. Probably this is too precise, and a better interpretation would be that there is a future interval of time in which both the walking and the talking are performed, possibly on different moments in that interval. So this kind of objections against (97) and (98) might be solved by using another model relative to which the formulas are interpreted. But concerning the scope aspect, the formulas seem correct, and therefore the rules will produce only (97) and (98) as translations for (96).

Conjoined verb phrases with verbs which are modified differently only have a reading in which both operators have narrow scope. We have already met example (99) with reading (100).

(99) A woman has walked and will run.

(100) $\exists u [\text{woman}_u (u) \land H[\text{walk}_u (u)] \land W[\text{run}_u (u)]]$.

If the verbs of the conjoined phrase are modified in the same way, there is a reading which corresponds with the above example: sentence (101) has a reading (102).

(101) The president will walk and will talk

(102) $\exists u [\text{W}_u [\text{president}_u (v) \leftrightarrow u = v] \land W[\text{walk}_u (u)] \land W[\text{talk}_u (u)]]$.

Sentence (101) can, however, be considered as dealing with a future president, so it also has reading (103).

(103) $\exists u [\text{W}_u [\text{president}_u (v) \leftrightarrow u = v] \land \text{walk}_u (u) \land \text{talk}_u (u)]$.

The possibility that the walking and talking are performed on the same moment in the future can be dealt with in the same way as I suggested for sentence (96). The fact that sentence (101) has reading (103) ($= 97$) suggests us that we consider sentence (101) as a syntactic variant of (96) and assign it, too, reading (98). The same treatment will be given of the perfect.

For the past tense the same pattern applies: sentence (104) not only has reading (105) but also readings (106) and (107).

(104) The president walked and talked.

(105) $\exists u [\text{W}_u [\text{president}_u (v) \leftrightarrow u = v] \land H[\text{walk}_u (u)] \land H[\text{talk}_u (u)]]$
(106) $\exists u [W[v[president_e(v) \iff u = v] \land walk_e(u) \land talk_e(u)]]$

(107) $\exists u W[v[president_e(v) \iff u = v] \land \neg [walk_e(u) \land \neg [talk_e(u)]]]$

Conjoined negated verbs do not follow this pattern. Sentence (108) has reading (109), but it has no reading with only one negation sign.

(108) The president does not walk and does not talk.

(109) $\exists u W[v[president_e(v) \iff u = v] \land \neg [walk_e(u)] \land \neg [talk_e(u)]]]$

A conjoined verb phrase which consists of equally modified verbs can, in some cases, be modified further. An example is (110), where a modifier is applied to a conjunction of verbs in the perfect.

(110) The president will have visited Rome or have visited Tokyo.

Conjoined verb phrases with equally modified verbs cannot be negated, as (111) illustrates. That example cannot be interpreted as a negation of a conjunction of perfect verb phrases, but only as a negated verb phrase conjoined with a non-negated one.

(111) The president has not visited Rome or has visited Tokyo.

If another modifier is applied first, the phrase behaves as a simple construction and can be negated, see (112).

(112) The president will not have visited Rome or have visited Tokyo.

5.3. Conjoined verb phrases with negated verbs

If in a conjoined verb phrase the first verb is not modified and the other verbs are negated, then the whole construction behaves as a verb phrase with unmodified verbs. This means that such a construction can be modified further; an example is (113) with reading (114).

(113) John will walk and not talk

(114) $W[walk_e(john) \land \neg [talk_e(john)]]$

Note that sentence (113) is not ambiguous with respect to the scope of $W$ because the interpretation of John is index independent. Were John be replaced by the president, then ambiguities would arise of the kind we have discussed before.

If in a conjoined verb phrase the first phrase is negated and the others are not negated, then the situation is different. A modifier
'absorbs' the negation: sentence (115) only has reading (116).

(115) *John will not walk and talk*

(116) $\neg \forall x (\text{walk}_x (\text{john}) \land \text{talk}_x (\text{john}))$.

If all the verbs in a conjoined verb phrase are negated, then the two patterns give rise to an ambiguity. Sentence (117) has both reading (118) and (119).

(117) *John will not walk and not talk*

(118) $\neg \exists x (\text{walk}_x (\text{john}) \land \neg \text{talk}_x (\text{john}))$

(119) $\neg \exists x (\text{walk}_x (\text{john}) \land \neg \text{talk}_x (\text{john}))$.

For conjoined verb phrases with verbs in the perfect a related situation arises. Sentences (120) and (121) seem to have one reading, whereas (122) has two readings.

(120) *John will not have walked and have talked*

(121) *John will have walked and not have talked*

(122) *John will not have walked and not have talked.*

Corresponding with the above sentences there are sentences with the contracted forms like *won’t*. Sentence (123) has the same reading as its uncontracted variant (120).

(123) *John won’t have walked and have talked.*

Sentence (124), however, is not equivalent with the corresponding uncontracted form (117): it only has reading (115), but not reading (118).

