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TEXT GRAMMAR AND TEXT LOGIC*

1. INTRODUCTION

1.1. This paper is intended as a contribution to the recent developments in the logical analysis of natural language. In particular, it investigates some of the logical properties of so-called TEXT GRAMMARS, i.e. grammars formally describing the structure of texts in natural language. Our main working hypothesis will be that the base of a grammar contains, or is identical with a (natural) logic, and that such a logic' should most appropriately take the form of what might be called a TEXT LOGIC. Besides a more general discussion of the relations between logic and linguistica and of the present status of logical systems in grammatical research, we will specify some of the main tasks and requirements of a text logic. Special attention will be given to the abstract structures underlying description, quantification and identity in texts. These problems are also relevant in standard sentence grammars, but it will be argued that they can be better formulated in the framework of a text grammar and its corresponding text logic, thus leading to a number of interesting generalizations. It must be underlined that our attempt is provisional and often highly speculative, and that the treatment of the different problems will remain rather informal.

1.2. One of the ideas that have led to the renewed attempts to bring to bear logical systems in the description of natural language is the hypothesis that the abstract or underlying structure of sentences may be identified with their LOGICAL FORM. Although in a somewhat different sense, this suggestion, to be found primarily in the writings of philosophers and logicians, has been taken up in recent work on generative grammar, especially by those propagating its variant known as `generative semantics'. [1] As is well-known by now,

• This is a slightly revised version of a paper contributed to the symposium `Zur Form der Textgrammatischen Basis', University of Konstanz (W.-Germany), September 3-9, 1972. I am indebted to the participants of the symposium for many useful comments, which regrettably could not be fully accounted for in this version. Many points of the global framework we intended to sketch here require separate and detailed treatment.

[1] `Generative semantics' is not a homogeneous direction within the theory of generative grammars. Its main propagators defend rather different views. See McCawley (1968) and the other papers in Bach and Harms (1968) and especially the programmatic anide of Lakoff (1971a). One of the most serious attempts in this direction has been Rohrer (1971). For criticism, see Chomsky (1970, 1971) and Katz (1971).

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the scattered attempts in this direction have, in a sense, put Chomsky's model upside down by abolishing syntactic deep structure and substituting for this deep structure the semantic representation or logical forro of the sentence. Several sequences of transformations would then assign lexical, syntactic and phonological structures to this underlying semantic representation. We will at present ignore the properties of such transformations, which in general may be viewed as local and global derivational constraints upon finite sequences of phrase markers. We are also aware that little is understood at present of the nature of the (transformational) rules relating semantic representations with abstract and more superficial syntactic structures, and that from the point of view of explicitness generative semantics cannot (yet) be considered to be a serious alternative to the standard, syntactically based grammars. Nevertheless, we take our discussion below as lending support to a grammar having semantical (or `logical') structures as its base structures. We will see in particular that these contain some important properties which are main conditions for the transformations to operate, e.g. the famous `identity'-condition determining definitivization, pronominalization, reflexivization and relativization. Thus, we share the view of many linguists and logicians who consider the elaboration of an explicit semantic theory as a task that is preliminary to our understanding of many syntactical (and lexical) rules and transformations. In order to arrive at a satisfactory degree of explicitness, such a semantic theory is assumed to have a non-trivial formulation (and ensuing formalization) in terms of (an) existing system(s) of modern logic, e.g. a MODAL PREDICATE CALCULUS, provided some important extensions and alterations are made, in order that such a calculus may adequately account for the abstract structure of sentences in natural language. Some of these extensions will be discussed below.

1.3. The ideas which, more specifically, have elicited the present paper have evolved from other's and our work on generative text grammars. As we will briefly indicate in the next section, such grammars — besides a description of the structure of sentences — must formulate conditions and transderivational rules relating sentences in a grammatical Coherent text. It has *been* assumed that such rules are based on the semantic structure of textual sequences of sentences. Many of these relevant intersentential relations seem to invite

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Although the scattered generative semantic studies do not at present have a well-defined grammatical basis which would be a serious alternative to Chomsky's syntactically based (extended) standard model (1965, 1970) we think it should be recognized that they have at least undertaken to treat a number of highly interesting semantic problems, neglected or inadequately treated in the standard model. Moreover, relations between logic and grammar are to be found especially in these semantic approaches.

to serious logical analysis, the more so while at least some of them appear to be identical with genuine logical principies. A (natural) text logic has as its main task to formulate these principies of intersentential relations, as well as the constraints which these put on the logical form of sentences in a text.

It is not strange that we claim that a logic of natural language should be a text logic, not only for empirical and grammatical reasons, but also for the simple reason that logical systems themselves are in fact formal text logics. Derivations (proofs) constructed by the rules and categories of such systems are also `discourses', consisting of coherent (consistent) sequences of sentences. We will argue below that there are certain non-trivial analogies between the structures and principies of formal proofs and systems (theories) on the one hand and the structures and principies of texts in natural language on the other hand. More in general we assume, then, that the most relevant application or elaboration of logic for natural language pertains to the abstract constructs we call `texts', such as they must be generated by text grammars, even when, e.g. speaking of (complex) sentences, we merely refer implicitly to texts.

Before we begin our preliminary remarks to support these claims and hypotheses, let us first briefly and informally recall the main characteristics of the grammar we have in mind.

2. THE HYPOTHETIC FORM OF TEXT GRAMMAR [2]

2.1. In general we adopt the main principies of current generative transformational theories, i.e. those defining a grammar recursively specifying an infinite set of abstract underlying structures and a set of transformations mapping these structures onto an infinite set of surface structures. The difference with sentential grammars, however, is that derivations do not terminate as simple or complex sentences, but as ordered n-tuples of sentences (n 1), that is as SEQUENCES. The intuitive idea, then, is that the text grammar must formulate derivational constraints such that certain sequences are

[2] For detailed discussion of the forms, properties, aims and applications of text grammars, or of text theories in general, cf. van Dijk (1971, 1972), Ihwe (1972), Petófi (1971), Kummer (1971a, b; 1972), also for numerous further referentes. We cannot give a survey of textual linguistics here. Its sources are, firstly, in Harris' discourse analysis and, secondly, in European developments of structuralism, especially in Germany. The names of Hartmann, Schmidt, Harweg, Heidolph, Lang, Rieser, Drubig are associated with this direction of thought, though approached from very different angles. In eastern Europe we have especially the work of Hellen (1970), Palek, Dane§, 2olkovskij, whereas in the U.S.A. linguists treating pronominalization, especially Karttunen (1968a, b; 1969a), often make (implicit) reference to discourse structure. For a methodological foundation of textual linguistics, see Sanders (1969) and Petöfi and Rieser (1973). For general text theory, see Schmidt (1972).

grammatical and others are not, viz. that the set of well-formed texts of a language is a subset of all possible sequences of sentences. In addition to constraints upon the ordering of the sentences in the sequence, there are constraints upon the possible forms of the semantic representations of the respective sentences-in-the-sequence, so-called **TRANSDERIVATIONAL CONSTRAINTS.** Put more simply: the meaning (or truth) of a given sentence S_i depends on the meaning (or truth) of the ordered i-l-tuple of preceding sentences. This seems rather obvious but any adequate grammar must specify the nature of these dependency-relations between sentences in a sequence. The formal and empirical advantage of such grammars is that sentence structure is not merely described in its own right but also relative to the structure of other sentences of the text. The `relative grammaticalness' thus defined more adequately corresponds to the actual structures of discourses (uttered texts, utterances) in verbal communication.

