CHAPTER 2

"RELEVANCE" IN LOGIC AND GRAMMAR

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1. Introduction

1.1. In philosophical and logical work on conditionals, entailment and the general principies of deduction, the problematic notion of "relevance" has given rise to a heated debate and genuine puzzlement. Although there have been attempts to account for the concept both axiomatically and semantically, it can hardly be pretended that such formalization goes beyond a rather intuitive understanding of the issues involved. As is often the case in the recent development of many types of non-standard logics, the intuitions invoked are clearly linguistic in character, i.e. pertain to properties of conditional sentences and arguments of natural language.

Since our intuitions about natural language are supposed to be made explicit by an adequate grammar, we would expect such a grammar to shed some light also on the rules and constraints determining relevance relations in natural discourse.

In this paper an attempt will be made to provide a general and informal discussion of `relevance' and related notions from this linguistic point of view. [1] More particularly, it will be argued that the relevance requirement must be satisfied by any compound sentence, viz. by all connectives, and by any coherent discourse, i.e. not only deductive or argumentative, in natural language. Although such a claim might have feed-back in the philosophy of logic, we will be concerned with the applications of some recent ideas from relevance logics in the explicit characterization of these properties of natural language.

1.2. There are developments in actual linguistic theory which have some striking similarities with the interest for relevance logics and conditional logics in logical theory. Whereas the generative transformational grammars elaborated by Chomsky and others were originally confined to algorithmic structural descriptions oí isolated sentences, it has been noticed, from different points of view, that both the syntactic and the semantic structures of sentences should be characterized relative to the structure of other sentences of discourse on the one hand, and relative to the structure of the speech context, on the other hand. The first argument has led to the attempt to construct grammars to account for the abstract structures of discourse, so-called `text grammars' [2], whereas the second argument has brought various branches of pragmatics (logical, philosophical, sociological) within the scope of linguistic research. [3] Thus, much attention has been paid, both within the "textual" and with the "contextual" perspective, to the notion of `presupposition' [4]. ***Mutatis*** mutandis, one could say that presupposition in these linguistic investigations plays a role similar to that of entailment in relevance logics: whereas a logical consequence is required to be relevant with respect to the premises by which it is entailed, a grammatical sentence in a discourse or conversation is required to be relevant with respect to the presuppositions which it may

be significantly asserted. Oí course, different concepts of "derivation" and "assertion" are involved here, but the analogies are interesting enough to serve as a starting point for a more general discussion about the relationship between formal and natural discourse, i.e. between logic and grammar.

2. Natural connection

2.1. In order to be able to evaluate logical treatments oí relevance we first should try to make our linguistic intuitions more precise and systematic, and to formulate provisionally the conditions of relevance in natural language.

Both in logic and in grammar relevance arguments pertain to relations between sentences (or propositions). On the one hand such a relation may hold between sentences in compound sentences, on the other hand between sentences in a discourse, derivation or proof, e.g. between premises and conclusion. Let us start with some observations on relevance relations in sentences of natural language, i.e. on the specific properties of connectives and connection in natural language. For shortness, we will speak of "natural connectives" and "natural connection".

2.2 'From a logical point oí view' one of the notorious properties of natural language is its vagueness and ambiguity. Connectives are no exception. That is, we may in `surface structure' express a certain connection, e.g. some type of implication, with a connective, e.g. and, normally used to express another connection:

(1)   John was not well prepared and failed his exam.

Similarly, an "underlying" connection need not be expressed by a connective at all:

(2)   Peter won't come; he is angry.

From such examples it may be concluded that natural connection should be studied at a sufficiently abstract leve], viz. at the level of "deep structure" or "logical form" of sentences. Although grammatically crucial we will not be concerned here with specific surface manifestations of natural connection. [5]

2.3 Another difficulty is the distinction between sentential and phrasal connection in natural language:

(3)   I'll go to the movies or to the theatre tonight.

(4)   I'll go to the movies tonight or 1'11 go to the theatre tonight.

(5)   Harry and Larry failed their exam.

(6)   Harry failed his exam and Larry failed his exam.

(7)   Harry and Larry are good friends.

(8)   Susy ordered fish and chips.

([9]) Sugar and water make syrup.

Such phrasal connections are possible especially for and and *or* (and in some special cases, e.g. *but* + negation) and make noun phrases out of noun phrases and verb phrases out

connectives may be derived from underlying sentential connectives, i.e. (4) is the hypothetical underlying structure of (3). The same holds for many cases of conjunctive phrasal connectives as in (5) and (6). Examples (7), (8) and (9), however, show that such a reduction to underlying pairs of sentences is not without problems. Instead of expressing a connection between sentences (or rather, propositions) they seem to express roughly a meaning like `together with' or each other', i.e. an operation on individuals to make n-tuples or sets. The difficulties involved here will be ignored in the present discussion and we will focus upon sentential (propositional) connection.

2.4. Although we have decided to neglect the specific syntactic properties of natural connectives in order to be able to focus our attention upon their abstract (`logical', semantic) characteristics, it should be noticed that natural connectives are expressed in different grammatical categories, viz. as conjunctions and as adverbs mainly, but also in modals (counterfactuals) and larger phrases (e.g. the reason why). These distinctions in surface structure are motivated by reasons of compatibility, distribution and substitutivity. Proper conjunctions cannot follow each other (*and or), whereas conjunctions and adverbs and abverbs and adverbs are compatible *(and yet, so nevertheless).* Again, such phenomena require explanation at the semantical level.

2.5. With respect to their `meaning', natural connectives are usually grouped in different classes, viz. conjunctions, concession, condition, consequence, causal, final, circumstantial (time, place, manner). These respective meanings must be made explicit in an appropriate semantics. Since most natural connectives do not have a counterpart in logical languages their interpretation is not formally straightforward. Nevertheless, one might reduce these various classes of connectives to a limited number of basic connectives, for which an appropriate formal language and hence an interpretation might be devised. Thus, it will be argued that all natural connectives manifest different types of "conditionals", varying according to the "strength" (modality) of the connection and to the truth value status, with respect to the actual world, of the connected propositions.

2.6. Arriving now at the heart of the matter we meet the condition that propositions related by natural connectives in a compound proposition are to be (pairwise) relevant to each other. This constraint seems necessary to mark off as "queer" the following sentences when used in normal contexts:
(10)   *Peter has a headache and Nixon will never resign.
(11)   *John went to Paris or his uncle is very rich.
(12)   *The film was terrible but the spring was early this year.
(13)   *If Harry comes to the party, the grass will be green.
(14) *Because Susy was ill, the Russians did not land on the moon.
That the condition of relevante is general and not dependent on the individual meanings of the respective connectives used can be concluded from the fact that in these examples no connective would make the sentence acceptable. The unacceptability of the following sentence

(15)   *John is very strong, but he could lift that stone.

What, then, are the conditions which determine the `connectibility' of propositions expressed by compound sentences?

One of the usual answers given in the logical and philosophical literature, at least for conditionals and entailment, is that the two sentences or propositions must share a "meaning component". [8] This requirement is pretty vague and needs further explication. In the first place it is necessary to distinguish at least between "meaning" and "sense" along the usual Fregean lines, or between intensional (conceptual, analytic) meaning and exteñsional (referential) meaning. Although this distinction is notoriously problematic, we will take these respective notions oí meaning both as functions from expressions (terms, sentences) taking as values concepts (thing concepts, fact concepts) on the one hand, and individuals (things, facts, truth values) in some possible world(s), on the other hand. This is still rather inexact; in particular we may want extensions to be determined by intensions, and hence reference by conceptual meaning, e.g. as a function from intensions (conceptual meanings) to properties of possible worlds. [?]

Now, although (conceptual) meaning relations may determine certain types of connection (e.g. entailment), this condition certainly does not hold in general. The propositions in example (10) and (11) aboye share a concept [human], but this does not make them connected. Hence the condition is not sufficient. To see that it is not necessary either, look at the following example:

(16)   If it has rained the grass will be green.

This is a perfectly well-connected sentence of which the propositions do not seem to share a concept. Again, this observation holds for any connective which may be substituted for *if then* in (16), and hence does not depend on the `meaning' of the respective connectives.

As we indicated aboye there is one case where concept-sharing seems to be a necessary condition of connection, viz. in analytic implications (entailments) expressed in natural language: [8]

(17)   Roger is a bachelor, so he is not married.

Notice however that such sentences are instantes oí general `meaning postulates' from the lexicon, and thus have a meta-linguistic character. This property explains the specific use of such sentences in learning situations and in argumentative discourse; the consequent does not satisfy the general principie of information increase in natural conversation. Notice further that conception-sharing condition only holds for this type of implication. Sentence (17) expresses a true proposition in all possible worlds where the proposition expressed by the antecedent is true. In other implications different types of necessity may be involved, not based on concepts but on the factual structure of the actual world and those worlds compatible with it. Thus, the following examples express an implication (holding in all possible physical-biological worlds) without sharing a concept relevant for the implication:

(18)   It is spring, so the trees get new leaves.

(20)   Peter stayed at honre, so he didn't visit us.

From this discussion it follows that a conceptual meaning relation between propositions is neither a sufficient nor a necessary condition for them to be relevant to each other, except for the specific case oí analytic implication.

Now, let us consider relations of referential meaning between propositions, i.e. relations determined by reference to the same things or facts in some possible world. As may be seen already in the previously given examples, e.g. (19) and (20), this condition comes much closer. In intuitive terms: Two propositions are relevant to each other if they are `about' the same thing. In more formal terms: if, under some interpretation and with respect to a given model structure, the value of a term in the antecedent is identical with that of a term in the consequent. This is precisely one of the semantic conditions which make pronominalization possible as in (19) and (20). Since we often use words which conceptually overlap in order to denote the same referents, relevance based on referential identities is frequently accompanied by at least partial conceptual identity.

The values of terms need not be individual "things" like concrete, observable, identifiable objects. They may also be other "facts" of a given possible world: time point, event, action, property, etc.:

(21)   John took his tea at 3 p.m. and at the same time the bomb exploded.

(22)   The bomb exploded nearby, but we didn't hear it.

(23)   Pete has the measles, and so had Jill.