(124) *John won’t walk and not talk.*

The way in which we may treat contracted forms depends on the organization of the morphological component. Suppose that one decides that the input of the morphological component has to consist of a string of words (where the words may bear features). Then the contraction of *will not* to *won’t* cannot be dealt with in the morphological component because sentence (118) gives no syntactic information about the intended reading. This means that the contraction has to be described within the rules: the rule introducing negation should have the option of producing contracted forms like *won’t*. If one has the opinion that the input of the morphological component has to be a syntactic structure, then the situation is different. I assume
that sentence (117) will have a structure in which will is directly connected with not and a structure in which walk is directly connected with not. This structural information desambiguates sentence (117) and provides sufficient information to deal with contracted forms: will not only reduces in case it is a constituent.

5.4. Terms

The PTQ fragment only has terms which require a third person singular of the finite verb. This is probably caused by the desire to keep the syntax simple. Incorporating pronouns for the first and second person singular would not be interesting in the light of our investigations for the following reason. The pronouns I and you get an index independent interpretation and therefore (125) and (126) are not ambiguous.

(125) I will have visited China
(126) You have discovered the solution.

In what follows we will only consider 'third-person' terms.

Disjoined terms give rise to the same scope phenomena as simple terms. Sentence (127) has a reading that says that the present president or the present vice president will go, and a reading that says that the future president or future vice-president will go.

(127) The president or the vice-president will visit Holland.

A complication may arise from quantifying in. One might first produce (128) and obtain (127) from this by means of quantifying in.

(128) The president or he will visit Holland.

This might result in a reading in which the present vice-president or the future president will visit Holland. Such mixed readings are not possible for sentence (127). This means that we have to constrain the possible applications of the quantification rule. I have not investigated these matters and I will therefore simply assume the (ad hoc) restriction that there are no terms of the form $T_1$ or $T_2$ in the fragment, where one or both terms are indexed pronouns.

In the examples above the determiners the and a are most frequent. For the term every president corresponding results are obtained: sentence (129) gets readings (130) and (131).
Every president will talk

\[ \forall u \text{ president}_u(u) \rightarrow \text{talk}_u(u) \]

If (129) concerns future presidents, it is unlikely that they have to be presidents at the same moment. One might try to represent such a meaning by formula (132).

\[ \forall u \left( \text{president}_u(u) \rightarrow \text{talk}_u(u) \right) \]

This is, however, not correct, since (132) would (vacuously) be true in situations such that for everyone there is a future moment at which he is not a president. I expect that the desired reading can be obtained by interpreting formula (130) in some model with interval semantics for time. Then (131) might get the interpretation that there is an interval in the future during which all individuals who are president in that interval will talk during that interval. The scope aspect of the meaning of (129) is then adequately represented by formulas (130) and (131).

For conjoined terms the same ambiguities will be obtained as for disjoined terms. Sentence (133) has a reading about present statesmen and one about future statesmen.

The president and the vice president will visit Cuba.

The problem of 'mixed' readings, noticed with respect to disjunctions, also arises here, and for conjoined terms a corresponding (ad hoc) restriction on quantifying in is required. Furthermore there is the same difficulty as for the term every president. It is not necessary that the two statesmen of sentence (133) will visit Cuba together. A solution might be found following the suggestions concerning the interpretation of (129).

5.5. Embeddings

An important source of scope phenomena are the embedded sentences (in verb complements and in relative clauses). LADUSAW (1974) and EGERHED (1981) point out several sentences that are not treated correctly in PTQ. A variant of an example of Ladusaw is (133).

Mary has found the unicorn that walks.

The rules produce the possible reading in which the unicorn presently walks. But they also produce a reading in which the unicorn walks on the moment of
discovery (which is not a possible reading). For the future tense this ambiguity seems to be correct, see sentence (134).

(134) Mary will find the unicorn that walks.

An example from EJERHED (1981) is

(135) Bill will assert that John loves Mary.

She argues that this sentence is ambiguous. On the one reading John loves Mary at the moment of asserting, and on the other reading he loves her now. PTQ cannot distinguish between these readings, nor can the present treatment.

In order to deal with embeddings, Ladusaw makes his syntactic rules rather complex (using e.g. dominance relations) and his success is partial. I would try to find a solution in the logic. Priorian tense logic is not a suitable logical language to deal with the semantics of embedded sentences. This is illustrated by example (136).

(136) A child was born that will become ruler of the world.

The will of the embedded sentence takes as 'starting point' the reference point used for the interpretation of the whole sentence, and not the reference point introduced by the past tense. Sentence (136) was one of Kamp's arguments for introducing the 'Now'-operator (KAMP 1971). However, more power is required. The 'now'-operator keeps trace of the first point of reference one encounters during the evaluation of the sentence: the point of utterance. SAARINEN (1978) gives examples which show that one needs to be able to keep trace of all points of reference one encounters in evaluating the sentence. One of his examples is (137).

(137) Bob mentioned that Joe has said that a child had been born who would become ruler of the world.

Saarinen argues that the would can have as starting point for its evaluation any of the reference points introduced by the previous past tense operators. So each operator introduces its own variant of 'now'. This means that considerable expressive power has to be added to the logic we use for representing meanings. Since I use the logic of PTQ, with its Priorian tense operators, it is not surprising that embedded constructions in general are not treated correctly by my grammar.
6. ONE OF THE RULES

Most of the scope phenomena discussed in the previous sections will be treated explicitly: in section 7 by providing a grammar. That grammar is in some respects different from the grammar used for the PTQ fragment. The differences have already been introduced in chapter 8: words may bear features, information provided by queries is used, the rules produce labeled bracketings (or, equivalently, labeled trees), and in the formulation of the rules certain basic operations can be mentioned. These aspects of the grammar will be considered below, thereafter one of the rules will be discussed extensively.