A sequence satisfying the necessary and sufficient conditions of dependency will be called **COHERENT.** Since sequences are theoretically infinite, the set of coherent n-tuples of semantic representations is also infinite. The base component of a T-grammar must recursively enumerate the members of this infinite set. It will be assumed that a coherent sequence of semantic representations determines, transformationally, the lexical, syntactic and morphophonological structures of the sequence.

2.2. The constraints upon the concatenation of sentences in a coherent sequence are of two different types. A first set determines the immediate, linear transition relations between the sentences. They are in part identical with the constraints holding between phrases and clauses in complex and compound sentences. We will call these constraints, micro-structural constraints **or MICRO-CONSTRAINTS.**

Our hypothesis about the form of a text-grammar, however, is much stronger. We claim that the coherente of sequences is also determined by what may be called **MACRO-CONSTRAINTS.** These have the whole sequence as their scope. Whereas the micro-constraints determine **LOCAL** well-formedness of sequences, macro-constraints operate at the **GLOBAL** level. The problem, of course, is how to formulate the macro-constraints and how to integrate them into the derivation of a sequence of semantic representations. Intuitively speaking, macro-constraints define the bounds within which lies the linear derivation of subsequent SR's, but how do we make explicit such a set of one-many relations between any macro-constraint and the forms of all the SR's? The way we formulate the problem suggests that we might treat the constraints as **FUNCTIONS.** In more grammatical terms we might say that a possible level of macro semantic structure must be mapped onto (into?)

a level of micro-semantic structure, viz. the global meaning of a text onto (into) the meaning(s) of a sentence or sequence. Such a mapping is operated by a set of transformations, of which the precise nature, however, is still obscure.

2.3. Although there are a certain number of serious linguistic and psychological arguments in favour of a postulated set of macro-constraints or global transderivational constraints, the remarks we have made aboye are still highly speculative, and we will not elaborate them here. In the following we will concentrate on the direct relations between subsequent semantic representations, i.e. on the local constraints upon textual coherence. It is at this level of feasibility' that we may formulate a first set of rules for a text logic.

3. FORMAL LOGIC AND NATURAL LOGIC

3.1. Some general remarks are in order about the relations between formal logic and natural logic. A first rather sceptical remark would be that we do know what formal logic is, but that we still largely ignore what a 'natural logic' could be. [3] That is, if the logic' of natural language is a logical system in the strict sense, it must satisfy at least a number of general requirements laid down in the theory of logic. If it is not a logic, but e.g. simply a part of grammar in which some logical notation is used, what then are its relations to formal deductive systems? [4] In this case we would be interested merely in

[3] The term `natural logic', which we adopt here for reasons of simplicity — indicating `the logic of natural language' — has found wide currency especially after Lakoff's article of the same narre (Lakoff, 1970). See also McCawley's `program' (McCawley, 1971). The status of natural logic, as discussed in Lakoff, is not wholly clear, although he treats a number of important questions which a natural logic should deal with. This is one of the reasons why we discuss at some length the general relations between logic and grammar and the status of text logic in particular.

The situation in this interdisciplinary field is somewhat confusing. Severa] syinposia have been held on the subject now, but are attended with rather by logicians than linguists, although linguists show growing interest for the logician's approach. These reject often a Chomsky type of grammar, especially its semantic component as originally elaborated by Katz and Fodor (1964) and Katz (1967, 1971), but it is substantially different as well from the generative semantic approaches of e.g. Lakoff and McCawley. In between lies the work of Keenan (1969, 1971, 1972a, b) and Kummer (1971a, b; 1972) to which we feel attracted most at the moment. Keenan (1969:2) has explicitly compared logical proofs/systems with texts, referring to Corcoran (1969).

[4] The relations between grammar and logic have been the topic of many anides in linguistics, logic and philosophy of language, since Frege, Carnap and Quine. For a recent survey of the problems, see Fodor (1970) and the recent discussions, especially about semantics, in ***Synthese*** (cf. Davidson and Harman (1971)). For other work in the field, cf. the interdisciplinary reader of Steinberg and Jakobovits (1971). The Festschrift for Carnap, ***Logic and Language*** (1962) only contains rather brief remarks about the subject, e.g. Jorgensen's (1962) article on the differences between logical calculuses and natural language.

the non-trivial relations: since even modern logic has its remote roots in argumentative discourse (and traditional sentence structure), it will not be difficult to find many similarities. The very fact that many introductory courses in logic contain chapters and exercises in which natural language sentences (arguments) are 'translated' into logical propositions and inferences, is significant enough about these relationships.

3.2. Instead of detecting similarities between formal and natural language let us first list some important differences which seem to prohibit direct identification of any current logical system with a system of natural logic. At the same time this list may be considered as a program for what must still be done before a logic is adequate to `represent' structures of natural language.

We begin with a set of very general, well-known characteristics setting apart a formal and a natural language:

3.2.1. FORMATION RULES in a logical language (LL) are specified merely in its syntax and do not take `meaning' or `interpretation' into account, of which the set of well-formed formula's (wff's) is independent. The same is true for the formation of complex structures, and, what is crucial, for derivational inference (proofs). Grammatical well-formedness in natural language (NL) is restricted also by a set of semantic rules (and the postulates of the lexicon).

3.2.2. In LL there is a direct relationship between the DERIVABILITY of wff's (from a set of axioms, definitions), their validity and their truth-value (viz. truth), whereas `meaningfulness' in NL is never dependent on syntactic structure alone (see below Section 3.4).

3.2.3. The SEMANTICS of LL is in general based on the notion of TRUTH (in some world or model), whereas the semantics of NL — not restricted to affirmative statements as standard logic is — includes other basic concepts (e.g. applicability, happiness). Moreover, the semantics of NL essentially includes rules of meaning (intension) on which rules of reference (extension) depend (see below Section 3.4.).

3.2.4. The structure and meaning of utterances in NL crucially depends on

Other recent discussions are collected in the proceedings *Linguaggi nella società e nella technica* (1970), where Lewis (1970), Davidson (1970) and Scott (1970), just as on the IVth International Congress of Methodology, Logic and Philosophy of Science (Bucharest, 1971), heavily criticize present day linguistic semantics.

all sorts of formal and empirical PRAGMATIC rules and factors, whereas **LL** (intentionally) has no rules of 'use' or 'application' (see below Section 3.5.).

These are (some) very general divergencies. Let us now list some features of the systems (e.g. modal predicate calculi) we might consider akin to a natural logic.

3.2.5. In NL we do not have pure VARIABLES. Pronouns (pro-verbs, pro-sentences) are differentiated according to genus, case and number (pro-verbs according to state, action or possession). That is, in NL we might speak of `semi-constants' (or, for that matter, of `semi-variables').

3.2.6. NL has no simple distinction between ARGUMENTS AND PREDICATES. Properties and relations are expressed in all major categories (verbs, nouns, adverbs, adjectives, prepositions), which are at the same time the 'arguments' which may be quantified and predicated `upon'.

3.2.7. The ORDERING OF ARGUMENTS in logical expressions is linear but arbitrary and does not reflect the structural (dependency) relations of NL-syntax or NL-semantics (subject, object; agent, patient, etc.). This fact makes logical expressions highly ambiguous in their interpretations.

3.2.8. QUANTIFICATION in NL is mostly restricted to selected (sub)sets of individuals with some properties or relations, and does not apply to all/some unspecified (unrestricted) sets of individuals defining a 'universe of discourse' (except of course in universal statements) (for detall, see below).