The picture, however, is more complex. Although rather generally formulated, the constraint seems too strong. Consider for instante example (18), which is clearly connected, but the two propositions do not seem to share identical referents. Relevance in this case seems to be based on what might be called "circumstantial identity". That is, the circumstances in which the second proposition may have a truth value (viz. truth) are specified by the first proposition - in this case, the consequent contingently implies the antecedent. In other terms: the antecedent is a sufficient and necessary condition for the second proposition. A similar connection holds for sentence (16) where the antecedent is (weakly) sufficient for the consequent.

There are other examples where referential identity is not required for relevance:

(24) John is old, but Peter is young.

Here, connection is established on the basis of identical "property types", viz. age. Although the particular properties are different - in this case contraries - predication in both cases is, so to speak, made from the same point oí view, i.e. with respect to the same inherent feature of the individuals (having age), which also determines the sort of correctness of the two propositions. [9]

Whereas the necessity of referential identity conditions thus must be formulated in a more general way, we may next ask whether the condition is at least sufficient. Let us again

(25)   *Peter passed his exam in mathematics and he is six feet tall.

(26)   *If John won that chess game, Mary won the beauty contest.

(27)   *While I took breakfast Nixon started his tour to the Middle East.

(28)   *Since Peter wanted it, the moon rose at 1:30.

In these sentences we have, respectively, identity oí individual object, partial property identity, time identity and propositional (fact) identity. Nevertheless, the sentences seem rather unacceptable for most normal conversational contexts. Apparently, referential identity is not a sufficient relevance condition. Hence this basis is too small to relate propositions. Looking at the examples in (25)-(28) we observe, intuitively, that although there is a semantical relation, viz. between denoted objects, there is no apparent relation between the *facts* denoted by the two propositions. Conversely, in the previous examples we saw that, although there was no identity of individuals, there was a relation between the facts denoted by the propositions, viz. a relation of necessary or sufficient conditioning of facts, e.g. a causal relation. In other words, we may conclude that two propositions are relevant to each other if and only if the facts they denote are related. Now, this condition is not surprising when we assume that (natural) connectives may be interpreted as relations between (or operations on) facts of some possible world or some possible course of events.

Of course, in case one should want to identify propositions with facts, the result is trivial. We therefore keep conceptual and referential meaning, and hence the meaning of sentences, viz. propositions, apart from the structure of the possible world itself in which such meanings have general or particular values. Nevertheless, we might want to know under what conditions facts are related. A simple formal answer would be: two facts are related if they form an ordered pair which is an element of the set of ordered pairs which is the value of the connective relation. At first sight this is a curious move back to the linguistic level because the set of fact pairs (or, for that matter, of fact n-tuples) seems constructable only via language expressions/meanings. Although we would not like to endorse such a claim without qualification, it has an interesting pragmatic bite: two facts are related if a speaker considers them to be related by uttering a sentence expressing a connection between propositions denoting these facts. This brings relevance exactly where many have thought it should be accounted for: in the pragmatics of natural language.

2.7 Conjunction. In order to specify the properties of natural conjunction we begin with some examples:

(29)   Peter went to the store and bought cigarettes.

(30)   Peter, please go to the store and buy me some cigarettes.

(31)   Mary took a sleeping pill and fell asleep.

(32)   Susy read a book *and* John played the piano.

It should first be observed that in these examples *and* may be substituted by *and there, and then, and at the same time,* respectively. If this is due to the inherent meaning of *and,* it should be reflected in the truth conditions. [10]

Sentences (29), (31) and (32) express a true proposition (i.e. a proposition having a fact in the intended world as a value) if the component propositions are both true. This is as

classical as it can be and uncontroversial. But it is only part of the story. First of all, e.g. in (29) and (31), we would hardly want to have the conjunction true if Peter went to the store yesterday and bought cigarettes today. Similarly for (31). Hence, we should build in the usual possible world condition that the propositions have facts as values in roughly the "same" possible world. Now, permute antecedent and consequent in (29) and (31), and we see that this condition is still too weak. The possible worlds must be linearly ordered in time, at least in (31), but with the proviso that the time points are sufficiently close. This is a vague condition, which can certainly be falsified by other examples when it is not further qualified. Intuitively, the two time points must define what we may call a single "situation". As such, neither possible worlds, nor time points, seem to be sufficient to achieve this task. That is, we would at least need a third situation *relative* to which two possible worlds are related such that they form one situation. [11] Although we do not yet have an appropriate pragmatics, this third situation may be taken as the *context* of utterance of the sentence. Formally, then, expressed in the semantics by a primitive operation of "compatibility" or "accessibility". In other words, we may say that the two time points/worlds define a *possible course of events* accessible from another course of events, viz. the context. A conjunction would then turn out true in a course of events if both propositions are subsequently true in the same course of events (accessible from the context).

Although these semi-formal conditions bring us a step closer, there are more aspects involved in natural conjunction. Moreover, the `possible course of events' device is not yet very clear and even seems to beg our question concerning the relatedness of facts. Take for example the following sentence:

(33) *Peter went to bed and bought cigarettes.

Why is this sentence clearly less acceptable in most contexts than (29)? In other terms: why is there no (normal) course of events in which the proposition expressed by (33) can be satisfied? [12] One of the reasonable answers would be: Going to bed is not the usual condition making cigarette buying possible, whereas going to the store is. At least for the mentioned examples we arrive at the conclusion that natural conjunction is noncommutative and has the character oí a sort of *conditional, where* both propositions are to be true, but where the consequent is true in a possible world determined by (selected by) the antecedent. [13] I.e. the consequent is to be interpreted in a possible course of events in which the antecedent is true.

Apparently, example (32) does not seem to fit this condition. First, it can be commuted *salva veritate.*   Second, the antecedent does not specify a condition under which the consequent is possible. Nevertheless, in order to be an interpretable conjunction, (32) must exhibit, though implicitly, a conditional form. Indeed, without previous information (32) would not as such be interpretable, and it may appropriately be uttered only after a sentence specifying the condition with respect to which both propositions are true, e.g.

(34)   After dinner Susy and John went to the library upstairs.

This is, the two propositions of (32) are not directly connected but via a third proposition. The meaning of *and* in (32) may thus appropriately be paraphrased by (and) in *the same situation.* Abstracting from implicit conditionals, this is the reading coming closest to logical

conjunction.

Clearly, the conditional involved in natural conjunction is *very* weak. The fact denoted by the antecedent is neither a sufficient nor a necessary condition for the fact denoted by the consequent. That is, the condition is one of the possible conditions which *anoto* the fact denoted by the consequent to occur, i.e. the antecedent selects one of the situations in which the fact denoted by the consequent is at least possible (or even probable, as in example (31)).

2.8. <u>Disjunction.</u> Natural disjunction plainly acquires the same weak conditional character as natural conjunction. Take, for example, the following sentences:

(35) John went to Paris or he went to Rome.

(36) Love me or leave me!

Usually, natural disjunction is exclusive, i.e. expresses a true alternative only if at least one of the propositions is false and the other true. Characteristic, further, is the fact that the speaker, at the moment of utterance, does not know which alternative is or will be realized. In the possible world terminology this would mean that the possible world (or course of events) in which the propositions are true or false is not accessible to (the worlds of) his actual knowledge. *Sentence* (35) is commutative and the disjunction there is thus based on a conjunction with an implicit (presupposed) condition. This is, indeed, how we interpret (35); we are expected to have the information that the alternative courses of events are to be compatible with e.g. the fact that John spent his last holidays *in* Europe. Hence, if, with respect to this initial situation, the first alternative is true, the consequent is false, and if the antecedent is false then the consequent is true, and conversely. In some cases, e.g. in (36) the disjunction, paraphrasable by *or else,* is noncommutative, such that only the first part of the truth condition is required; nothing `follows' from the satisfaction or nonsatisfaction of the consequent. (At the moment we leave undiscussed the specific problem concerning the interpretation of imperatives, which also requires an appropriate pragmatics.)

A disjunction is false if both propositions are true or both are false in a world accessible from the context, i.e. the speaker knows that there is no alternative.

2.9. <u>Contrastive, Concession.</u> Whereas conjunctions and disjunctions in natural language have a weak conditional character, all other connectives either directly express or indirectly presuppose stronger conditionals, viz. contingent implications of various strength. Although there are stylistic and pragmatic differences (different presuppositions), contrastives and concessions have analogous semantic and truth conditions. Take for example the following examples:

(37) John is very clever, but he could not prove the theorem.

(38) Although John is very clever, he could not prove the theorem.

(39) John is very clever yet/nevertheless he could not prove the theorem.

The basic condition, again, is that both components are true in a possible world accessible from the context. Whereas in other implications the consequent more or less "necessarily" follows from the antecedent, as we shall see below, the inverse holds here; the falsity of the consequent "follows normally" from the (true) antecedent. Since, however, the consequent is

true, these connectives somehow express an "exception" to an implication. This fact, hence, excludes any kind of necessity of the connection, and we therefore have to resort to weaker modals and corresponding quantifiers in the model-theoretic account, viz. *probability* and *for most,* respectively (where *'probability'* assumes the meaning it has in natural language: *`it is probable that').* So, whereas the basic condition is that both components are true in some possible world - e.g. the actual world - the further condition is that for most alternative possible worlds (or course of events) accessible from the context, in which the antecedent is true, the consequent is false. Hence, there is at least one situation in which this is not the case, and that situation is actualized.

The reading of contrastive *but* aboye, however, is not the only one. Consider, e.g. sentences like (24) (`John is old, but Peter is young'). Here nothing even of a probable ιmplication seems present. Indeed, in such cases and may often be used too. Intuitively, it seems that whereas in the stronger *but* and in the concessions the truth value is contrary to what is expected, the weaker contrastive expresses that the predicates of the two propositions are somehow contrary, or mutually exclusive. The criteria involved are pragmatic: the "contrast" expressed depends on the expectations of the speaker (and the knowledge of the speaker about the expectations of the hearer) in a given context. So, whereas in the strong contrast we have maximal difference, viz. contradiction, in weak contrast we have contradictories of predicates or simple difference with what is expected, e.g. *A and B* instead of *A and C.* As for conjunction and disjunction, we omit many details. The main task is to briefly resume the systematic semantic properties of natural connection, manifesting the different ways facts, and hence propositions, are relevant to each other.