The features are used mainly to facilitate the explicit formulation of the rules. It is, for instance, shorter to write formulation (A) instead of (B), and probably easier to understand.

(A) add features ((past, sing 3), δ)

(B) replace δ by its third person singular past tense form.

The features are not intended as a part of a general theory about features, and therefore I will only introduce those features which I find useful for the treatment of the present fragment. These are: past, pc (for participles) and sing 3 (for the third person singular). Other features are not needed (e.g. there is no feature pres since walk_sing3,past \rightarrow walked, and walk_sing3 \rightarrow walks).

The most important query that will be used is \textit{Fin}. The Fins of a sentence or verb phrase are its finite verbs, i.e. the verbs which agree (in person and number) with the subject of the sentence. So it is about the same as the query Mainverb introduced in chapter 7. I prefer to avoid the name mainverb in the present context, because auxiliary verbs (such as will and do) can be used as finite verbs, and maybe not everyone would be happy to call those auxiliary verbs 'mainverbs'. The other query that will be used is \textit{Verbphrase}. It gives the information what the verbphrase of a given sentence is. For the present fragment it turned out to be the most simple to define the queries directly on all trees, and not within the root operation (as was the method employed in chapter 7).

The labeled bracketing are used mainly to give a correct treatment of conjoined phrases. FRIEDMAN (1979) has shown that for dealing correctly with the conjoined and embedded phrases of the PTQ fragment, it is sufficient to have the bracketing available: the labels are not needed.
For the fragment under discussion the same holds: no rule needs the information provided by the labels. The choice of the labels is, for our purposes, arbitrary. Which labels actually have to be chosen, can only be decided if larger fragments of English are considered, then we might decide which rules need which information. The decision to call *will* in *John will run* an auxiliary is arbitrary from my point of view, I have no arguments pro or contra this choice. Since labels play no essential role in the discussion, I will simplify the presentation of the grammar by omitting the labels, e.g. in the presentation of the produced expressions and in the formulation of the root operations. Furthermore, I will omit brackets around simple lexical items. (e.g. using *run* instead of [*run*]). These simplifications allow me to write (139) instead of (138).

(138) [[John][love], [Mary],]_IV_ S
(139) [John[Love, Mary]].

The basic operations we will use are *root* and *adjoin*. The operation *root* takes a sequence of trees as argument, and connects them with a new common root, labeled with a given category (see chapter 7). The operation *adjoin* takes two trees as argument, and connects them with a new root, which bears the same label as the root of the second argument.

As introduction to the presentation of the grammar I will extensively consider one of the rules. It is the rule which has the effect that the modifier for future tense is introduced into sentence (140), thus obtaining (141).

(140) John, walk, sing, and talk
(141) John will, sing, walk and talk.

Every sentence cannot be used as input for this rule; for instance a sentence in the future tense cannot be futurized again. There have to be restrictions on the possible applications of a rule introducing future. For other modifiers the same holds: not every sentence can be modified. One might wish to have in the grammar a single rule for the introduction on sentence level of all modifiers. This rule has to mention under which circumstances a future may be introduced, and the same for other modifiers. Moreover for each modifier it has to describe precisely in which way it has to be introduced. In this way we would obtain one great rule with a lot of subclauses. For reasons of elegance and understandability I prefer to have for each modifier a separate rule.

We have to characterize the sentences to which a certain modifier can be added. There is a hierarchy which accounts for the relative scopes of modifiers as we observed this in sections 3 and 4 (conjoined phrases give rise to complications). The hierarchy is

\[ \text{[neg][past][fut][perf]]} \]

This hierarchy claims, for instance, that negation always has wider scope than the perfect. It also says that future can be added to a positive perfect sentence and to a positive sentence in the present tense. It says moreover that future cannot be added to a negated sentence because that would give rise to an incorrect order of scope.

The hierarchy suggest to us how the possible applications of the rule introducing future has to be restricted. It can only be applied to sentences in the positive present perfect and in the positive present tense. The rule introducing future then has to contain a specification of what such sentences look like. One might expect as characterization of sentences in the positive present perfect that the sentence has as finite verb the auxiliary have, and as characterization of a present tensed sentence that its finite verb is in the present tense. Such a description is not sufficient. In the description of the present tensed sentences one has to exclude finite verbs which are modifiers themselves (has, will, do). Furthermore we have to exclude negations. If conjoined verb phrases are involved, further caution is required. These considerations show that the desired characterizations will become rather complex. I do not doubt that such characterizations are possible, but I prefer to use a somewhat different method.

The method I prefer consists of subcategorization of the sentences and verb phrases. This subcategorization is not obtained by describing explicitly which sentences belong to a certain subcategory, but indirectly by means of the rules. The rule which introduces the perfect gives the information that the sentence obtained belongs to the subcategory of sentences in the perfect tense and the rule which introduces negation gives the information that if the rule is applied to a perfect sentence the resulting sentence is the subcategory of negated perfect sentences. In this approach the rules take expressions of specified subcategories and produce expressions of specified subcategories. In this way we avoid complex conditions in the rules: the grammar does the job.