3.2.9. The STANDARD QUANTIFIERS of logical systems are not sufficient to represent all aspects of quantification in NL ***(a, one, some, the, most, many, all, few, every, any, no,*** etc.), although there are attempts now to provide a logic for these quantifiers.

3.2.10. TRUTH FUNCTIONAL CONNECTIVES (logical constants, logical connectives) in LL have properties which are rather different from (even the 'corresponding') intersentential connectives (conjunctions) in natural language:

— these are not (always) associative, distributive, commutative,

— disjunction is inclusive or exclusive in NL,

—material implication (conditional) is not equivalent with semantic implication; for example, in general it makes no sense in NL to say that false antecedents make an implication true. The same holds for (logical) entailment,

—the standard connectives are not inter-definable (by the De Morgan Laws) in NL with preservation of truth/meaning (they have different presuppositions),

— logical connectives are truth-functional but are independent of the meaning of the propositions they relate (see our general point 3.2.1.),

— there are no logical analogues of the conjunctions of concession *(although),* contrast *(but),* cause *(because, for, since),* consequence *(so, that),* time *(then, when, since),* place *(there, where, wherefrom, etc.), etc.,*

— the logical monadic operator of negation applies in NL both to propositions and to nearly all grammatical categories of the proposition. It rather has the character of a modal operator than that of a truth functional constant.

3.2.11. The basic **LAWS, PRINCIPLES** and **THEOREMS** of standard logic do not always apply in NL:

— double negation does not mean the same as affirmation,

— the law of the excluded middle has many (stylistically relevant) exceptions in NL: contradiction is not meaningless in NL,

— as we saw aboye, the De Morgan Laws only hold under specific interpretations of sentential connectives in NL,

— the same is true for the associative, distributive and commutative laws,

— all valid wff's (tautologies) in LL are not necessarily tautologies (with respect to meaning) in NL, i.e. they `convey information', in the intuitive sense of this expression,

— there seems to be no argument why such paradoxical theorems as $p\ (p\ q),\ q\ (q \vee p)$ or the like would hold in NL.

3.3. The aboye list is not exhaustive. It must be admitted, however, that — apart from the general principies inherent to logical systems — our remarks hold for standard systems. There have been numerous attempts to eliminate the un-intuitive aspects of the systems, or to bring the representation of logical propositions closer to those of natural language, so that inference would depend on more and `weaker' factors. Many systems try to avoid some of the basic laws and rules of inference. Other systems introduce new quantifiers and are based on restricted quantification. Higher order calculi permit quantification of predicates, propositions, indices, etc., whereas the discussion on the status of the truth functional connectives is permanent. [5] The main set of improvements is undoubtedly due to the elaboration of all sorts of **MODAL SYSTEMS** and, especially, their semantics. Expressions are now available to

[5] It is impossible to list here all references to attempts to extend standard logic. For a general discussion and references we may refer especially to Rescher (1968) and Hughes and Cresswell (1969, Ch. 17).

account for necessity, possibility, time (tense), place, etc. and sentences are `performatively' differentiated as `statements', 'questions', 'commands', %chef sentences', 'action sentences', etc., all with their own — though often si milar — logical properties of inference.[6]

Although we take these developments to be highly interesting and as a necessary process of 'weakening' standard logic (without loss of explicitness) towards the processes underlying natural language (and argumentation), we may still note the following problems:

3.3.1. The set of well-known MODAL OPERATORS in current logical systems is still much smaller than the set of modalities in NL (where we have *likely, probably, expectably, hopefully, surely, perhaps, etc.).*

3.3.2. Modalities in logic remain (of course) LOGICAL MODALITIES, whereas modalities in NL are always contingent: logical necessity (possibility) is different from contingent (physical, psychological) necessity and possibility.

3.3.3. It is not yet clear what a serious calculus and semantics would look like having as possible operators all known modalities preceding their nuclear propositions: the problem of scope and world ordering is huge and is attacked only for some rather simple combinations of operators.

3.3.4. Some main LAWS OF MODAL LOGIC do not hold in NL. Firstly, there are those laws corresponding to their non-modal analogues — which have material implication instead of necessary (logical) implication (entailment): e.g. *q —3 (p p), p (q v p).* Other laws problematic in NL are those (see 3.3.2.) relating the different modalities (dependence of necessity and possibility), the status of necessity and the relations between quantification and identity in modalized propositions (the Barcan formula).

Again it must be admitted that some logicians also reject the counterintuitive consequences of these systems, although, in general, they are valid principies of LOGICAL inference.

For *modal logic* we refer in general to Hughes and Cresswell (1968) and the work of Carnap (1957). For modal semantics, see van Fraassen (1971). For *tense logic we* may mention Prior (1957, 1968, 1971) and Rescher and Urquhart (1971).

Question (i.e. *Erotetic) Logic* has been studied especially by Harrah (1963, 1969) and Belnap (1969). For *Command Logic* see Rescher (1966), *Beliefl Knowledge* (epistemic) *logic,* see Hintikka (1962), and for *action/event,* and in general *deontic logic,* see von Wright (1963) and Hilpinen (ed.) (1971). This list is not exhaustive, and should include especially inductive logic and the logic of preference. We mention all these directions just to emphasize the amount of work which has been done on special, though often related, fields, and the amount of work which still must be done to construct a serious synthetic system, required by a natural logic.

3.4. Some observations in the preceding paragraphs pertain to the
of logical systems. Although both the semantics of logical and natural languages are still under central discussion, there are some crucial divergencies in their development which merit brief attention here. Let us again focus upon (modal) predicate logic.

As was said earlier most logical work on semantics is extensional, in that individuals n_1, n_2 or n-tuples of individuals $<n_1, n_2 ...>$ from a given domain *D* are assigned, in one or more worlds w_1, w_2 ..., to the terms of the expression; arguments being true if there are such individuals, predicates if there are such n-tuples of individuals, and propositions if both conditions hold (and the individuals for which they hold are identical); necessary propositions holding in all worlds of the set W and possible propositions in at least one w_i of W. Such an account has been of great influence in modem logic but seems to do not much as far as `meanings' of expressions are concerned, even when we view meanings as sets of truth conditions. In the first place we have the problematic character of the notion of TRUTH itself, for which it would be more appropriate to substitute some notion like SATISFACTION[7], in order to account for non-affirmative expressions in NL (and LL). Secondly, arguments having different meanings may denote the same individuals as their extensions, whereas different predicates may have the same n-tuples as their extensions. In the third place, it is not wholly obvious that the domain of individuals should be specified independently of the worlds themselves: their `existente' may be restricted to some worlds, so that is would be adequate to speak also of necessary and possible objects. Intuitively, then, it would be more adequate to have a semantics consisting of a model which includes a world-independent set of (basic) properties or relations, of which each member may be satisfied (or not) by the individuals or n-tuples of individuals of each world.

Even an INTENSIONAL approach does not seem to alter these facts if we take intensions as functions from expressions to extensions, or as functions from `indices' (factors of interpretation) to extensions s, since this would still result in the fact that all tautologies — being true in any world — or contradictions — being false in any world — would have the same value (extension) and hence have no difference of meaning. Similarly, it is problematical how to determine a function having no value (extension) at all, as is the case for all (other) intensional objects, viz. the opaque meanings of *(the) president, (Me) neighbour, (Me) girl with (Me) blue eyes,* which not simply may be identified with

[7] The use of alternative notions for 'truth', e.g. satisfation, has been discussed by Harrah (1963), Hintikka (1961, 1963).
[8] This view is taken e.g. by Montagne (1970a, b), and Lewis (1970).

the classes of objects satisfying these properties. We will return to these basic issues below.