2.10 Conditionals, Causals, Implications. We can be brief about the stronger natural connectives, viz. conditionals, causals and implications of different types, because these have had extensive attention in the philosophical and logical literature.

Notice first of all that not all conditionals have implicational strength.   Weak conditionals have semantic properties analogous to those of natural conjunction. Compare for example the following sentences:
(40)   If you go to the store, please buy me some cigarettes.
(41)   I went to the store and bought you some cigarettes.
In neither case the condition expressed by the antecedent is somehow sufficient or necessary, but only "possible" (cf. the paraphrase of this if   *[then]* by in *case).* The only difference involved is the fact that the speaker has no epistemic access to the truth of the antecedent (which is *a fortiori* the case for all future possible worlds, and thus in all speech acts pertaining to future acts of speaker and hearer: promises, requests, etc.). Thus, while some conditionals are as weak as conjunctions, others have probable and necessary modalities which also characterize causals and implications:
(42)   If it rains the protest march will be cancelled.
(43)   If it rains tomorrow the grass will soon be green.
(44) If Harry said so, it's okay with me!
The facts denoted by the antecedente are sufficient conditions for the facts denoted by the

consequents. That is, in al] (or most) possible worlds where the antecedent is true the consequent is true (in no, or nearly no, possible world is the truth of the antecedent compatible with the falsity of the consequent). The further condition, specifically distinguishing conditionals from conjunctions on the one hand and causals/implications on the other hand, is that the speaker does not (yet) know whether the antecedent is true. Yet, although the facts are unknown the relation between certain facts is known: or rather, the relation between fact types (concepts) is known, e.g. in the form of lawlike propositions or rules, holding all (most) possible worlds (compatible with the actual world). This general inductive knowledge provides the access, from the context, to some distinguished possible world, or possible course of events. This generality, of course, does not hold for examples like (42), where possibly an *ad hoc* relation between facts is expressed, characteristic of conditions functioning as sufficient *reasons* for action. Hence, in all possible (future) worlds compatible with the intention/decision of an agent the antecedent is inconsistent with the negation of the consequent.

Notice also that in many cases a natural conditional implies that the negation of the antecedent is consistent with the negation of the consequent, i.e. if the antecedent turns out to be false so will the consequent, because conditionals are often exclusive from a pragmatic point of view. This is always the case for conditionals where the antecedent does not (only) express a sufficient but (also) a necessary condition, as in an examples like:
(45)   If I go to Paris, visit the Louvre.

These remarks do not yet provide a full picture of the "truth conditions" of (hypothetical) natural conditionals. As for the other connectives, the pragmatic status of notions like "truth", "assertion", etc. have not been clarified. In this perspective there have been attempts to formulate truth conditions for a (logical) relevant conditional with a pragmatic clause stating when the sentence is assertive in a given possible world." Only assertive sentences can receive a truth value, whereas a conditional is assertive only when its antecedent is true. Although such a proposal comes closer to a serious treatment of relevant conditionals, it has several difficulties when it is not further specified. Clearly, the factual truth status of the two propositions does not determine whether a sentence expressing them is assertive or not. The pragmatic conditions of assertability are to be formulated in terms of knowledge and assumptions of the speaker. Next, what is asserted is certainly not the consequent-under-condition-of-the-truth-of-the-antecedent. Assertion, as was noticed, is a function of previous discourse and/or assumptions of the speaker, i.e. of contextual structure. This can be seen from the following example:

(46)   A: When will the protest march be cancelled?
            B: The protest march will be cancelled if it rains.

The assertion made by B is certainly not (only) pertaining to the consequent (here, typically, in topic position - indicating the standard position of presupposed elements), but rather to the conditional antecedent.

From this very brief discussion it seems to follow that the conditional antecedent must

be true, or rather thought to be true, only if it has presuppositional character, i.e. if it is equivalent with a proposition (or its entailment) expressed in a previous sentence or describing the knowledge of the speaker. Under that condition the utterance of a conditional may be - under still further conditions - an appropriate assertion. Assertions are (speech) acts, which are not true or false but appropriate or inappropriate, successful or unsuccessful. Now, an assertion is appropriate if the speaker believes that the proposition expressed by the sentence he utters is true. [15] In case of a conditional, thus, neither antecedent nor consequent are asserted, but the conditional relation between them. Hence, a conditional is true if that relation exists in the intended possible world, i.e. if in all (most) alternatives to that possible world the existence of the fact denoted by the antecedent proposition is incompatible with the absence oí the fact denoted by the consequent proposition. This is still a partial account, but it will do for the moment.

In other conditionals, like (44), the antecedent is not hypothetical, but expresses a proposition assumed to be true by the hearer. In that case, indeed, the antecedent has presuppositional character, whereas it is asserted that the consequent is true *and* that this fact depends on the truth of the fact denoted by the presupposed antecedent. The assertion, then, is appropriate, *inter alía,* if the antecedent is true, and if the speaker believes that the consequent is/will be true and that this truth depends on the truth of the antecedent. Abstracting from this pragmatic condition, thus, the proposition expressed by the sentence (uttered) in an assertive act is true if both facts exist in the actual world and if the first is a sufficient condition for the second (i.e. incompatibility of its absence with the presence of the first in most alternatives). This gives precisely the truth conditions for causals. Indeed, sentence (44) seems to be equivalent with sentence (47):

(47)   Since Harry said so, it is okay with me.

In this example the first proposition is again presupposed. This is also the case in many other causals:

(48)   Because of the airline strike, we will not go to India.
(49)   We will not go to India, because of the airline strike.
(50)   We will not go to India, for the airline is striking.

In the first two sentences, the *because* clauses (nominalized in surface structure) are presupposed, which is not the case in (50), *where* two propositions are asserted (plus the causal relation between the facts denoted by them). From the truth condition given, we see that causals are like natural conjunctions in that both propositions are true in the actual world, and like conditionals in that the fact or situation denoted by the antecedent *necessitates* or *probabilizes* the fact denoted by the consequent. Causals, themselves, may be of different strength, and *scope,* depending whether the related facts are connected in most or all alternative possible courses of events, and whether these alternatives are physical, biological, psychological, etc. alternatives. We will not here discuss the numerous other philosophical problems related with the notion of causation.

Whereas in causals the antecedent is known to be true in the actual world, and in the (hypothetical) conditional it is unknown to be true in the actual world, the specific property

of *counter factual* conditionals, is that the antecedent is known to be false in the actual world. [16] As with the other conditionals, however, it is supposed to be true in some alternative world, which may in this case, however, be basically different from the actual world in that other basic postulates are true in it. The minimal difference is that in the alternative world the antecedent is true but false in the actual world. All other things may be equal and indeed are usually kept constant in case something is asserted about a possible alternative compatible with the factual world. Since the antecedent "determines" the consequent, the fact denoted by the consequent will also be false in the actual world.

Natural *implications* have, as we saw earlier, a specific status and are normally used in meta-linguistic (language teaching) and argumentative discourse. The truth conditions are well-known, and similar to those of the causals, but with more general necessity involved: Truth in "all" possible alternatives (empirical or logical):

(51)   Peter has been in Paris, so he has been in France.

(52)   John went to the movies, so he is'nt here.

These implications may also be in the other connective "modes": `If (since) Peter has been in Paris ...', `If Peter has been in Paris ...', `If Peter would have been in Paris ...'.

2.11. The previous sections were intended as a brief (incomplete) characterization of the main semantic properties of the natural connectives. Using terminology and some proposals from recent relevant semantics of logical connectives, we see that in principie all natural connectives can approximately be defined in terms oí various types of "conditionals". Specific differences are either stylistic (which we didn't discuss at all) or pragmatic (presuppositions, assumptions of the speaker, viz. the structure of the context) on the one hand, whereas on the other hand the semantic differences are based on the following criteria:

strength of the connection [17]
--possible: conjunction, weak *but,* weak if (in *case)*
--probable: concession, conditional, causal
--necessary: causal, implication

(ii)   truth in actual/non-actual/epistemically (in)accessible possible world(s) of one/both proposition.

This is still rather confused and hardly a new result. Further conclusions should be drawn from the brief analysis given.

First of all, we observed that all connectives have 'conditional' character. Hence it seems to be misleading to talk about a (one) conditional connective, at least in natural language. Secondly, it was shown that what usually is considered as a (relevant) conditional, often expressed by *if ….[then],* covers the different degrees of connective *strength,* i.e. represents different connectives. Put in other terms: all connectives have an if-counterpart. Consider e.g. the following pairs:

(53)   *(a)* If I am in Paris, I'll visit Madam Tussaud.
           (b) I was in Paris, and visited Madam Tussaud.
(54)   *(a)* If he didn't visit Madam Tussaud, he climbed the Eiffel Tower.

(b) He visited Madam Tussaud or climbed the Eiffel Tower.

(55)   (a) (Even) if Holland played best, it didn't become world champion.

(b) Holland played best, but didn't become world champion.

(56)   (a) If Mary is ill, *she* won't visit us.

(b) Because Mary was ill, she didn't visit us.

(57)   (a) If the king is beheaded, he is dead.

(b) The king has been beheaded, so he is dead.

(58)   (a) If John is a bachelor, he isn't married.

(b) John is a bachelor, so he isn't married.

Similarly, all connectives have a subjunctive (counterfactual) counterpart, expressed by *if...*

connective at all, but rather, so to speak, expresses a semantic *mode* of connected propositions. Whereas the "other" natural connectives denote a possible, probable or necessary connection between facts which are *known* (and hence either asserted or presupposed) by the speaker to exist (i.e. to be true in the actual world), i *f then* statements express the same connections respectively for a possible world (course of events) which is epistemically inaccessible. The third mode of assertion, viz. counterfactuals, expresses facts to be false in the actual world but true in some alternative world. Since counterfactual worlds are strictly speaking also epistemically inaccessible, we could take subjunctive conditionals as a specific submode of the second mode, although it shares with the first mode, the factual mode, the property that the speaker knows or assumes something about the actual world, viz. the falsity of the propositions.

Instead of speaking about, respectively, a factual and a hypothetical mode, we might use terms like transparent and opa que. In *transparent assertions* the speaker knows whether the propositions are true (whether the facts denoted by them exist) in a world accessible from the context, whereas in opaque *assertions* the speaker does not know whether the facts exist (and hence can assert only a relation between fact types, actualized in some world, most worlds or all worlds). [18]

In seeking for the `relevante' behind conditionals we seem to have overlooked the fact that `conditionality' itself is the criterion we needed, viz. as a requirement of any (at least natural) propositional connection.