I have already mentioned two subcategories of expressions to which
future tense can be added: the positive sentences in the present tense and those in the present perfect. For these subcategories I will use the names \( \text{perf} \) \( S \) and \( S \) respectively. For the category of all sentences I will use the name \( \text{full} \) \( S \), so \( S \) in this chapter has a different meaning than in PTQ. In the rules many more subcategories are relevant than the ones mentioned here. The names of almost all subcategories that will be used, are indicated by the following scheme of names:

\[
(\text{neg})(\text{past})(\text{fut})(\text{perf})S.
\]

The names of subcategories are obtained from this scheme by replacing each subexpression of the form \( (\alpha) \) by the expression \( \alpha \) or by the empty string. Some examples of subcategories are as follows:

<table>
<thead>
<tr>
<th>name</th>
<th>intuitive characterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S )</td>
<td>sentences in the positive present tense</td>
</tr>
<tr>
<td>( \text{neg} ) ( \text{past} ) ( S )</td>
<td>negated sentences in the past tense</td>
</tr>
<tr>
<td>( \text{past} ) ( \text{perf} ) ( S )</td>
<td>unnegated sentence in the past perfect</td>
</tr>
</tbody>
</table>

For verb phrases a related system of subcategories will be used. The system is somewhat larger because there are some categories for conjoined phrases, e.g. the category of conjoined phrases consisting of verbs in the perfect. The names which can be used are given by the following scheme

\[
(\text{conj})(\text{neg})(\text{past})(\text{fut})(\text{perf})IV.
\]

Whether a conjoined phrase belongs to a subcategory of conjoined phrases is determined by the rules. This might have as a consequence, however, that the subcategorization of a phrase and the intuitive expectation about this do not always coincide. One might, for instance, expect that \( \text{will have walked} \) and \( \text{have talked} \) is a conjoined phrase. Since it behaves as a single verb in the future tense it is considered as an expression of the subcategory \( \text{fut} \) \( IV \). For the set of all verb phrases we use the name \( \text{full} \) \( IV \), the subcategory \( IV \) consists (in principle) of unmodified verbs.

Now I return to the rule under discussion: the one which introduces future tense. One might design a two-place rule which combines the modifier \( \text{will} \) with a sentence of the subcategory \( S \) or \( \text{perf} \) \( S \). Then the rule yields a sentence of (respectively) the subcategory \( \text{fut} \) \( S \) or \( \text{fut} \) \( \text{perf} \) \( S \). The translation of \( \text{will} \) introduced on the level of sentences has to be \( \lambda p M[\vdash p] \), where \( p \) is a variable of type \( <s,t> \), and the translation rule corresponding with this syntactic rule could then be \( \text{MOD}'(\hat{S}') \). Such a rule exhibits a
a remarkable property: there is just one expression which can be used as first argument of the rule. Since only one argument is possible one could as well incorporate all information about this argument in the rule. In this way the rule with two arguments is replaced by a rule with one argument. I consider such a one-place rule as simpler and therefore I will follow this approach.

A one-place rule which introduces future in a given sentence has to contain some syntactic operation which has the effect of introducing will. In this way will becomes a syncategorematic symbol. This will, when considered in isolation, does not get a translation. But this does not mean that its introduction has no semantic effect: its effect is accounted for by the translation rule (which introduces the future tense operator \( \mathcal{W} \)). Nor does the syncategorematic introduction of will mean that it has no syntactic status. The role of will in the syntax can be accounted for in the surface structure which is produced by the rule. There it can be given the position it should get on syntactic grounds and there it can get the label it should bear.

For other verb modifiers the same approach will be followed. There is no semantic or syntactic reason to have essentially different derivational histories for past sentences and sentences with future. Both verb modifiers can be introduced by means of one-place rules. That there is a great syntactic difference (in English) between past and future can be accounted for in the produced bracketing: there the introduction of past has the effect of the introduction of an affix and the introduction of future the effect of introducing an (auxiliary) verb. Also the difference between future tense in French (where it is affix) and in English can be accounted for in the labeled bracketing. Notice that the decision to introduce verb modifiers syncategorematically is not made for principled reasons, but just because it gives rise to a more elegant grammar.

Next I will consider the formulation of the rule introducing future on the level of sentences. This rule can be considered as consisting of two rules: one producing expressions of subcategory fut S (from expressions in the subcategory S) and one producing expressions of the subcategory fut perf S (from perf S expressions). The subcategorical information is combined in the following scheme (or hyperrule, see the discussion on Van Wijngaarden grammars in chapter 6, section 5):

\[ R_{\text{fut}} : (\text{perf})S \rightarrow \text{fut}(\text{perf})S. \]
From this scheme we obtain information about actual rules by replacing (perf) on both sides of the arrow consistently either by perf or by the empty string. The scheme says that there is a rule (function) from the subcategory S to the subcategory fut S and a function from the subcategory perf S to the subcategory fut perf S. Which particular rules there are is determined by the syntactic operation \( F_{\text{fut}} \). It consists of two syntactic subfunctions which have to be performed consecutively.

\[
F_{\text{fut}}: \text{delete } (\text{sing } 3, \text{Fin}(S)); \\
\text{adjoin } (\text{will}_{\text{sing}} 3, \text{verb phrase}(S)).
\]