3.5. Furthermore, logical systems, as we suggested, in general lack a serious PRAGMATICS. The important work which has been done in this domain is empirically much too pover to account for the numerous rules and categories determining the adequate use of expressions in NL [9]. On the other hand much of it may simply be seen as part of semantics. Not merely time, place and speaker would need explication, but also intentions, knowledge, beliefs, attitudes, and similar notions, which hitherto have been discussed mainly within philosophy and the social sciences.

3.6. The remarks of this section are not intended as a show-down of the role of modem logic in the analysis of natural language, but rather as a reminder of the difficulties and the tasks which await us in such an inquiry. In that perspective the use of current logical systems is not only fragmentary but empirically inadequate when they do not accommodate the specific properties of NL we have enumerated aboye. It may be rightly asked whether a natural logic which would result from the suggested adaptations is not too weak to be a logic at all. At least the principies of logical inference either would grow enormously complex or would need a complete revision, which would mean a complete redefinition of logic (and for that matter of all the formal systems based on it). These last observations seem unduly pessimistic, and the best line of research would be on the one hand to investigate which principies of current logic do in fact hold in NL or in some important fractions of NL, and on the other hand which extensions of these logics are theoretically and methodologically sound such as to account of some important structural principies of NL. Much of the preliminary research in this last part of the inquiry, however, will initially be largely informal and prepared by philosophy of language and linguistics itself. Many of our observations on text logic below regrettably belong to this stage.

3.7. A final, methodologically important, remark must be made here. Any logical system (language') accounting for natural language is (part of) an empirical theory. Since the empirical object is a language, such a system would be a meta-language. Strictly speaking, then, logical languages are to be

[9] We think e.g. of the work of Montague (1968, 1970a, b) which bears little resemble with any form or task of (empirical) pragmatics, and we would rather range it as a specific type of syntax (and its semantic interpretation). Similar remarks hold for the, though rather different, monograph of Martin (1959). For recent discussions on the status of pragmatics, see Schmidt (1972), Stalnaker (1970), Bar-Hillel (ed.) (1971), van Dijk and Franck (1972) and van Dijk (1974).

compared with grammars not with natural languages. In this respect our list of divergencies between logic and language seems to beg the question. As part of the grammar, a natural logic would have to describe meaning (or reference) structures not `replace' them. This is true to some extent, but the task of logic, would essentially consist in a **FORMAL RECONSTRUCTION** of the mechanisms of natural language, an aim which we assume to be identical with the formal derivational descriptions in generative grammars, which also generate sentences/texts together with their structural description.

4. TEXT LOGIC

4.1. *Introduction*

4.1.1. The previous remarks should wam us not to assume a task like the elaboration of a `text logic' before more is known about the logical form of sentences. Similar objections could be made against text grammars, but there is serious evidence that our understanding of sentence structure grows when we go beyond the limits of the sentence. The same, we think, may be said about a natural logic, apart from the fact that any serious logic precisely formulates the rules (LL-transformations) relating propositions in well-formed texts: proofs. Below, we will analyse in some detail this analogy between 'formal texts' and 'natural texts', and their respective `derivations'. Furthermore, we would hardly want to construct a natural logic which does not include such fundamental concepts as presupposition and consequence, notions that can be defined only over ordered n-tuples of propositions/sentences, i.e. in texts. The same is true for an adequate treatment of description, quantification, identity, tense, modalities and other basic aspects of logical form, both in LL and NL.

4.1.2. In this section we want to discuss the general status, aims and tasks of a text logic and to study in some detail, though informally, some of its central problems. As such, then, our observations and suggestions are intended rather as preliminaries towards a text logic than as part of this logic itself. The problem is that it seems methodologically unadvisable to construct directly such a logic before we know what empirical facts it must account for. In order to characterize these facts we will resort to ordinary discourse supplied with some machinery from generative grammar on the one hand and modal predicate calculus on the other hand. Gradually, the discussion of some of the empirical (viz. semantic) facts will force us to extend the provisional apparatus. We do not claim that such an extended calculus (which must undergo further internal elaboration) is identical with a text logic, but it is assumed that text logic must at least contain analogous extensions with respect to standard calculi.

4.1.3. The **STATUS OF A 'TEXT LOGIC'** is not clear a *priori.* When conceived as a logical system in the strict sense, it cannot have empirical claims and can be tested only on the validity of its theses (theorems), i.e. on the correctness of its deduction rules, the appropriateness of its axioms, and on its consistency and completeness. At the same time it would require a formal semantics (model theory) and formal pragmatics to interpret this calculus. If it manages to take into account all relevant aspects of logical inference we have listed earlier, viz. plurality quantification, modalities (alethic, epistemic, deontic, chronological, topological), etc., it would be a sort of super-logic, which at present would be more a dream or a program than a feasible construction.

If taken as part of a generative text grammar, a text logic would have to make empirical claims as to the abstract underlying structures of sentences and texts. That is, its structures must be an appropriate input for the other grammatical rules, they must be identifiable with or relatable to meaning structures and thus make explicit such notions as ambiguity, synonymy, paraphrase, coherence, presupposition/consequence, and the like. It seems impossible to perform such a task without a corresponding lexicon. Hence the logic would contain a set of (basic) predicates, defined (derived) predicates, meaning postulates, and construction (projection) rules and constraints. This last requirement precisely would define the logic as a **NATURAL** logic, since its categories and rules would not only be formal but also contingent. This contingency is not the same as that characterizing natural language itself with respect to the psycho-social factors of its use in verbal communication, which an abstract but empirical grammar does not either account for, but a contingency with respect to the given empirically based structures of expressions in natural language. A natural text logic may only explicitly reconstruct not construct such structures. In this respect it is fundamentally different from a formal (text) logic, which only has internal criteria of adequacy, whatever the further analogies may be. Furthermore, these analogies are explained by the fact that modern logical systems do not develop arbitrarily, but follow roughly — in their intended interpretations and corresponding calculi — our basic intuitions about the logical structure' of the world, which in tum is also, though vaguely, reflected in natural language and the discourses we use to speak about that world.

Concluding these extremely general remarks we will assume, then, that a `formal text logic' is simply identical with a very powerful (i.e. weak) modal logic, specifying all relevant rules, principies and theorems determining well-formed Inferential texts', i.e. proofs. A 'natural text logic' is a more general and a still weaker system, part of an empirical theory (a theory of language) specifying the general rules, principies, constraints, etc. determining the abstract (meaning) structure of any text, including argumentative texts as abstractly specified by formal text logic. Formal logic, then, is the set of specific constraints defining a specific TYPE OF TEXT, *viz.* texts in which the derived statements are required to be valid (true). This does not mean that a natural text logic could not in a similar way be constructed as a deductive system, only its intended interpretation, then, must have empirical relevance, since such a system would be part of an empirical, natural grammar

Clearly, at this point the boundaries between logic and linguistics and their respective status, aims, and tasks are blurred : both explicitly specify the abstract structure of texts and the relations between text structure (including meaning) and the world(s).