In reducing natural connectives to one basic type, viz. conditional, with different degrees of strength, we also seem to be one step closer to the systematic relationships between *connectives and modalities,* a central topic in the entailment discussion. [19] Whereas implications are usually associated with (different sorts of) necessity, now the weaker connectives are associated with possibility. At the same time, we saw, a notion like "epistemic accessibility" between possible worlds has been used to characterize if-conditionals. Of course, all this requires a serious formal semantics, and the remarks here are merely preliminaries in that perspective.

For reason of simplicity we use a provisional piece of notation for the three basic types

of conditional connectives: [2°]

A 0—■ B: it an A situation it is possible that B

A V—■ B: it an A situation it is probable (likely) that B

A ❑--> B: it an A situation it is necessary that B

Assuming 'A * B' to mean, in general, 'A is a condition for B', it may of course be asked whether the three basic conditionals can simply be defined in terms of with modal operators:

A 0-4 B = 0(A * B)

A V-->   V(A* B)

A 0—> = EI(A * B)

Such a question can be answered only if we know exactly what the modalities used here mean in natural language. It has often been pointed out that the modalities of natural language are at least "empirical" modalities, in the sense that our use of `necessary', `likely', and `possible' either corresponds to possible worlds which are compatible with our own, actual, world, or with that portion of actual worlds (and those compatible with them) which are epistemically accessible.

A first problem is whether A 0—■ B, and hence (if the definition is correct) 0(A * B), is equivalent with A * OB, which might be inferred from the intuitive readings given above. [21] Indeed, there are examples in natural language where we do not easily find a difference in meaning:

(59)   It is possible that, if Peter comes to the club, Harry will throw him out.

(60)   If Peter comes to the club, it is possible that Harry will throw him out.

(61)   It is possible that Harry will throw him out if Peter comes to the club.

Apparently, the `it is possible (that)'-clause at the beginning has only the main clause as its scope, which is a normal phenomenon in complex sentences which have a subordinate clause in initial position (e.g. "It is strange that, although she always wrote him, he never sent her a letter"). This observation does not prevent sentences like (59) from having different meanings. A more "logical" reading would be that there is at least one situation in which Peter's visiting the club is a sufficient condition for Harry to throw him out, whereas in (60) Peter's visit is a sufficient condition to make throwing him out possible. Sentence (59) is already true when there is one (imaginable) situation of "coming-throwing out", whereas in (60) in any situation where Peter comes to the club the possibility may arise that he will be thrown out. (60) is inconsistent with the information that usually (in most situations) Peter's visit is a sufficient condition for not being thrown out. Strictly speaking, it is always "possible" (empirically and under appropriate circumstances, e.g. Harry's abilities, etc.) that Peter is thrown out of the club when he is there, which would make (60) trivial when the phrase `it is possible that' in the second clause would not pertain, as in (59), to the whole sentence, that is to the connective. Moreover, in our examples 'if has been used with the meaning of a sufficient condition, i.e. with likeliness of necessity involved. The question, thus, is whether in natural language 0(A B) is equivalent with A ❑—> <>B. In this respect the given examples seem to differ from sentences like

(62)   If I (were to) throw a dice, a six may turn up (it is possible that ...).

Here, the possibility is as such "necessitated" by the fact denoted by the antecedent. Indeed, the antecedent expresses a necessary condition. In other cases the initial "operator" does certainly not have the consequent as its scope, but rather, again, the connection, or the antecedent:

(63) It is possible that George will hold the lecture only if he is well paid.

(64) George will perhaps hold the lecture if he is well paid.

(65) Maybe, if he is well paid, George will perhaps hold the lecture.

Notice that in (64) it is not the case that George will perhaps hold a lecture once being paid well; rather the speaker makes a guess as to the sufficiency of the conditions which are compelling for George to hold his lecture. In (65) a good fee is supposed to be a possible condition for George to consider holding a lecture at all; *maybe* has the antecedent, it seems, as scope, and *perhaps* the connection of the two propositions. Clearly, *maybe* and perhaps - which are the usual natural forms to express `it is possible that', which is rarely used - do not have the same propositions as their scope.

The connectives considered so far have a rather one-sided character. Conditionality (relevance) is so to speak asymmetric: A condition allows, probabilizes or necessitates its consequence, but nothing seems to be said about the relevance of the consequence with respect to the antecedent. [22] Nevertheless, we make frequent use of the notion of, e.g. *necessary condition, as* in the characterization of sentence (62). That is, throwing a six is a possible consequence of a necessary condition of throwing dice. Similarly, jumping from the Empire State Building is a possible condition for a (practically) necessary consequence: death of the one who jumped. Finally, our being at the beach is merely possible with respect to the possible consequence of playing football. Notice that, as such, the sentences or propositions are not possible or necessary; they express proposition/facts which are possible or necessary conditions *relative to* a consequence, and possible or necessary consequences relative to a condition. Whereas the left-right relation has been called a conditional or an 'implication', we may use the term *presupposition* for the right-left ("backward") relation with the same qualification as to the "strength" of the relation. The usual notion of presupposition is that of a necessary presupposition, which is logically entailed by the consequence.

Thus, in order to fully capture relevance in both directions we introduce a new piece of notation, viz. a box, diamond or triangle with the arrow point to the left:

A 4-0B: A is a possible condition (presuppositon) for B;

A <—VB: A is a probable condition (presupposition) for B;

A «—❑B: A is a necessary condition (presupposition) for B.

These backward connectives combine with the forward connectives, yielding nine complex types of connection. There is nothing particular about such a notation; it is well-known from the double arrow of logical equivalence. The informal semantics of the connective would roughly run as follows: in at least one (in most, in all) situation(s) where B is the case, A is also the case. A sentence like

(66) I was in the grocery store and met Fred

would thus be represented (globally) as p •-00—> q, because meeting Fred does not exclude

my being at the store, nor does my being at the store exclude a meeting with Fred. Now, backward connectives seem to have a meaning very close to, if not identical with, modalities oï forward connectives, in the foliowing way:

A 4-00--> B = 0(A 0—> B)

A 4— 0—> B = (A **0**-➔ B)

A 4—❏❏-4 B = ❏(A ❏—> B)

Indeed, if A necessitates B in all possible situations then A is a necessary condition for B, i.e. B cannot occur without A, and conversely. In terms of selection functions: B is true in all worlds determined (selected) by f_A *(in* some world w.), and whenever B is true in come world w_i is a member of the range of each function determined by each world in which A is true.

There is another way of talking about possible worlds, at the same time accounting for the fact that intuitively we seem to identify a possible world rather with a *course of events* than with a state (or state description, partial or complete). That is in terms of (horizontal, left-right) *trees.* Each path in the tree is a possible course of events, each node is a situation where branching is possible, i.e. where different events may subsequently occur at the same time in a different path. As usual there is one specific path, viz. the actual world (with its factual history and future) with a variable point (node), viz. the "now" of the moment of utterance of a sentence expressing a proposition "about" the tree. Each node is identified by a set of propositions (true at that state of the course of events). The node levels are characterized by the same points (assuming time structure to be constant in all empirically possible worlds). The arrows relating to the nodes denote state changes. Further refinements and explicit graph theoretical definitions will not be given here. We will now say that A allows B(A 0—+ B) if a node A leads to a node B in a path, A necessitates B if from a node A (i.e. a node where A is an element of the node characterization) all paths (from A) lead to B. A is a possible condition (presupposition) of B, if B may be reached from a node A in at least one path, A is a necessary condition if in any path B can only be reached through a A-node.

In the next sections we will see that the natural connectives are also closely linked with derivational aspects of connection. That is, propositions are not only relevantly connected in complex or compound sentences but also in sequences of sentences. More particularly, it might be argued that the connectives we have been discussing should be defined in derivational terms, where the antecedent plays the role of one of the particular premises, and the consequent the role of "conclusion". This is a familiar relationship in logic, but it is worth investigating as to whether it has a more general character. One of the main arguments for such a derivational treatment of connectives is the fact that many assertions pertain to facts we do not (yet) know or cannot possibly know to be the case. Hence such assertions must incorporate at least part of an inferential structure, with a certain number of premises of a more general character (about general relations between facts) remaining implicit. [23]

2.12. Although we have argued aboye that non-truth-functional connectives of natural language are of one basic type of "conditional", having varying degrees of strength - which we have rather classically captured by using the usual notions of necessity and possibility,

together with the non-standard notion of likeliness - we are not yet in a position to differentiate between sentences with an if-clause and sentences with e.g. a because-clause. In both cases necessitation may be involved, in the first case, as we saw, in possible worlds not directly accessible for the speaker's knowledge, in the second case in the actual world (i.e. the actual course of events which is epistemically accessible).

In the first place this difference in the "meaning" of these two "connectives" is not fully correct. Causals may also express propositions which cannot yet be known, but at most believed:

(67)   Because he is ill-prepared, John will fail his exam.

(68)   John is ill-prepared, so he will fail his exam.

The difference with a sentence with an if-clause, here, is that only the consequence in the causal is epistemically inaccessible, although doxastically accessible, whereas the condition is known to be true in the actual world. However, the converse is also possible:

(69)   Because he failed his exam, John must have been ill-prepared.

(70)   John failed his exam, so he was ill-prepared.

Apparently, **because** need not introduce the clause expressing the conditional clause, but may also introduce a conclusion from which (by "backward inference") a hypothetical premise can be asserted if that conclusion is (factually, epistemically) true. Now, in both cases also if-clauses may be used:

(71)   If he is ill-prepared, John will fail his exam.

(72)   If he failed his exam, John must have been ill-prepared.