Agreement is dealt with in a primitive way: the rule is correct only for subjects which require the third person singular form of the verb. This is sufficient because our fragment contains only such terms. Notice that there is for both rules indicated in the scheme, one single syntactic operation. For the corresponding translation rule the same holds: there is one translation rule which reads as follows:

\[
T_{\text{fut}}: W[a'].
\]

7. THE GRAMMAR

7.1. Introduction

Now we come to the kernel of the proposal: the rules. Presenting an discussion on how to treat a certain phenomenon is one step, but providing for explicit rules is another important step. The rules presented here are not just a formalization of the previous discussion. They contain more information because I have to be explicit about details I did not discuss (see also section 7.5). The rules do not deal with all phenomena mentioned in section 2 (simple modifiers) and in section 3 (compound modifiers). Furthermore the rules deal with all phenomena concerning conjoined verb phrases discussed in 4.2 and 4.3, except for the contracted forms. As for 4.4, the fragment contains disjuncted terms, but no conjoined ones. Although embedded constructions are in the fragment, the predictions of the rules are in several cases incorrect.

The fragment described by the rules is an extension and variation of the PTQ fragment. The lexical elements are supposed to be the same as in PTQ, except for verbs like try to, which loose their to. The rules (schemes) presented below, replace the PTQ rules \( S_3 \) (relative clauses), \( S_4 \) (IV+T),
\( S_8(IV/IV+IV) \), \( S_9(S/S) \), \( S_{10}(IV/IV+IV) \), \( S_{14}(\text{quantification of } T \text{ into } S) \), \( S_{15}(\text{quantification into } IV) \), and \( S_{17}(\text{variants of } S_4) \). Other rules are assumed to be as in FTQ, with the change that now bracketings are produced.

The rules will be presented in the form described in the previous section; i.e. by presenting their \( S, F, \) and \( T \) component. Furthermore, some of the rules are accompanied by comments or examples. In the examples the subcategory of the produced expression is mentioned between braces. The rules are divided into six groups. Each rule bears an index in the 900-series.

7.2. Rules

I. Rules modifying verb phrases

\( S_{901} : (\text{conj})IV \rightarrow \text{perf } IV \)

\( F_{901} : \text{if } do \text{ is among } \text{Fin}(a) \text{ then delete this } do; \)

\( \text{add feat } (pc, \text{Fin}(a)); \text{ adjoin } (\text{have}, a) \)

\( T_{901} : \lambda x \text{Hi}(a'(x)) \)

example: \( F_{901} (\text{[walk and[[do not]talk]]}) = \text{[have[walk}_{pc} \text{ and[[not talk}_{pc}]]]} = \text{have walked and not talked } (\text{perf } IV). \)

comment 1: The subcategory indication \( \text{conj} \) is not mentioned in the output subcategory because the resulting phrase behaves as an simplex verbphrase in the perfect.

\( S_{902} : (\text{conj})(\text{perf})IV \rightarrow \text{fut}(\text{perf})IV \)

\( F_{902} : \text{if } do \text{ occurs in } \text{Fin}(a) \text{ then delete this } do; \text{ adjoin } (\text{will}, a) \)

\( T_{902} : \lambda x \text{Hi}(a'(x)) \)

example: \( F_{902} (\text{[walk and[[do not]talk]]}) = \text{[will[walk and[[not talk]]]}} \)

\( \text{(fut } IV) \)

\( S_{903} : (\text{fut})(\text{perf})IV \rightarrow \text{past(fut)}(\text{perf})IV \)

\( F_{903} : \text{add features } (\text{past,Fin}(a)) \)

\( T_{903} : \lambda x \text{Hi}(a'(x)) \)

examples: \( F_{903} (\text{[walk and[[do not]talk]]}) = \text{[walk}_{past} \text{ and[[do past not]talk]]} = \text{walk and did not talk } (\text{past } IV) \)

\( F_{903} (\text{[will walk]}) = \text{[will past walk] = would walk } (\text{past fut } IV) \)

comment: Notice that this rule has the same translation rule as the rule introducing perfect \( (S_{901}) \). In case we use a logic which allows for dealing with the semantic differences between past and perfect, the translation rules would be different.
II. Rules producing tensed sentences

\[ S_{904} : S \rightarrow \text{perf } S \]
\[ F_{904} : \text{delete features } (\text{sing } 3, \text{Fin}(a)); F_{901} (\text{verb phrase}(a)); \]
\[ \text{add feat } (\text{sing } 3, \text{Fin}(a)) \]
\[ T_{904} : H[\alpha'] \]

**example:** \[ F_{904} ([\text{John walk} \_3]) = [\text{John have} \_3 \text{ walk}_p] = \text{John has walked } (\text{perf } S) \]

**comment:** If one decided that have cannot have wide scope (see section 3),
then this rule would have to be removed from the syntax.

\[ S_{905} : (\text{perf})S \rightarrow \text{fut}(\text{perf})S \]
\[ F_{905} : \text{delete features } (\text{sing } 3, \text{Fin}(a)); F_{902} (\text{verb phrase}(a)); \]
\[ \text{add feat } (\text{sing } 3, \text{Fin}(a)) \]
\[ T_{905} : W[\alpha'] \]
\[ S_{906} : (\text{fut})(\text{perf})S \rightarrow \text{past}(\text{fut})(\text{perf})S \]
\[ F_{906} : \text{add feat } (\text{past}, \text{Fin}(a)) \]
\[ T_{906} : H[\alpha']. \]