4.1.4. What, then, are the more particular AIMS AND TASKS OF A NATURAL TEXT LOGIC? Aboye we mentioned several times that such a logic would have to account for the `semantic structure' of sentences and texts. Primarily, the linguist would understand, in this case, an explication of `meaning structure', and hence the formulation of those rules of grammar determining the (grammatical) `meaningfulness' of sentences and texts, such as any native speaker intuitively knows them, an intuition (competence) which underlies his testable judgements on his language. This knowledge of `meaning rules', includes a purely internal knowledge of similarities and differences of meanings, both of `words', sentences and texts: synonymy, antinomy, paraphrase, presupposition, consequence — independent of concrete use and reference. Besides a specification of the structure of propositions/sentences, a text logic more specifically determines the logical relationships between sentences in a well-formed, coherent text. These include specific constraints upon the ordering and scope of quantifiers and modal operators, relations of identity, equivalence, similarity and elementhood, inclusion and entailment between arguments, predicates and whole propositions, and the ordering of the propositions themselves. At the same time the text logic will specify the truth or satisfaction conditions for sentences-in-texts and texts, i.e. it includes a reference theory of natural language specifying the properties of the models in which they may be interpreted. Part of the textual coherence conditions enumerated aboye are definable only at this, extensional, level. Problematic, of course, are the precise relations between meaning structures and relations and the referential structures.

It is clear, that of all these tasks and aims we can only discuss some fragments below.

4.2. *Proofs, Systems, and Texts*

4.2.1. We suggested aboye that there might be some non-trivial analogy between grammatical generation of textual sequences of sentences and formal deduction in logical or mathematical PROOFS. Before we discuss some of the rules holding between sentences in coherent texts, we must make some remarks on this supposed analogy. Let us first briefly consider come characteristics of formal proofs. The crucial idea, here, is to construct a `discourse' consisting of subsequent propositions which may follow each other under certain conditions which permit either to change a proposition (or in general a well-formed formula) into another, or to introduce a new wff. These conditions are, variably, called `transformations', (of deduction), 'principies', laws', etc. For such a discourse the following always must hold : For any formal discourse *D*, consisting of an ordered n-tuple $\langle S_1, S_2, \ldots, S_n \rangle$, of wff's: $\langle S_r, S_2, \ldots, S_{„-1} \rangle$ -3 *S*. That is, the last sentence logically (necessarily) FOLLOWS FROM (IS ENTAILED BY) the ordered (n-1)-tuple of preceding wff's, and is true under the following conditions

(i) that for each S_i (S_i $S_{,,}$), S_i ís true,

(ü) the correct transformation rules have applied.

This entailment is false just in case $\langle S_r, S_2, \ldots, S_{„-1} \rangle$, the PREMISSES, are true and $S_{„}$, the CONCLUSION, false. (Whereas from false premises we may derive any proposition whatever, including $S_{„}$, which makes the entailment true).

Any wff which is part of *D* must belong to the following set:

(1) a wff derived from another wff by transformation rules,

(2) a definition,

(3) a previously proved theorem,

(4) an axiom.

Finally, another main characteristic of formal proof is the fact that it is based on rules pertaining to the SYNTACTIC form of wff's alone. That is, whatever may be substituted for the variables in the premisses, the conclusion will always be true if the premisses are true. Of course, in SYNTACTIC terms, the notion of truth does not enter, and we may speak only of the DERIVABILITY of a conclusion from its premisses. In SEMANTIC tercos we may correctly say that a conclusion is semantically entailed by the premisses if it cannot possibly be false when the premisses are true. Any proposition which is semantically entailed by its premisses must also be formally derivable from it.

4.2.2. Let us now see in how far a derivation of a sequence of sentences, a text, can be significantly compared with such formal discourses we call proofs. A first similarity is rather superficial, viz. the fact that both appear as discourses, i.e. as ordered n-tuples of propositions. Another aspect is that in

order to generate a sentence/proposition S_i after a sentence S_{i-1} a number of rules must be followed. These rules, however, are **(TEXT) GRAMMATICAL RULES,** whereas the rules for writing S_i after S_{i-1} in a proof are **LOGICAL RULES** of inference. Furthermore, it cannot simply be said that the last sentence of a natural text is either logically derivable from all its previous sentences or semantically entailed by them. The issue we started with, however, was that the basic grammatical rules relating subsequent sentences are identical with the rules relating logical forms' or `semantic representation' of these sentences, and that such rules may be called to form a (natural) text logic. Such a text logic may appropriately be called a **LOGIC,** in the traditional sense, if its rules are 'sound principles of inference', based on the formal structure of the propositions alone.

On such an interpretation of a logic, a text logic could not possibly be a logic, because we cannot **INFER** sentences from (a set of) preceding ones. In more rough terms : a given sentence does not seem in any way to be 'included' in the set of preceding sentences, nor the truth of the sentence to be

In order to resolve such a problem of any logical approach to natural language, we may first try to weaken (or generalize) the notions of inference or logical entailment. In stead of saying that a sentence S_i necessarily/logically follows from $<S_1, S_2, ..., S_{i-1}>$ we should perhaps say that S_i **POSSIBLY FOLLOWS** from $<S_i, 5_2, S_{i-1}>$. That is, we should lay down the rules which formulate the conditions under which a following sentence is **ADMITTED,** given a set of previous sentences. In fact, this is a more general case than the logically/necessarily determined conditions of inference which of course, by $L(p) \_3 M(p)$ are always possible. Notice that in a proof we may have more than one logical consequence from a set of premisses. That is, a particular conclusion is also merely a **POSSIBLE** one with respect to the rules and the other **POSSIBLE** conclusions.

Furthermore, the notion of 'conclusion' in proofs is rather arbitrary : it may be any proposition which is the last of the derivation, and any wff derived within a proof is also a 'conclusion' with respect to the previous wff's. The difference is rather pragmatical: it is the aim of the logician to arrive by derivation (i.e. to prove) a **GIVEN** or **ASSUMED** wff.

4.2.3. Given these similarities and differences between logical (mathematical) proofs and texts of natural language, there seems to be one solution left. We must not regard any proposition/sentence/logical form of a text as a wff comparable with the wff's **WITHIN** a particular proof, but rather as its result, i.e. the conclusion derivable from it. That is, any sentence of a text must be seen as a **THEOREM** which may be derivable/proved if and only if a set of previous theorems have been derived are valid. Since this set must PRECEDE the derivation of S_i, the whole set of `theorems' is ordered under the precedence relation. Under this interpretation we discover the analogy between a text and a THEORY, or SYSTEM, consisting of an ordered (consistent) set of theorems. Furthermore, we are close to the well-known GRAMMATICAL DERI of particular sentences, starting from an initial symbol (an 'axiom') and following certain rules, although this derivation includes the FORMATION RULES, which in logic do not properly belong to proof itself, which is trans-formational ' in character. Thus, a text must be formally constructed by deriving its respective sentences as theorems of our (text) logic. In these derivation, of course, the previous theorems play an important role, and precisely give the text its coherence, for if we would only apply definitions, axioms, etc. we would generate wff's, but not wff's which are well-formed with respect to the previous wff's. Hence the analogy between textual coherence and the formal consistency of logical systems. However, it remains to be seen in how far textual coherence and consistency can be compared when we realize that texts in natural language may well-contain sentences which, taken in isolation, are contradictions of each other. Clearly, notions of ordering, with respect to time or worlds, play a role here.

As for the semantical differences analogies between proofs (systems of proofs) and texts, we have already remarked that the criteria we are looking for, pertain to meaningfulness of a sentence with respect to that of preceding sentences, which in turn determines the satisfiability (truth, falsity, relevance, happiness) of the sentence in the world 'constructed' by the preceding sentences and their presuppositions and consequences. We will study the particular aspects of these general notions especially on such notions as identity, description and entailment in texts.