These two sentences have each at least two readings. In the first place, the speaker does not know (in 71) whether John is ill-prepared and (in 72) whether he failed. In terms of the tree-semantics: In (71) the first clause, true in a path assumed to be close to the actual world path, is likely to lead to a node where the second proposition holds, whereas in (72) this node of the consequent proposition is asserted to be reached probably through a node where the antecedent is true. The second reading runs parallel, but there the *if* seems to mean if **indeed** or **since,** expressing an assumption about the actual world based on indirect information about the facts, e.g. inferred from the assertion of a previous speaker. With such proviso as to the truth of the antecedent the speaker expresses that he is committed to the truth of the consequent only for the world in which the antecedent is indeed true. lnstead of introducing a third operator for the propositional attitude of "(justified) assumption" - besides knowledge and belief - we will simply call such worlds "weakly" accessible. In most cases such epistemically accessible worlds will turn out to be identical with the actual world. Hence, *if* is naturally used in those cases where the fact (a condition or a consequence) is true in a world which is epistematically inaccessible or only weakly accessible. Notice that in both cases at least one fact, either the condition or the consequence, remains unknown, whereas in causals at least one fact is known.

These conditions determining the appropriate use of if-clauses and because-clauses as different manifestations of the same connective (necessary or probable conditional) have a pragmatic character, i.e. pertain to the structure of the context at the moment of utterance, viz. to the epistemic properties of the speaker. Similarly, differences as in sentences (69) and

(70) between subordinate and coordinate clause connectives also are to be formulated in pragmatic terms like `assertion', `presupposition', `focus', etc. Having studied the derivational aspects oí connection and relevance, we therefore must also pay attention to the pragmatics of relevance.

Of course, we might, in a formal language making natural language structures explicit, try to express certain pragmatic facts in the formulas, as has been done with the semantic differences (necessity, probability, possibility) in the connectives. Thus, we may use symbols for `it is asserted that' (1-'), for `it is presupposed that' el% possibly with indices ranging over speakers, or follow the well-known road of epistemic and doxastic logics. Similarly we may, "within" the connectives, introduce the different accessibility types: B is known (believed, assumed) to be a necessary consequence of A (A ^{k} --> B), and/or use truth-or fact-operators. Most of these possibilities have been explored elsewhere, especially in different non-standard logics, and need not be discussed here because it is not our aim to set up an appropriate formal language.

3. Natural derivation

3.1. The two main uses of the term `derivation' occur in logic (and mathematics) and, more recently, in the theory of (generative) grammars. In this section a third, perhaps more general, use of the term will be made, which however is linked both with the logical and the grammatical notions.

There are different ways to characterize formal derivations in logic and mathematics: [24] syntactically as an operation on sets of sentences; semantically as an operation on propositions, truth values or facts; pragmatically as a certain discursive, goal-oriented act. The usual characterizations of the notion of derivation involve several aspects of each of these levels, although derivations (or proofs) are mainly considered to be syntactic objects. Such objects consist of wff's or sentences (of some formal language) which are sequentially ordered. This ordering is pairwise determined by rules, such that a sentence S_i may follow from sentences $<S_1, S_2, ..., S_{i-1}>$ "according" to the rules. These rules pertain to the (syntactic) form of the sentences, i.e. they establish which formulas (sentences) are formal transformations of each other. Here, a bit of semantics usually comes in: *trans formations are* to be semantically *equivalent,* i.e. *have* the same truth value under all interpretations. Transformation rules are thus strictly truth preserving rules. Secondly, there are rules (deduction rules) which may be called weakly truth preserving because they determine that a certain formula/sentence type B may follow a formula/sentence type A iff when A is true **B** is also true (but not conversely, as in the transformations). Thus, truth is preserved but not the "whole truth", so to speak. The set of rules defines a set of possible or admissible derivations and is thus characteristic of a given system. Similarly each system may have a set of formulas/sentences which are considered true a priori, viz. axioms. It is possible to formulate transformation rules in the form oí axiomatic equivalences. Finally, there are other basic equivalences holding for any derivation of the system: definitions. In general, thus, a (formal) derivation is any ordered *n-tuple* of sentences/formulas *satis fying,* linearly, the *axioms,* definitions and rules of a given

system. More particularly, the proof or derivation of a formula/sentence S_n *is* an *ordered* pair of an ordered n-tuple of formulas/sentences (premises) $<S_1,...,S_{n-1}>$ and S_n (conclusion), such that $<<S_1,...,S_{n-i}>,S_n>$, i.e. $<S_1,...,S_{n-i},S_n>$ is a derivation satisfying the axioms, definitions and rules of a given system. Since the rules are truth preserving, the axioms are true a priori, the conclusion is true if the premises are.

This is of course most elementary (and incomplete) but we must see in what respect a notion oï natural derivation differs from the principies recalled aboye.

A grammatical derivation of a given sentence, as it is usually understood in generative-transformational grammatical theory, is also an ordered sequence of *formulas,* on which formation rules and transformation rules operate. [25] Formation rules (or rewrite rules) start from an "axiomatic" symbol, rewrite it as an n-tuple (n > 1) oï other symbols, representing syntactic categories, which are each rewritten as another n-tuple, and finally substituted by lexical elements of the appropriate category (rules and substitutions being submitted to further constraints). These formation rules define the abstract underlying syntactic structure ("deep structure") of the sentence, of which the surface structure is obtained by sets of transformations, which were originally intended to be meaning preserving (semantic "interpretation" would apply to deep structures only). Notice that both formation rules and transformation rules in grammar operate on abstract symbol sequences; unlike in earlier grammatical theory, transformations do not relate sentences. A sentence which is appropriately derived is said to be (syntactically) "grammatical", and "meaningful" (or semantically grammatical) if its deep structure can be appropriately interpreted by semantic rules (or, in other versions oï the theory, if its deep structure is a correct semantic representation). Details are, again, left out.

3.2 There is a sense of derivation in natural language, or rather in grammar, which is closer to the notion of a formal derivation. That is, a sentence S_i can be said to be (naturally) derived if there is a sequence of sentences $<S_1,...,S_{i-1}>$ from which it may "follow" according to a certain number of rules, principies, definitions and "axioms". Whereas in the previous section we considered relations between sentences (or propositions) in compound sentences, we are here concerned with relations in discourse. In that perspective we may say that a sentence in a discourse may be derived *relative to* the previous sentences in the discourse. Clearly, this notion of derivation does not in general include truth preservation, neither strongly nor weakly. But, if something should be "preserved" in such derivations, what else could it be? A first candidate would be "grammaticalness", but this is trivial when syntactic well-formedness is concerned, and not sufficient when semantic interpretability is at issue; the mere fact that each sentence of a sequence can be interpreted does not make it a discourse. Yet, taking a somewhat stricter sense, viz. *relative interpretability, we* are getting closer; it is indeed a property of discourse that each sentence is to be interpreted relative to the interpretation of previous sentences (if any). There are various formal ways to account for such semantic relations, e.g. by interpreting not only relative to a possible world but also relative to a body oï information (i.e. the previous sentences of the discourse, and/or information about the

context), [26] or by progressive formulations of constraints on the set of model structures in which each sentence is interpreted. [27] Aboye we have seen that identity oí individuals (discourse referents), though neither necessary or sufficient, is an important feature of such relations. The same holds for other set-theoretical operations and relations. Such relations are also often expressed in syntactic (and lexical) structure, e.g. by the use of pronouns, articles and sentential adverbs, and by specific syntactic structures, e.g. initial position, embedding, etc. This is all well-known and needs no further discussion. [28]

From these remarks it appears that natural discourse cannot simply be defined syntactically (the presence of pronouns and articles, say, is not sufficient) but is based on semantic constraints. In fact the same holds for a formal derivation, which could perhaps be formulated in pure syntactic terms, but which would be pointless without the semantic "intention" behind the pure syntactical rules, viz. truth-preservation. In natural discourse we thus also "preserve" something of the sense or referential meaning oí previous sentences. Only in some cases does the truth of a sentence make the following sentences in a natural discourse also true. More generally the preservation of reference guarantees that the following sentences can be interpreted at all (classically: have a truth-value). A discourse satisfying these constraints on reference will be called *coherent.* From the informal conditions given this means that a coherent discourse need not be true (in the actual world), although it might be the case that it should be true in some possible course of events (and the courses of events accessible therefrom). In somewhat different terms we here meet the basic conditions of *relevance* formulated in the previous section. Thus, a discourse is coherent if for each of its sentences the previous sentences are relevant. More particularly, a discourse is *maximally coherent* if for each sentence all previous sentences are relevant, and *maximally coherent* if there is no more than one relevant sentence preceding that sentence. Most natural discourses are not maximally coherent in the strict sense, although the previous sentences may be indirectly relevant in that they are relevant for a relevant preceding sentence of a given sentence.

In natural discourse other aspects of coherence are involved. Whereas coherence defined in terms of relevance, i.e. as relative interpretability of sentences, is so to speak "linear", there seems to be a kind of coherence which has a more global character and which we may accordingly call *macro-coherence.* This concept is not easily defined in usual semantic terminology and will first be made clear with an example. Take, for example, a discourse manifesting a story about my vacation in France. In such a story a sentence referring to my sight-seeing tour in Paris may be relevant to a sentence referring to my climbing the Eiffel Tower, since the first fact is a probable condition for the second fact (which is itself a possible consequence of the first fact). In this sense my discourse is linearly coherent. Similarly, being at the Cote d'Azur or swimming at Cannes. Yet, we intuitively interpret the whole story as being coherent in some sense, viz. as a discourse about my vacation in France. Hence, the whole discourse is relevant with respect to a sentence or proposition like 'This summer I passed my vacation in France', which as such need not be expressed in the discourse. This condition recalls the truth conditions of commutative conjunction. Thus, a discourse is

macro-coherent if there is a sentence such that each sentence of the discourse is relevant with respect to that sentence, i.e. if each fact denoted by the propositions of the discourse is a possible, probable or necessary consequence of some conditioning fact. Visiting Paris, indeed, is a possible consequence of being on vacation in France, and so is my stay at the Riviera. Without such a condition of macro-coherence we might have discourses which although they are linearly coherent are not interpreted as coherent at all, because they lack the intuitive "unity" following from the condition that they are "about" the "same" complex fact. Conversely, we would exclude discourses which are not linearly coherent but which are nevertheless acceptable, e.g. the description of a room. The sentence or proposition with respect to which a discourse is globally coherent has important empirical correlates. We may see it as the "abstract" or the "tale" of some discourse, in conversation often preceding the discourse as an "announcement" or "opening". Cognitively, such a proposition is important for the complex procedures of planning and executing and of interpreting (in the non-formal sense) a sequence of sentences as a discourse. Further details and a discussion of the numerous theoretical problems involved in the explication of macro-coherence and macro-structures of discourses will be omitted here. In the perspective of this paper, however, the notion of macro-coherence is important because it makes sentences relevant to each other, indirectly and at a higher level, which as such and superficially are irrelevant. [29]

Another feature of natural - and certainly of formal - discourses is *consistenc*y.[313] Notice first of all, that consistency is not strictly speaking a condition of coherence: both B and -.B may not both be true (at the same time, and relative to the same possible world and the same previous *sentences* and the same context). The consistency requirement is, however, not *always very* strict in language use. Since we may have inconsistent beliefs we may engage in inconsistent discourse. Perhaps the requirement should be formulated only for the sentences uttered (and the propositions thereby expressed) and not for all sentences (propositions) which somehow "follow from" them. In that case we may speak oí surface or weak consistency, which is to be defined in doxastic terms, and deep or strong consistency, which has the absolute logical character.