III. Rules for negation

\[ S_{907} : (\text{conj})(\text{past})(\text{fut})(\text{perf})IV \rightarrow \text{neg(past)}(\text{fut})(\text{perf})IV \]
\[ F_{907} : \text{case } 1 \text{ there is one verb in } \text{Fin}(a): \]
\[ \text{let } f \text{ be the list of features of } \text{Fin}(a) \]
\[ \text{if } \text{Fin}(a) \text{ is be, will or have then replace it by } [\text{be}_f, \text{not}], \]
\[ [\text{will}_f, \text{not}] \text{ or } [\text{have}_f, \text{not}] \text{ respectively; } \]
\[ \text{otherwise adjoin (root(do, not), a).} \]

\[ \text{case } 2 \text{ there is more than one verb in } \text{Fin}(a). \]
\[ \text{if do is in } \text{Fin}(a) \text{ then delete this do; } \]
\[ \text{adjoin (root(do, not), a).} \]
\[ T_{907} : \lambda x \, \forall [\alpha'(x)] \]

**examples:** \[ F_{907} ([\text{will walk}) = [[\text{will not walk}] = \text{will not walk } (\text{neg fut IV}) \]
\[ F_{907} ([\text{try not to walk}])] = [[\text{do not][try not to walk]]]) = \text{do not try not to walk } (\text{neg IV}) \]
\[ F_{907} ([\text{walk and}(\text{do not talk})] = [[\text{do not}[\text{walk and}(\text{not talk})] = \text{do not walk and not talk } (\text{neg IV}) \]

\[ S_{908} : (\text{past})(\text{fut})(\text{perf})S \rightarrow \text{neg(past)}(\text{fut})(\text{perf})S \]
\[ F_{908} : F_{907} (\text{verb phrase}(a)) \]
\[ T_{908} : '1\alpha'. \]
IV. IV-complements and adverbs

\[ S_{909} : IV \times (\text{conj})(\text{neg})(\text{perf})IV \rightarrow IV \]

\[ F_{909} : \text{if} \ do \ \text{is the only element of} \ \text{Fin}(\tilde{b}) \ \text{then produce} \]
\[ \text{root}(a, \text{root}(\text{not}, \text{root}(to, \tilde{b}))), \text{where} \ \tilde{b} \ \text{is obtained from} \ \tilde{a} \ \text{by} \]
\[ \text{deleting} \ do \ \text{not} \]
\[ \text{otherwise} \]
\[ \text{if} \ \text{there are occurrences of} \ do \ \text{in} \ \text{Fin}(\tilde{b}) \ \text{then delete these} \ do\text{'s;} \]
\[ \text{root}(a, \text{root}(to, \tilde{b})) \]

\[ T_{909} : a'('^{\beta'}) \]

\[ \text{examples:} F_{909} (\text{try},[[\text{do not}]\text{run}]) = [[\text{not}[\text{to run}]]] \ (IV) \]
\[ F_{909} (\text{hope},[\text{have talk}_{pc}]) = [[\text{to}[\text{have talk}_{pc}]]) \ (IV) \]
\[ F_{909} (\text{wish},[\text{walk and}[\text{do not} \text{talk}])] = [[\text{wish}[\text{walk and}[\text{not talk}])]] \]
\[ (IV). \]

\text{comment:} \ The \ resulting \ phrases \ are \ of \ the \ subcategory \ IV \ because \ all \ verb \ modifiers \ can \ be \ added \ to \ them. \ The \ possible \ inputs \ of \ the \ rule \ are \ characterized \ as \ (\text{conj})(\text{neg})(\text{perf})IV, \ predicting \ that \ all \ verb \ phrases \ of \ the \ corresponding \ categories \ can \ be \ input \ for \ the \ rule. \ This \ prediction \ is \ incorrect \ witness \ (142). \]

\[ \text{(142) John regrets to have talked.} \]

Further investigations are required in order to decide which verbs take which modified complements.

\[ S_{910} : IAV \times (\text{neg})(\text{conj})IV \rightarrow IV \]

\[ F_{910} : \text{root}(\beta, a) \]

\[ T_{910} : a'(\beta') \]

\[ \text{examples:} F_{910} (\text{slowly}, \text{talk}) = \text{talk slowly} \]
\[ F_{910} (\text{voluntarily},[[\text{do not}[\text{talk}]]]) = [[\text{do not talk}][\text{voluntary}]] \ (IV). \]

V. Rules for conjoined phrases

In section 5 we observed that conjoined phrases behave in various ways. This means that they are in various subcategories and that they have to be produced by several rules. The first two rules mentioned below do not create a conjoined phrase, but say that all modified verb phrases and sentences are members of the categories full IV and full S respectively. Most conjunction and disjunction rules are defined on these categories.
\[ S_{911} : (\text{conj})(\neg)(\text{past})(\text{fut})(\text{perf}) IV \rightarrow \text{ful} IV \]

\[ F_{911} : \text{no change of the expression} \]

\[ T_{911} : \alpha' \]

\[ S_{913} : \text{full IV } \times \text{full IV } \rightarrow \text{full IV} \]

\[ F_{913} : \text{root}(a, \text{and}, \beta) \]

\[ T_{913} : \lambda x[\alpha(x) \land \beta'(x)] \]

\[ S_{914} : \text{full S } \times \text{full S } \rightarrow \text{full S} \]

\[ F_{914} : \text{root}(a, \text{and}, \beta) \]

\[ T_{914} : \alpha' \land \beta' \]

\[ S_{915} : \text{as } S_{913} \text{ but now for disjunction} \]

\[ S_{916} : \text{as } S_{914} \text{ but not for disjunction.} \]