4.3. *The Basic Apparatus*

4.3.1. In order to be able to describe the main properties of relations between sentences in a text, we adopt the following basic apparatus, which is standard but which will gradually be modified below. The system is essentially a *Modal Predicate Calculus* (MPC) of first order.

4.3.2. *Syntax*

4.3.2.1. The syntax of the system will, initially, have the following sets of *symbols:*

(1) a set of argument (individual) variables: $x, y, z, \ldots,$
(2) a set of individual constants (arbitrary names): a, $b,$
(3) a set of individual (proper) names: $n_1, n_2, n_3, \ldots,$
(4) a set of predicate variables: $f, g,$

(5) a set of predicate constants (names): ***F, G,*** *H,...,*
(6) a set of structure markers: (,), [,], (, }, and a comma,
(7) a set of quantifiers: Y, 3,
(8) a set of logical connectives (dyadic operators): A, V, ⊃
(9) a monadic operator:
(9) a set of modal operators: O ; G.

4.3.2.2. Provisionally we take the following (standard) ***formation rules*** defining the well-formed formulas (wff's) of the system:

(1) A predicate variable/constant followed by an ordered set of individual variables/constants/names — which are enclosed in parentheses and separated by comma's — is a wff, called ***atomic formula,*** abbreviated as a.

(2) an atomic formula preceded by a set of quantifiers, binding each — non-bound — occurrence of an individual variable is a wff.

(3) Any wff as ***defined in (1)*** or (2) preceded by a set of modal operators is a wff.

(4) any wff as defined in (1), (2) or (3) preceded by the monadic (negation) operator is a wff.

(5) Any wff as defined in (l)-(4) will be called ***simple.***

(6) We form well-formed ***complex formulas*** or ***compounds*** out of any simple wff's by one logical ***connective*** for each pair of simple wff's.

(7) The properties of simple wff's as specified in (2)—(4) also hold for compound wff's.

(8) No other sequence of symbols is a wff of this system.

4.3.3. ***Semantics***

4.3.3.1. The (wff's of this) calculus (are) is interpreted in a Kripke-type semantics for modal predicate systems with the help of a ***model*** defined as a quadruple ***<D, V, W, R>,*** where ***D is*** a domain of individuals (objects') u_1, u_2, where *V* is a value-assignment function assigning to each individual variable a member of ***D*** and to to each *n-place* predicate (predicate of ***nth*** degree) a member from a set of ***(n*** + 1)-tuples of members of ***D*** and a member w, of W, which is a set of ***(possible) worlds*** or ***(alternative) state of affairs,*** ordered by a relation ***R.*** Depending on the particuliar modal system this relation may be reflexive, transitive, symmetric, etc.

A wff has an interpretation or value in a world w, when it is either ***true*** (satisfied) or false (non-satisfied) in that world. It is true (satisfied) just in case the ***(n+1)-tuple*** consisting of the values of the individual variables (i.e. members of ***D)*** and *w,* is a member of the set of (n+ 1)-tuples which is the value of the n-place predicate. The values of compound formulas/logical connectives is calculated with the usual truth tables and the truth conditions for simple formulas given aboye. Quantified formulas are true for any or at least one value of the variable respectively (where other variables have constant value). Modalized formulas: logical necessity of a wff, if true in any member w_i of W; logical possibility, if true in at least one member w_i of W. These brief indications (which would need precision) will suffice here.

4.4. *Quantification and Identification*

4.4.1. Although we will not primarily discuss the structure of (isolated) propositions of our text logic TL, it is necessary to lay down, firstly, on which terms of the proposition the coherence relations in texts, e.g. identity, are based. That is, in order to define some relation like identity between operators, arguments, predicates or propositions, or between the individuals of the universe of discourse in which each sentence has its `scope', we must have reliable means to **IDENTIFY** these individuals. This identification is traditionally defined with a set of **QUANTIFIERS,** Y for universal quantification, 3 for existential quantification, roughly interpreted as:

(Yx): for all *x: — x —* ,
(3x): for at least one *x: — x —* ,

where (Vx) may be defined as (— 3x)— (a) and (3x) as (a), where a is any wff, containing x as a free variable, *bound* by the quantifier dominating it.

In order to represent the quantification of nouns in NL these two quantifiers are insufficient. In particular we have no means, thus, to quantify over **SINGULAR INDIVIDUALS,** that is, to express that our wff has a truth value in case there is just *one* individual satisfying it. Similar remarks may be made for **PLURAL** quantification: we may want to express that a proposition has truth value for *Many x* or *Most x,* for *Few x, Every x* or *Each x,* etc.

Let us concentrate on the quantification of singular individuals.

4.4.2. The extant philosophical and logical work on `particulars', `singulars' and their corresponding (in-) definite descriptions, is vast [10]. Little, however, of the main results have found their way finto grammar, and only recently discussion on quantification, description and modalities also

[10] Of the numerous contributions to the study of singulars and descriptions, see Reichenbach (1947, Section 42, Section 47), Geach (1962), Linsky (1967), Strawson (1959, 1971), Rescher (1968, Ch. 9), Hintikka (1970), Donellan (1970) and Vendler (1968).

Many of the points of view, though diverging, are used in our account, although we believe that a 'textual' treatment of the issue in fact makes explicit numerous references to `discourse' made in these approaches. In this perspective descriptions and their properties are derivable from sequences. In stead of (merely) operators we therefore introduced -appropriate quantifiers, and distinguished between particular and non-particular singulars. The problem has not exhaustively been treated here and we hope to be able to treat it in more detail in future work.

becomes central in linguistic work n. It is impossible to review this work here and we will rather approach the problem from a systematic point of view, with special attention for the implications for text structure. Conversely, we will see that most of the unresolved problems can appropriately be restated in terms of textual relations.

Both in (text) grammar and in logic we need a general PRINCIPIE OF INTRODUCTION for referential expressions. That is, from the domain of objects — including 'abstract', 'possible', Intensional' objects — we select a subset of objects constituting the UNIVERSE OF DISCOURSE. This well-known term significantly bears relation to the fundamental and general notion of text on which we focus. The problem is, as we will see below, that the use of unrestricted quantifiers and their (bound) variables seem to identify the universe and the universe of discourse, an identification which does not hold for any discourse.

The introduction principie we mentioned under such labels as 'ontology', `existence', etc., is often related with a discussion on the nature of the existential quantifier (3), which sometimes is said to have the character of a predicate and not an operator [12]. Since any object may 'exist' — according to a modal semantics — in some world, including constructed and imaginary worlds, the problem of (ontological) existence is logically irrelevant for our discussion, since existence in the actual world is merely one type of existence among, logically equivalent, others. Intuitively speaking, but theoretically crucial, is the pseudo-paradox that objects 'come to existence' by the very fact that we talk about them. This is the case for many objects discussed in ordinary, literary and scientific discourse. Now, the introduction principie simply states that reference to any individual (including classes) presupposes their explicit or implicit introduction as-individuals-for-the-discourse, viz. as DISCOURSE INDIVIDUALS, DISCOURSE REFERENTS, or the like.

The formal representations of this principle is traditionally given by existential and universal quantifiers, where the universal quantifier implies logically the existential.

Our first claim is that universal quantification in general PRESUPPOSES existential quantification, since existential quantifiers (or rather existentially quantified propositions) are implied both by the affirmation of universality and its negation.

Our introduction principie follows this une — and we will see below that it

[11] Besides the work of Lakoff (1970, 1971) mentioned aboye, see Bach (1968), MacCawley (1968, 1970), Karttunen (1968a, b; 1969b, 1971) and Kuroda (1971), among others. See van Dijk (1972, Ch. 2). See also Bierwisch (1971) and Bellert (1969, 1971a, b).