3.3 The notions of coherence and consistency, briefly discussed aboye, are general properties of natural discourse. In what respect, however, can we sensibly speak of natural *derivation?* As we indicated aboye, the terco `derivation' denotes a binary relation, viz. between a specific sentence (the conclusion) and a set of sentences (the premises). In case premises can at least partially be identified with previous sentences in a discourse, the conclusion must be coherent with those premises, i.e. the premises must be relevant (denote conditions) for the conclusion. Coherence here may be minimal, in the sense that only one premise may be directly relevant for the conclusion, although each premise must be relevant for another premise (or for the conclusion, for that matter).

Although there are obvious relations between formal derivations (proofs) and (argumentative) discourse, natural discourse cannot as such be identified with a derivation in the strict sense. Whereas previous sentences may be necessary premises in order to "derive" a given sentence in a discourse, they may not be sufficient. Natural discourse leav es many of

the premises implicit. In conversation these may be omitted because the speaker knows that the hearer knows them or can infer them from the premises given. General meaning postulates and contextual features are examples in case. When talking about a house I may utter a sentence like 'The front door stood open' without having explicitly specified that that house has a (one) front door and that that front door can be open or closed. Yet such information is necessary, e.g. in order to explain the grammaticalness of the definite article. The speaker assumes that the hearer knows that, in general, houses have a (one) front door and that the proposition 'There is a (particular) front door' may be inferred - by *modus ponens* - from the asserted proposition 'There is a house'. In other *cases* several inferential steps may be needed. Previous sentences, thus, should be compared with previously derived theorems in formal derivations, whereas meaning postulates, holding for any natural discourse (of a given language system), are to be compared with axioms or definitions. The major difference is that a sentence in a discourse does not logically follow from axioms and other premises, and thus another notion of consequence must be involved.

Since discourse relations, as we saw aboye, are based on semantic relationships and not on `syntactic derivability', we must look for the natural counterparts of entailment between "premises and "conclusion". Entailment itself is too strong and only pertains to some cases of natural derivation (viz. natural inferences). Not truth but relevance (reference) is to be preserved in natural derivation, so we need the derivational counterparts of our natural connectives. Instead of saying that a sentence derived from previous sentences if "necessary" with respect to these previous sentences, the conclusion may be probable or merely possible. Given the premise/previous sentence `We were at the beach yesterday' we may derive, in a very weak sense of "derive", the sentence `We played football at the beach'. In other terms, having asserted the first sentence, we may assert the second sentence. As in formal proofs, we here have a form of *conditional* assertion.[31] According to the strength of the derivational relationship we thus distinguish (three) degrees of assertion, viz. `1--0' for *so necessarily,* `1--Cr for *so probably* and 1-0' for *so possibly* (or, correspondingly, the vertical notation with a line under the premises, if the premises are already given, viz. true). Thus the following argument-derivation is "valida:

(73)   Yesterday we went fishing.$_0$
        We caught five trout

But the following is not:

(74)   Yesterday we went fishing ,
        We didn't like the film

This way of treating discourse further suggests a natural equivalent of the deduction theorem: If given A we may possibly-assert B, then we may assert A and B (or if A, then-possibly B), and conversely. Example: If we may assert `We caught five trout' relative to a sentence (or rather, once having asserted) `Yesterday we went fishing', we may assert (under the same contextual conditions) `Yesterday we went fishing and caught five trout', and conversely. The converse case is interesting for those contexts in which the first proposition is already known by the hearer. This informal principle of natural derivation relates discourses

with compound sentences at the level of assertion, i.e. at the level of pragmatics. Other pragmatic aspects of assertion and derivation will be discussed below.

Until now, nothing has been said about the **rules** defining such derivations. Whereas strong **modus** ponens holds for the implicative cases, weaker versions are required for the other conditionals. Since natural conjunctions are also conditionals, simple detachment of the components is not possible, [32] at least not for the consequent, which is true only in antecedent-worlds and hence not true "in general", although both components are true in a natural conjunction if the conjunction is true. The truth of the antecedent, although determining the truth of the consequent, does not have this restriction and follows from the truth of the whole conjunction, it seems (the antecedent is true in precisely those worlds in which the conjunction is). Thus from A 0--> B, we may infer A (in the factual mode of this connective). The same holds for the other connectives of this mode. Still, if B is really relevant for A it seems difficult to detach A, at least in those cases where B changes or specifies the meaning of A (i.e. the meaning of A in isolation):

(75) John beat his wife yesterday, and she won the game today.

Since following sentences may remove ambiguities or make meanings more precise (selecting a specific reading), the detachment of the antecedent is possible only under a given interpretation. Since this interpretation is co-determined by the connection with the consequent, we somehow must preserve, again, the relevance in the inference rules, viz. of premises with respect to the conclusion. Hence, the antecedent may not be asserted in isolation, but as-a-conclusion-from ... In that case we also may allow the detachment of the consequent, since the relevance-qualification specifies "when-where-why" the consequent holds. In other words: The assertion of a conclusion is always the assertion of a

conclusion with-respect-to-its-premises. Hence the notions of derivation and proof are relative, not only with respect to the "derivational history".

Detachment of the consequent in the hypothetical modes of the connectives follows roughly the well-known **modus** ponens pattern. Since in this case the connection is, as a premise, asserted in general (for any world) or asserted for a world or situation which is epistemically inaccessible, the assertion of the consequent (which presupposes that it is known to be true) requires the assertion of the antecedent (with the same presupposition, and usually with respect to the actual world). Notice that the strength of the inference depends on the strength of the connective:

$$[A \; 0 \text{-->} \; S], \qquad A \; \}\text{-}0 \; B$$

$$[A \; V \text{-->} \; B], \qquad A \; [\text{-}V \; B$$

$$[A \; 0 \text{---} \; 13], \qquad A \; I\text{-}0 \; B$$

The brackets indicate that the connection is asserted hypothetically (or generally). Again, relevance is to be preserved in the sense that B only is asserted to hold for the particular A-world(s). Similar rules hold for what may be called presupposition detachment, given a (bi-)conditional and the truth of the consequent.

From this brief discussion it follows that the derivation-argument in (73) further requires a more general sentence as a premise.

The status of natural discourse is something in between a derivation within some system, viz. as an ordered set of sentences related by certain rules, and the system itself, conceived as a set oí theorems which may be derived (proven) from axioms, definitions and previously derived theorems. Pragmatically, the theorems/sentences are intended to *be* asserted, e.g. because they are "interesting" or "characteristic" for some reason. The derivations are rather the "underlying" logical/grammatical apparatus determining the relative truth/grammaticalness of the respective theorems. Indeed, there is no strict distinction between a derivation and a system of theorems; any derived sentence in a derivation may be considered as a "theorem", and any theorem may be considered as a sentence in a longer derivation of other theorems. As we remarked aboye, the practica! difference in both cases with natural language discourse is that in language use we omit the definitions and axioms (meaning postulates) and do not indicate by which rules our derivational steps are defined. In that sense a logical derivation/system should be compared with an explicit grammatical reconstruction oí a discourse, i.e. with a grammatical derivation. The specific status of argumentative discourse, then, is characterized by the necessary probable character of the inferential assertions, the explicit mention of general sentences, and the specifically intended ("aimed at") conclusion.

3.4. The discussion about relevance, i.e. coherence in discourse, is still not very precise and remained rather general. The general condition is roughly that a sentence S_i may be asserted, given the assertion of $S_1,...,S_{i-1}$, if S_i is at least a possible consequence of some sentence S_{i-k} (k > 1). At the object leve] this means that the fact denoted by the proposition(s) expressed by S_i occurs in at least one possible course of events determined by propositions(s) expressed by S_{i-k} (where k = 1 is usual, i.e. a sentence is mostly a possible consequence of the immediately preceding sentence). The question now arises again what "sort" of facts are usually thus connected in a discourse, and whether these connections are the same as those necessary to make complex sentences connected."

Starting with the latter question it may further be asked whether identity of connection conditions for sentences and discourses implies that any discourse can, at least theoretically, be reduced to one complex sentence, and conversely. Such a reduction is of course excluded for dialogue-discourses, in case such theoretical units would be well-defined. The same, however, often holds for (monologue) discourses if the respective sentences manifest different "speech acts":

(76) It is so cold in here. Will you please shut the door?
(77) *It is so cold in here and will you please,shut the door?
(78) What is the time exactly? I'm late.
(79) What is the time exactly, because I'm late.

Clearly, the utterance of a sentence is not merely the expression of one or more propositions

but at the same time the accomplishment of some pragmatic act. In the examples given these acts are e.g. assertion, question and request, which cannot be accomplished at the same time (with the exception of complex or indirect speech acts if expressed by the same sentence: 'Can you pass me that hammer?', `You are crazy!' etc.). These pragmatic differences will be treated in the next section. Conversely, hypothetical assertions are not easily transformed into discourses because the consequent cannot be asserted independently of the antecedent, which determines the worlds in which the consequent is true. Of course the same holds for the other connective mode, but there each connective has a counterpart for separate, coordinate assertion *(so, there fore, yet, still,* etc.). Differences here are again pragmatic, and pertain to the presuppositions of complex sentences. Compare, for example, the following one- and two-sentence discourse fragments:

(80)   (i) This morning I met the minister. His plans were to cut our budget by fifty percent.

        (ii) *This morning I met the minister and his plans were to cut our budget by fifty percent.