The following two rules produce verb phrases which can be modified further.

\[ S_{917} : \text{IV } \times (\neg)\text{IV } \rightarrow \text{conj IV} \]

\[ F_{917} : \text{root}(a, \text{and}, \beta) \]

\[ T_{917} : \lambda x[\alpha(x) \land \beta'(x)] \]

\[ S_{918} : \text{as } S_{917} \text{ but now for disjunction.} \]

The following rules produce constructions with an exceptional character.

\[ S_{919} : \neg \text{ IV } \times \neg \text{ IV } \rightarrow \text{conj perf IV} \]

\[ F_{919} : \text{delete } \text{do} \text{ from } a; \text{ add feature}(\text{pc, Fin}(a)); \]

\[ \quad \text{delete } \text{do} \text{ from } \beta; \text{ add feature}(\text{pc, Fin}(\beta)); \]

\[ \quad \text{root}(\text{have}, \text{root}(a, \text{and}, \beta)) \]

\[ T_{919} : \lambda x[\alpha(x) \land \beta'(x)] \]

\[ \text{example: } S_{919} (\text{[[do not have]],} \text{[[do not talk]]}) = \]

\[ [\text{have}][\text{[not walk}_{\text{pc}}] \text{ and } [\text{not talk}]] \text{[conj perf IV]} \]

The corresponding translation is

\[ \lambda x[\text{walk}(x) \land \text{talk}(x)]. \]

Note that the output of \( S_{919} \) can be used as input for \( S_{920} \), i.e.

future tense can be added to the output of \( S_{919} \).

\[ S_{920} : \text{perf IV } \times (\neg)\text{perf IV } \rightarrow \text{fut perf IV} \]

\[ F_{920} : \text{delete } \text{do} \text{ from } \beta; \text{ adjoin } (\text{have}, \text{root}(a, \text{and}, \beta)) \]

\[ T_{920} : \lambda x[\alpha(x) \land \beta'(x)] \]

\[ \text{example: } F_{920} (\text{have walk}_{\text{pc}}) \text{[[do not][have talk}_{\text{pc}}]]) = \]

\[ \text{will have walked and not have talked } \text{[fut perf IV]} \]
\[ S_{921} : \neg \text{perf IV} \times \neg \text{perf IV} \rightarrow \neg \text{fut perf IV} \]

\[ F_{921} : \text{delete do from } \alpha; \text{ delete do from } \beta; \]
\[ \text{adjoin(} \text{will, root}(\alpha, \text{and, } \beta)) \]

\[ T_{921} : \lambda x \forall[a'(x) \land \beta'(x)] \]

**example:** \[ F_{921} ([(\text{do not})[\text{have walk}_{PC}]], [(\text{do not})[\text{have talk}_{PC}]] = \]
\[ \text{will}[[\text{not[have walk}_{PC}]] \text{ and } [\text{not[have talk}_{PC}]]] \]
\[ \text{will not have walked and not have talked (neg fut perf IV).} \]

**comment:** If the example given with rule \( S_{920} \) is negated, the resulting phrase is identical with the example given for rule \( S_{921} \). The respective translations are different, thus accounting for the ambiguity noted in section 5.

\( S_{922}, S_{923}, S_{924} \) as \( S_{919}, S_{920}, S_{921} \), but now for disjunction.

**VI. Other rules**

\[ S_{925} : T \times \text{full IV} \rightarrow \text{full S} \]

\[ F_{925} : \text{add feature (} \text{sing3, Fin(} \beta)\text{)} \]
\[ \text{root}(\alpha, \beta) \]

\[ T_{925} : a'(\beta') \]

\[ S_{926} : T \times (\text{neg)(past)(fut)(perf)IV} \rightarrow (\text{neg)(past)(fut)(perf)S} \]

\[ F_{926} : F_{925}(\alpha, \beta) \]

\[ T_{926} : a'(\beta') \]

\( S_{927, n} : \text{CN} \times \text{full S} \rightarrow \text{CN} \)

\( F_{927, n} : \text{see } F_{3, n} \text{ in PTQ} \)

\( T_{927, n} : \text{see } T_{3, n} \text{ in PTQ} \)

\[ S_{928} : S/S \times \text{full S} \rightarrow \text{full S} \]

\[ F_{928} : \text{adjoin}(\alpha, \beta) \]

\[ T_{928} : \text{see } T_{7} \text{ in PTQ} \]

**comment:** The requirement that the sentence is an element of the category \( \text{full S} \) prevents the introduction of a verb modifier after application of \( S_{928} \). Hence negation cannot have wide scope in:

\( (143) \quad \text{Necessarily John does not run.} \)

\[ S_{929, n} : T \times (\text{neg)(past)(perf)}S \rightarrow (\text{neg)(past)(fut)(perf)}S \]

\[ F_{929, n} : \text{see } F_{10, n} \text{ in PTQ} \]

\[ T_{929, n} : \text{see } T_{14, n} \text{ in PTQ} \]
\[ S_{930,n} : T \times (\text{neg})(\text{past})(\text{fut})(\text{perf})IV \rightarrow (\text{neg})(\text{past})(\text{fut})(\text{perf})IV \]
\[ F_{930,n} : \text{see } F_{10,n} \text{ in PTQ} \]
\[ T_{930,n} : \text{see } T_{15,n} \text{ in PTQ} \]
\[ S_{931} \text{ and } S_{932} \text{ as } S_{929} \text{ and } S_{930}, \text{ but now for the categories full S and full IV respectively.} \]

### 7.3. Morphology

I will not explicitly describe a morphological component since that would be an ad hoc version. I have already sketched (section 4) two views on what the input for this component could be: either the whole surface structure or only the string of lexical items (with features). In both approaches it cannot be determined whether a certain occurrence of will was introduced on sentence level or on verb phrase level. There is for the morphological component just one will. Analogously there is just one have, whether is was introduced as auxiliary at some stage, or as a main verb describing the relation between owner and property.

### 7.4. Fins and verb phrase

In the rules the queries verb phrase and Fin are used. Below I will give a definition of these queries. Although I have described the framework as one which produces labeled bracketings, I did not specify labels because they are not needed in the rules. In the definition of Fin the labels are useful and I will refer to them. (If the reader has objections against this situation — not introducing the labels explicitly, but still using them — then he should neglect the labels. It does not lead to different predictions of the grammar.)

In the definition below V is a parameter which stands for all verbal categories, i.e. V has to be replaced by IV, IV, IV/IV, or Aux (or whatever the label is of will, have and do). The X,Y and S stand for arbitrary labels, and Ø for the empty set.

\[
\begin{align*}
\text{Fin}(a) & = a \quad \text{if } a \text{ is a verb} \\
\text{Fin}([a]_V \text{ and } [\beta]_V) & = \text{Fin}(a) \cup \text{Fin}(\beta) \\
\text{Fin}([a]_V \text{ or } [\beta]_V) & = \text{Fin}(a) \cup \text{Fin}(\beta) \\
\text{Fin}([a]_V, [\beta]_V) & = \text{Fin}(a) \\
\text{Fin}([a]_X, [\beta]_S, [\gamma]_Y) & = \text{Fin}(a) \quad \text{if } X \text{ is not a verbal category} \\
\text{Fin}(a) & = \emptyset \quad \text{if } a \text{ does not satisfy one of the above clauses.}
\end{align*}
\]
Verb phrase is defined analogously.

\[
\text{Verb phrase}(\alpha) = \alpha \quad \text{if } \alpha \text{ is a verb}
\]

\[
\text{Verb phrase}(\left[\alpha\right]_S, \left[\beta\right]_S) = \text{verb phrase}(\alpha) \cup \text{verb phrase}(\beta)
\]

\[
\text{Verb phrase}(\left[\alpha\right]_S/\left[\beta\right]_S) = \text{verb phrase}(\beta)
\]

\[
\text{Verb phrase}(\left[\left[\alpha\right]_I, \left[\beta\right]_I\right]_S) = \beta
\]

\[
\text{Verb phrase}(\alpha) = \emptyset \quad \text{if } \alpha \text{ does not satisfy one of the above clauses.}
\]

7.5. Final remarks

I would like to end by saying something about the methodology. I fully agree with the final remark of PARTEE 1979a (p.94): 'It can be very frustrating to try to specify frameworks and fragments explicitly; this project has not been entirely rewarding. I would not recommend that one always work within the constraint of full explicitness. But I feel strongly that it is important to do so periodically because otherwise it is extremely easy to think that you have a solution to a problem when in fact you don't.'

Some remarks about my experiences in formulating the rules.

1. The project was not entirely successful. It was too difficult to do everything correctly at once. By providing explicit rules, I am also explicit in cases where I know the proposals to be incorrect (see section 5), or to be ad hoc (e.g. agreement).

2. The rules are explicit about borderline cases in which it is not evident that the produced sentences or the obtained readings are possible (e.g. verb phrase complements with a verb modifier).

3. The rules describe a rather large system and they make predictions about a lot of kinds of sentences I never thought of (for instance because they do not resemble the phenomena I thought of when designing the rules). I would feel safer about the correctness of the rules if I had a computer program producing hundreds of sentences of the fragment, together with their reduced translations.

4. Writing explicit rules forced me to consider the 'irrelevant' details. It turned out for instance that of the three methods for defining Fin's mentioned in JANSEN 1980, in fact only one was applicable.

5. Considering some larger fragment explicitly gave me suggestions for finding arguments. I have presented a related treatment of verb modifiers in JANSEN 1980 as well, but most of the arguments given in sections 2, 3 and 4 of this chapter are new, and these were found when I extended
the fragment with the quantification rules and conjunction rules.

Although the first three points are not really a recommendation for the rules presented here, I would not like to call these negative consequences of working explicitly. They are inherent to such a method of working, and constitute, in my opinion, rather an advantage. Shortcomings of a proposal with explicit rules are easier found than of a proposal without. Therefore such an approach is, generally speaking, a better starting point for further research and improvements.