[12] For the use of restricted quantification, see Rescher (1968, 303, 315-318) and Keenan (1972a).

holds for all presuppositions — and requires that all introduction of discourse referents is formally accounted for by a set of **INTRODUCTION OPERATORS**, of which the well-known existential operator is just one. The introduction principie selects from the universal domain of objects a set of `discourse objects', which may have a cardinality ranging from 1 (the unique set), to oo (the universal set). It will be assumed, however, that quantification in texts is normally of a **RESTRICTED** type, that is, quantification holds for subsets of individuals defined by a given property (the set of men, the set of winged horses, etc.). The denomination of the elements of these subsets is conventional, and based on a simple or complex naming procedure, i.e. either by (proper) name or by simple or complex (productive) descriptions *(Mary, girl, person next door).*

The argument variables, then, have elements of these subsets as their values (referents). Instead of *there is an x such that x is a man (and...), we* would directly have *diere is a man (...),* written e.g. as (3 *man x)(...x...);* universal quantifiers in this restricted sub-universe may be called **GENERAL QUANTIFIERS** [13].

Notice that the introduction principle holds for general statements as well: *for all men...* presupposes: *there is a set of objects which are men.*

4.4.3. Taking these principles of restricted quantification — for which appropriate theorems may be specified — as our basis, we may proceed to the quantification and identification of individuals in texts. The same story is repeated here, for talking in a text of *all men, we* normally — apart from generalizations (as occur frequently in scientific texts) — refer to a subset of the set of men (which was already a subset of the universal set of `things'). Of course, there is no limit to these restrictions, which makes quantification always **RELATIVE.** This relatedness in texts may be defined as a set of

THE SUB—SETS ARE DEFINED FOR WHICH FURTHER QUANTIFICATION IS VALID.
The introduction principle regulates the definition (delimitation) of these subsets and hence the scope of further quantification. The introduction

[13] Our definition of the uniqueness quantifiers is parallel to the definition in context provided in Whitehead and Russell (1927). For a discussion, see Rescher (1968, Ch. 9) and the papers in Linsky (1971).

In van Dijk (1972, Ch. 2) we also made a distinction between particular and non-particular uniqueness, both for 'indefinites' and 'definites', but there we applied it still merely to terms, which made us distinguish between epsilon-operators and Sta-operators for indefinite (non-specified) non-particular and particular tercos respectively, whereas the definitivized terms would be formed with iota and lambda operators for particulars and non-particulars (abstractions) respectively. The account presented in this paper has the same purport but seems simpler to me, especially by the use of constants and (proper) names in the syntax, a procedure which we only hinted at in our book.

operators formally serve this purpose and we will now see if we need other operators besides the existential quantifier to do this job.

4.4.4. Let us take some concrete examples in order to arrive at adequate formalization.

Consider such sentences as

(1) A man is walking in the street,
(2) Mary wants to marry a Moroccan,
(3) On the comer of our street is a cinema.

The expressions *a man, a Moroccan,* and *a cinema* are normally interpreted as referring to ONE object, named in this case by a single lexical item. We will say that to acquire the status of discourse objects or discourse referents their corresponding expressions must be formally introduced as such, which in natural language is often manifested by the indefinite article (or another indefinite determiner). However, there is no point to use an existential quantifier in these examples since this one determines truth (satisfaction) not for JUST ONE but for AT LEAST ONE (some) individual. Of course, the truth values partially overlap but since there are different presuppositions in each case, a statement with an existential quantifier could be false and a statement including reference to JUST ONE individual true. The latter would entail that the statements when referring to more than one individual would be false.

Taking sets of men, Moroccans and cinemas as presupposed by the discourse (e.g. as implied by our knowledge of the language or the world), we want to express that these statements are valid for one individual having this property. To express this singularity we will define a UNIQUENESS OR SINGULARITY QUANTIFIER, e, with the aid of the well-known existential and universal quantifiers:

(4) DEF 1: *(ex) (gx)* for (3x) *[gx* A *(V y) (gy (x* = y))j,

or if, indeed, we want to consider 3 as primitive:

(5) DEF : *(ex) (gx)* for *(3x) [gx n* (3y) (gy (x y))],

which in restricted notation would be:

(6) DEF *1″: (egx)* for *(3gx)(-3gy) [x* y].

We use an epsilon to denote this quantifier in order to indicate that propositions closed under it are true just for one element of a set. An alternative notation would be e.g. E_1x or /x.

Our analysis seems to follow the usual Russell-Quine line for unique descriptions. The difference, however, is that we do not introduce uniqueness in definite terms but in quantification of indefinite propositions. We thus meet the well-known objections, e.g. made by Strawson (Strawson, 1971: Chapter 1), against the russellian analysis. Indeed, definite descriptions do not assert existence or uniqueness (as in fact parts of a formal definition do not 'assert' anything at all, following Strawson's own remainder of the use-meaning distinction) but 'imply', i.e. presuppose them. On our analysis, then, these presuppositions are formally introduced, by certain operators (e.g. *ex),* as preceding propositions. In case there are no preceding sentences, we may consider the set of propositions which may be used to describe the pragmatical context or situation as such preceding sentences, for which the same principies are valid. In our opinion most of the interesting intuitions and proposals of Strawson, Geach, Linsky and others are thus formally accounted for. A natural link can thus be established between 'indefinite' description and definite description (see below).

Now, although tne definition as proponed aboye seems formally in order, it remains somewhat artificial. Any calculus, and especiálly a number theory or a natural logic based on it, would be more elegant, it seems when providing a means to introduce direct unique quantification of singular elements of a set, e.g. by taking ex as a **PRIMITIVE.** This would at least avoid the rather awkward and an un-intuitive procedure for defining singulars by discarding first all other elements of a set with the identity clause.

Once introduced *ex as* a primitive we might speculate about a corresponding axiomatics. Its negation followed by a negation, meaning `not for a single one not' or `nothing(nobody) not', would then be a possible definition of the universal quantifier. We will not further discuss these possibilities here.

The uniqueness quantifier fairly well captures part of the intended meanings of (1)—(3): reference is made in each case to one single object. Notice that this quantifier makes a statement true just in case a single individual (or single class) satisfies it, but that it is not specified which individual is referred to. That is, this uniqueness is **INDETERMINATE** and therefore may be characterized as a quantifier of **CHOICE** of an element from a set, just as the existential quantifier selects 'some' (`several) discourse referents."

Indefinite expressions, however, may also denote one **PARTICULAR** element of a set, and it may be attempted to account for this fact by an appropriate quantifier. Strictly speaking, of course, quantification merely restricts the **NUMBER** of individuals for which a statement has truth value, and not the

[1a] **Notice** that indeterminate (non-particular) individuals are individuals in the strict sense, not some sort of *arbitrary* individuals being 'any' member, that is *all,* members of a class, for which the appr opriate symbolism is the universal or general quantifier (see below for this possible reading of our example sentence). For criticism of 'arbitrary individuals' see Rescher (1968, Ch. 8).

fact that these individuals are non-particular or particular. The notion of particularity, furthermore, seems to be based on PRAGMATIC rules, such as

(7) Speaker knows/has identified the individual a.