        (iii) As I met the minister this morning, his plans were to cut our budget by fifty percent.

Apparently a two-sentence discourse can in such cases only be reduced to one sentence if the antecedent is subordinate. The constraints on coordinate connection, thus, are stronger than those on connection between independent sentences. Sentence (80ii) would be grammatical if the second clause would be something like `... and I asked him whether our budget would be cut', or `... and he told me our budget would be cut'. For such cases the constraint seems to be that in compound sentences the subject-topic of the second clause must denote an individual referred to in the first clause. Although this is the rule for many cases, we earlier have met examples where the constraint is too strong (certainly for indirect, commutative conjunction; see example (32)). The only reason why (80ii) is ungrammatical, then, must be the fact that the antecedent is not a condition for the consequent; the plans of the minister do not depend upon his meeting with me, whereas my asking and his telling about the plans do depend upon this meeting. The corresponding two-sentence discourse (80i) thus must be grammatical for other reasons. One of these reasons is certainly the fact, already observed aboye, that discourses mostly leave a number of sentences implicit, e.g. when they are entailed or presupposed by other sentences. In (80) for example, I may only tell about the plans of the minister when I somehow have heard about them, i.e. when told about them during my meeting with the minister. Apparently such deletions are less free in connected sentences.

Another rather intricate problem pertains to the degree of complexity of compound sentences. That not all n-sentence discourses can be reduced to one-sentence discourse with appropriate connectives has other than stylistic and cognitive reasons. Consider the following examples:

(81)   (i) This morning I met the minister. At first he didn't recognize me, but then suddenly he saw that I was his old school pal.

(ii)   This morning I met the minister, but at first he didn't recognize me. Then he saw that I was his old school pal.

(iii) *This morning I met the minister, but at first he didn't recognize me, but then he saw that I was his old school pal.

One of the problems involved is the scope of the respective connectives. In compound sentences with more than one connective it is not always clear whether the connectives relate three propositions pairwise or one proposition with a pair of connected propositions. The further constraints on combinations and iterations of natural connectives in compound and complex sentences, however, cannot be given in the framework oí this paper.

Finally, we must briefly try to answer the first question of this subsection: What kind of relations determine whether facts denoted by the propositions of compound sentences have continuity (individual identity)? We need some principies determining admissible expansion, e.g.:

(I)   *Predicate Introduction:* A sentence S_i contains a predicate expression denoting a possible property of an individual referred to in a sentence S_{i-k} or otherwise contextually identified. This individual may be an object, but also a property, an event or an action.

(II)   *Individual Introduction:* A sentence S_i contains a relation expression denoting a relation between an individual which has been identified (contextually or in Si-k) and another individual denoted in S_i for the first time.

(III)   *Relation Introduction:* S_i contains a relation expression denoting a relation between two previously identified individuals.

Whereas in formal (deductive) derivations truth is preserved and hence no "new" synthetic truths are produced, natural discourse is "expansive" in that new informational elements may be added according to the three principies of coherent expansion. These principies also determine the relations of possible presupposition and possible consequence, which are characteristic of natural discourse derivation. Coherence is thus guaranteed on the one hand by admissible (possible) expansions of synthetic information and on the other hand by relations of identity between individuals of different sorts (objects, properties, events, etc.). This continuity may, in surface structure, be expressed indirectly, e.g. *via* set-theoretical operations or relations of individuals with individuals already identified and referred to (for example in `We went for a walk. The sky was blue and the birds were singing', or `We came to a small town. The streets were deserted', where such relations are given by meaning postulates in the lexicon, or by general knowledge about objects, circumstances and events and their properties and relations). These semantic conditions of relevance in natural discourse are still rather imprecise, and, although they may at least partially be reformulated in explicit model-theoretic terms, much empirical work on different constraints of coherence for various discourse and conversation types is yet to be done.

4. The pragmatics of relevance [34]

4.1. For natural language the syntax and semantics of relevance needs to be embedded in an account of its pragmatic features. By a pragmatic theory of language, however, we do not mean the kind of contextual semantics or 'formal pragmatics' that has been proposed by Montague and others. [35] There contextual indices merely help determine truth conditions, thereby defining contextually dependent (semantic) relevance, e.g. relative to time, location, speaker or hearer. Rather, the pragmatic component provides its own (pragmatic) interpretation rules. Such rules assign speech acts, that is, specific elements from a set of social acts (e.g. assertions, questions, requests, congratulations or accusations) to meaningful sentences. Obviously, this is possible only if such meaningful sentences are actually uttered or used. Hence we need a function, representing an `utterance act', taking meaningful sentences into some (pragmatic) context. Whereas well-formedness is the key concept of syntax, and meaningfulness or truth that of semantics, pragmatics has appropriateness as its central notion. And similarly, appropriateness, relative to some (pragmatic) context, is defined in terms of appropriateness conditions. Thus, for an assertion some oí these conditions are that S believes that p, that S believes that H does not know that p, and that S wants H to know that p. This means that a pragmatic **model** should feature two specific members, viz. S (speaker) and H (hearer) of a set of language users, a set of cognitive states (knowledge, beliefs, opinions or wants) paired with the set of language users, and finally a set of social situations. The latter set is necessary because some appropriateness conditions require formulation in terms of social relations, such as dominante between speech participants, as in commands. Together, these properties define elements of the set of (pragmatic) **contexts,** of which the actual context, c_0, is a specific member. Obviously, pragmatic contexts are merely a formal abstraction of the 'real' communicative and social situation in which speech acts take place, and consist only of those features that systematically make utterances, interpreted as speech acts, (in-) appropriate. Apart from contextualizing meaningful sentences and assigning them speech acts, these pragmatic models at the same time provide part oí the features for a contextual semantics, such as knowledge or belief sets of language users, or indices such as t_0, representing 'time of speaking' (now). Also the pragmatic component allows us to tie truth conditions to specific subsets of speech acts, such as assertions. Requests or congratulations would not have such truth conditions (in the strict sense). Hence a semantics for natural language should not be truth conditional, but have more general intensional or extensional interpretations, an issue that cannot be further dealt with here.

For our discussion of relevance, this brief summary of some of the basic notions of pragmatics provides some further suggestions for an explication of its intuitive meaning. Thus, a sentence, or the speech act performed by its appropriate utterance in some context, would be irrelevant if one of the appropriateness conditions is not satisfied. Thus, if S knows that H knows that p, then the assertion 'that p' is irrelevant in that context. In that **case,** relevance simply collapses with the notion of appropriateness.

4.2. More interesting is an analysis of pragmatic relevance in terms of **compound speech acts** or **speech act sequences, just as** we have treated syntactic or semantic relevance. Classical

speech act theory is mostly about isolated speech acts. However, in more than ten years of text linguistics and discourse analysis it has become a nearly trivial insight that [also] *speech* acts do not come alone but appear in coherent texts or dialogues. It follows that pragmatic appropriateness, relative to some context, also requires conditions on the relations between subsequent speech acts." A speech act may be appropriate only after another one has been appropriately performed, or before another speech act will be performed. For instance, the assertion 'I have forgotten my watch' may *as* such be inappropriate in some context, but relatively appropriate before (or after) the question 'What is the time?' in such a context. This is obvious when we realize that speech acts, by definition, *change the context.* Once p has been appropriately asserted, the context changes, with the result that H knows that p, so that the same assertion would become inappropriate in the next state of the *course of speech* (inter-) *action.* The same holds for a formal discourse semantics that keeps track of changing model structures." Relevance of speech acts, according to this approach, would be defined in terms of relative appropriateness for speech acts in compound speech acts or speech act sequences. In that case a speech act $^{A\cdot}$ is relevant if it is appropriate in some pragmatic context c_i, such that c_i is the result of the contextual changes operated by previous speech acts In that case we will also simply say that A_i is `relevant' with respect to the previous speech acts. However, just as in the semantics, relevance is not only defined in these `linear' terms, viz. with respect to previous or following speech acts, but also needs a *global, overol(* definition. Just as propositions need to be relevant also to a global theme, macrostructure or topic of conversation, a speech act must be relevant with respect to an overall or *macro speech act,* that is, the `point' of a text or conversation. [38] Thus, a whole letter may pragmatically function as a request or as a threat, and the same may hold for other discourse or interaction types. Such overall speech acts are appropriately performed only if their component speech acts are appropriately performed in their respective (changing) contexts. Thus, in the course of an overall request, the performance of a command may be inappropriate or irrelevant with respect to the global context defined for the macro speech act. Global (speech) acts are accounted for in terms of global intentions, with respect to final results, and of component and auxiliary acts, against the background of a more general logic of (inter-)action.

Speech acts pairs may be connected by (pragmatic) *connectives.* [39] These connectives seem to have different meanings from their corresponding semantic uses. Just as we have aboye found intensional constraints of relevance on natural semantic connectives, we here also have a number of specific constraints. Thus, we cannot simply link two speech acts with *and:* It is cold in here and could you please shut the window' is at least somewhat odd. Rather, the second speech act requires an independent sentence as its realization, and such a second sentence might be introduced with a pragmatic *So.* The kind of `pragmatic consequence' involved would mean that given the context established by the first speech act, the second speech act becomes a legitimate next `move' in a dialogue. Similarly, pragmatic *and* would mean something like an `addition' to a previous speech act, as in `See you at the panty tonight. And, don't forget those records!'. Finally, pragmatic or does not denote some

conditions), as in `Would you like a beer? or, aren't you thirsty?' In other words, these pragmatic connectives express specific *functions* following speech acts may have relative to previous ones, e.g. a conclusion, an addition, or a correction. Similarly, pragmatic *but* may express the function of an objection (often by a following speaker). Derivations, or formal and natural arguments, are thus pragmatically 'closed' by an assertion (or other speech act) that functions as a conclusion, often signalled by *So.*

Against this background we can proceed to define a number of classical logical notions for this pragmatic component. We will find pragmatic tautologies such as 'I am speaking', but may also link the semantics with the pragmatics by some kind of pragmatic `completeness': truth iff appropriateness. For instance, performatives such as 'I promise you to take the record with me' or **'I** congratulate you on your new house', would be true iff they are used as appropriate speech acts. Limitations of space, however, do not allow us to examine these implications here. It has become clear though that these notions cannot simply be defined as straightforward analogies of their formal (syntactic or semantic) counterparts. Thus, although the proposition 'John will arrive by train this afternoon at 5 &dock' entails `John will arrive', the corresponding speech acts (assertions) do not entail each other in the sense of preserving appropriateness (H may already know the proposition expressed by the second speech act). At most, we could say that a speech act entails (presupposes) the propositions characterizing its appropriateness conditions, such as 'I know that...' or `Probably you don't know yet that...'. Further work will be necessary to elaborate these and other notions for a discourse pragmatics. We have seen however that pragmatic relevance not only requires some additional notions, or explains further aspects of language use, but also provides a new dimension for the notions of syntactic or semantic relevance discussed aboye: severa] expressions of natural language (such as `pragmatic' connectives, but also particles) require direct pragmatic interpretations in terms of properties of or relations between speech acts.

5. Cognitive relevance"

It has become clear in the past few years that a grammar or, more generally, a theory of discourse cannot be adequate without a cognitive and social framework. Even the pragmatic component briefly outlined aboye is merely an abstraction of various cognitive and social features of the context. Semantic and pragmatic coherence, both local and global, need a specification of beliefs, knowledge or opinions for which we should formulate systems of cognitive representations, such as frames and scripts. [41] Propositions and hence speech acts may become relevant to such knowledge or belief schemata in memory. Sequences such as **'I** went to the station. I bought a ticket. I went to the platform. I got into the train' are coherent, and each proposition relatively relevant, only with respect to a **TRAIN TRIP** script, for instance. And the same may hold for (global) speech acts scripts, such as the sequencing of speech acts in a court trial. This also means that the specific social situation needs to be spelled out, such as the various features of a court trial (who is allowed to make which speech

a full-fledged empirical account is an explication of the actual processes or strategies that take place in the on-line interpretations of the sentence or speech acts of a discourse. The `relevant' production or understanding of a sentence or speech act in discourse will in that case depend on successful strategies for the analysis of the communicative context, of macrostructure formation, of establishing local coherence, of retrieval in episodic memory and oí knowledge use in general.

Cognitive interpretation theory, however, has been traditionally formulated in terms of concepts or meanings, and not in referential or denotational terms. In order to define truth, reference, co-reference, and the usual conditions of coherence for discourse, however, we also need some sort of *cognitive models.* Recently there has been some theoretical and experimental work on such models, often inspired by logical model theory. [42] In our view such models are episodic knowledge structures, representing accumulated episodic experiences about similar `situations'. Language users form or retrieve such `situational models' in order to construct semantic or pragmatic representations of discourse, and conversely interpret discourse in order to update such situational models (adding new individuals, new properties, new events, or changing others). For each discourse, a particular model is constructed from the relevant fragments of similar, more general models. Such models represent, cognitively, what we 'imagine' when understanding a discourse. This means that they will usually be `richer' than the semantic representation, because they also feature a large amount of episodic or more general (social) knowledge about such situations. This information may be left implicit in the text (and its representation), and provides the basis of an empirical definition of the notion of presupposition. Most obvious is the use of such models in the on-line interpretation of co-referring expressions, verb tenses, connectives, and so on, because they are the cognitive representation oí what the respective sentences of a text are *about,* and how these sentences gradually *build* some possible situation (introduction oí individuals, their properties and relations, time and location, possible act or event sequence, etc.). Pronouns, thus, can be strategically interpreted as the individuals in the model, under some description, that are now relevant according to the sequential or textual topic. Yet, since models are not only constructed on-line by bottom-up processing of input phrases, clauses or sentences, but also top-down, by the retrieval of (expected) overall or local properties of the model or the corresponding general knowledge scripts, (co-)reference is also possible to individuals that have not earlier been mentioned explicitly, or to elements of propositions that can be derived from earlier propositions, such as macropropositions (themes).

This brief account of some of the actual developments in a cognitive theory of discourse shows that relevance in natural language ultimately requires an empirical foundation in terms of a strategic approach to interpretation relative to memory models and social models of the situation and the communicative context.

6. Postscript 1981

Seven years have gone since this paper was written. During this time, not only (relevance and other) logics, logical grammar, text grammar and linguistics have undergone considerable developments which would require a completely new approach to the problem of relevance and relevant connectives, but also my own domain of interest has changed. During most of these seven years I have been predominantly engaged in the development of cognitive models of discourse comprehension (mainly with Walter Kintsch of the University of Colorado at Boulder). This work is a natural consequence of my earlier, more 'formal' or 'abstract' approach to such notions as connection and coherence in discourse. Very roughly speaking I now would certainly at least add or integrate an approach in which `relevance' among propositions, sentences or speech acts in discourse would still be formulated in terms of local and global semantic or pragmatic coherence, but I would formulate the conditions in terms of constraints on the knowledge, beliefs and opinions of language users, the cognitive processing (understanding, representation and retrieval) of such constraints and the strategies for actually using them while understanding and `evaluating' sentences, sequences and discourses. In other words, the notion of `relevance for some speaker/hearer in some context', as used in this paper, would now have a more or less precise and empirically tested model. My actual research is geared towards an extension of that model towards social-psychological contexts and their features.

FOOTNOTES

1. See for an earlier discussion of some of the ideas in this paper my "Connectives in Text Grammar and Text Logic", in van Dijk and Petöfi and for further development see van Dijk 77. This and the following notes of this paper have been slightly adapted, mostly bibliographically, in 83. Except for sections 4. and 5. below, the discussion in the paper has been left unchanged. New references only pertain to the theory of discourse, not to logical theory.

2. Arguments in favour of text grammars have been formulated in van Dijk 77. For a survey of text linguistic work since the early seventies, see e.g. de Beaugrande and Dressler 81.

3. See details in section 4 below, also for references.

4. See Petöfi and Franck 73 and, later, the papers in Karttunen and Peters 79, among many other new publications about presupposition.

5. For references about the grammar oí connectives see van Dijk 77.

6. See Anderson and Belnap 62.

7. We will not here go into the intricacies of the notion of `meaning'. See e.g. the papers in Davidson and Barman 72; Hintikka, Moravcsik and Suppes 73; Guenthner and Schmidt 79; and Lyons 77.

8. See Urquhart 73 for details.

9.   See Thomason 72.

10.   *See* Woods 70, who concludes negatively because the intensionality fully derives from the meaning of the connected propositions. See also Urquhart 72.

11.   See Routley and Meyer 73a for an account of accessibility relations.

12.   This argument requires `normalcy' of possible worlds (regular laws or rules obtain). See e.g. Goble 73 and Lewis 73. We are here concerned with worlds that are compatible with our `own' empirical world.

13. See Stalnaker and Thomason 70, for such selection functions 9and comments upon it in Lewis 73.

14   Cf. Belnap *Jr.* 73.

15.   See section 4 below for the notion of appropriateness (for assertions).

16.   Lewis 73 does not adopt this condition, which obviously holds for natural language uses of counterfactuals.

17.   Lewis 73 gives a different account of degrees of strictness. See Stalnaker 70 for a discussion of the relations between conditionals and probability.

18.   Cf. the relation between connectives and opacity/transparence in such equivalent sentences as 'Mary wants to marry a millionaire' and 'Mary wants to marry (any) man, if he is a millionaire'.

19.   *See* Aqvist 73 for a discussion about the modal nature of connectives.

20.   Lewis 73 uses similar notation, but with a different meaning. See van Dijk 77 for an elaboration of the formal semantics of natural connectives, where *if* (then) is taken as a modal operator rather than as a connective.

21.   See Karttunen .. in Kimball .. and Kimball's comments of that paper (pp.21-27). Obviously we have a different view of modalities in natural language.

22.   Gabbay 72 also only allows backward dependence of consequents upon antecedents, a position which in general will also hold for natural language. Bi-directionals are only used in order to show how consequents may require or presuppose specific antecedents. For sufficient and necessary conditions, cf von Wright 71 in Hilpinen 71 pp. 159-177.

23.   See Lewis 73 for this kind of derivational treatment of connectives.

24.   van Fraassen 71 discusses these metalogical aspects.

25.   Kimball 73 discusses these formal aspects of grammars.

26.   See Urquhart 72 for a different use of this device.

27.   A first model-theoretic account of discourse coherence is given in Ballmer 72 see also Petöfi and Rieser 74 and van Dijk 77. (See note 37 below).

28.   See van Dijk, 77 and .., for these conditions.

29. See especially the later elaboration of this notion in van Dijk 80.

30. For the relations between consistency and coherence for sets of sentences, see e.g. Rescher 73.

31. Cf. Scott 71 for details about conditional assertions and entailment.

32. Urquhart 72 does not allow detachment for intencional conjunctions either, but does not specify further reasons.

33. The relation between text and context will be discussed in the next section.

34. This section has been completely rewritten and abbreviated ten years after the paper was written. Obviously, this means that many new insights and developments are integrated, however succinctly, in this new version. In order to maintain the coherence of the paper, we have tried to formulate some of the pragmatic notions of relevance in tercos that are familiar to formal linguists and logicians, but we have avoided trying to devise a really formal pragmatic component. As will be clear from the next section, we have in the last decade paid attention rather to the cognitive theory of discourse understanding, and abandoned the formal approach. There is still too much text theoretical and empirical work to be done before we can engage in really meaningful formalization. Many features of discourse semantics and its empirical basis are still unknown (such as many details of coherence), and the same hold for pragmatics. The remarks in this section are a brief summary of e.g. van Dijk 77 and of the papers, van Dijk 81 to which we refer for further details and many additional references.

35. See Montague, 74.

36. See van Dijk 77 for details, especially also the more general foundations of the theory of speech act sequences within the framework of a philosophy of action.

37. Such (semantic) discourse models have revived increasing attention in recent years. See e.g. Kamp 81 in Groenendijk et al 81 and the contributions in Joshi and Webber 81.

38. For these pragmatic (and semantic) macrostructures, see van Dijk 77 but also van Dijk 80.

39. See "Pragmatic connectives" in van Dijk 81.

40. For details and many references of this cognitive background of a theory of discourse and relevance, see especially van Dijk and Kintsch 83. The various meanings of the cognitive notion of relevance have been discussed in van Dijk 79.

41. See especially Schank and Abelson 77.

42. For details, and for discourse understanding both van Dijk and Kintsch 83 and van Dijk 84; see further Johnson-Laird 83.