We will not analyze these pragmatic aspects here and merely look at the possible syntactic and semantic ways to represent particularity. [15] Since we want to include in our syntax as closely as possible the conditions which will make the propositions true or false, we will introduce a quantifier selecting a DETERMINED individual from a set, i.e. ranging over an IDENTIFIED object. We will call this quantifier a PARTICULARITY or IDENTIFICATION QUANTIFIER and will tentatively define it as follows:

(8) DEF 2 *(Ix) (gx)* for *(ex) (gx A x=n$_i$),*

or in restricted notation:

(9) DEF 2' *(Igx)* for *(egx) (x = n$_i$).*

We see that this quantifier implies (presupposes) the choice or uniqueness quantifier and imposes the further condition that the one individual of the set is identical witn a 'fixed' or 'identified' individual for which we appropriately may use a *constant as a name.* [16]

We now seem to have the appropriate apparatus to represent the sentences (1)—(3), the ambiguity of which is now explicitly accounted for by different underlying forms, e.g. for (1):

(10) (i) *(ex) (man(x) A street(y) A walking in (x, y)),*
(ii) *(Ix) (man (x) A street(y) A walking in (x,* y)).

(where we neglect for the moment the appropriate quantification of *street* and other aspects of meaning). The difference in meaning clearly comes out when we consider possible following sentences, on which the different readings impose restrictions. After reading (10)(i) we may have a sentence

[15] Of course, a belief logic, e.g. Hintikka (1962), may step behind this condition and make it part of the calculus. The whole problem of transparence and opacity of reference is connected with the ambiguity of `knowing' and 'believing'. That is: I may know some individual n, without knowing hiin by a certain name or description, e.g. as the 'inurderer of Johnson'. See Quine (1960, Ch. 4), Donellan (1971). For a linguistic account see Hall Partee (1970), especially for the related problems for pronominalization.

[15] Constants as names have been used in *Principia Mathematica* in order to refer to a particular object in the definition of definite descriptions (Whitehead and Russell, 1927, Ch. 3 and 14). Quine uses free variables to indicate existing objects in derivations (see Note 19, below). For a discussion of russellian names, see e.g. Prior (1971; Ch. 10 and Appendix). Lambert and van Fraassen (1970; Note 13) also use n to denote constants in identity relations. Cf. Lemmon (1965; Ch. 4).

like *I can hear his voice from my study.* That ís, I may ínfer the presence of a man in the street simply from hearing his voice. There may be' more men in the street and no identification of wHicH man is crying is specified. Similarly, I may say *A man cried at me from the audience* without being able to see wmO is crying, which permits a following sentence like: *But I did not see who it was.* The second reading makes such following sentences ungrammatical. Here we could have subsequent sentences such as */t is my father* or *His name is Winston Churchill.*

The same distinction holds in sentence (2), *where* Mary may want to marry a particular Moroccan, say Ibn Hafiz, or some, non-particular Moroccan which I have not identified, but of which I know, e.g. by hear-say that Mary wants to marry him.

In this sentence there is a third reading, based primarily on the INTENTIONAL MODALITY of the sentence as expressed by *want.* Notice that in the first reading, Mary will normally have identified ~Id she is going to marry, that is, reference to him is TRANSPARENT for her and OPAQUE for the speaker in that reading but (in some weird situation) transparent for the speaker and opaque for Mary, e.g. in case she wants to marry a particular man identified by the speaker (as being a Moroccan) but of which she does not know he is from Morocco. Now, the third reading introduces an 'intensional object', which does not refer to any particular or non-particular Moroccan at all, but to a non-particular Moroccan in the world of her intentions or dreams. In this case the statement will be made true just for ANY man if only he is from Morocco. To represent this reading we normally will use the universal (any = arbitrariness) operator and put the property in a CONDITIONAL : for all *x,* if x is a Moroccan, then Mary wíll want to marry him, or conversely : íf Mary wants to marry a man, then he must be a Moroccan, which makes it a bi-conditional :

(11) (Vx) (Moroccan (x) **W** marry (Mary, *x)).*

In sentence (3), finally, we will normally have the only reading saying that I am speaking of one particular, identified cinema, which I might give a name (even a particular proper name if I remember it).

Notice that in the bi-conditional reading of sentence (2) as represented in (11) the quantifier does not imply ontological existence. In a sentence like *Mary wants to marry a millionaire from her local village* the class of objects satisfying the conditional may, in fact, be empty. Which clearly separates the world of possible or imagined creatures from the world of actual creatures and which makes the use of some modal operator for 'intentionality' necessary (e.g. 'W'). We will see below that thís condition ís crucial for the coherente of texts.

We do not discuss here such readings of indefinite anides which are used to express generality or definitions, e.g. in *A cinema is a house where they show movies to a public* or in *A student of literary theory should know the principies of linguistics and logic.*

4.4.5. We have discussed at some length some properties of the introduction principie for discourse referents with the aid of quantifiers, in order to have a sound basis to treat **DEFINITE NOUN PHRASES** and **PRONOUNS in** text, that is some of the surface manifestations of textual coherence. In general we may state the following intuitive **PRINCIPLE OF COHERENT PROGRESSION:** all discourse referents identical with those appropriately introduced by the introduction operators are to be counted as particulars in the rest of the text, if interpreted as identical in the same world(s) as those in which they were introduced. A rule of grammar, then, assigns a feature [+ DEF] to the expressions which refer to objects satisfying this principie. In English this feature selects *the* from the lexicon, whereas the introduction operators are manifested by such lexemes as a, *some, any,* etc. The principie of coherent progression also holds for cases in which a discourse referent is not — in surface structure — explicitly introduced in the text. The rule then applies to presupposed (and hence interpolatable as preceding propositions in the logical forro) pragmatic propositions such as (7) aboye:

(12) Speaker knows/assumes that Hearer knows, that Speaker is referring to object a and that Hearer knows/has identified a.

which may be formulated in symbolic terms with the aid of the introduction operators. Such a device presupposes that a pragmatic component is associated with the logic, such as to be able to formulate underlying constraints for the logical forro and its interpretation (cf. van Dijk and Franck, 1973).

Now, the problem is how we may formulate in explicit terms the different aspects of the principie of coherent progression. Tne terms in which it is given aboye are clearly extensional, and it may be asked if there are no pure meaning or intensional properties involved in coherence relations. Finally, it is necessary to have some deeper insight into the main condition of the principie: **IDENTITY (IN A WORLD OR ACROSS WORLDS).**

4.5. *Identity*

4.5.1. As we suggested aboye, coherence relations in texts often presuppose a relation of **IDENTITY** between (terms of) propositions or/and between the discourse referents which they denote. However, a notion like identity, as is well-known, is highly complex, both from a philosophical and a logical point of view. Again, we will omit a discussion of all relevant work in this domain and treat the issue with reference to some examples. [17]

The usual definition of the binary predicate constant IDENTICAL, which may be introduced as a primitive in the syntax, is the following:

(13) $x = y$ for (9) $(9x\ 9y)$,

a second order definition in which we quantify over properties.

The same definition may be reformulated in set theoretical terms. In this definition the identity relation holds, rather paradoxically, for INDISCERNABLE OBJECTS which are stated to be the same. The paradox merely lies in the fact that we use two different expressions (x and y) to refer to ONE object, just as in the basic thesis $x = x$, expressing self-identity. In this strict interpretation of identity, the identity is equivalent with self identity, which is logically necessary and hence true in each world : $(x = y)$ $(x = y)$, that is, the identity of x and y entails the necessary identity of x and y, and conversely ; hence $(x =$ ❑ $(x = y)$, (where here, means strict equivalence). In general, however, weaker notions of identity are used, also referred to as `equivalence', `similarity', 'analogy', etc. E.g. two symbols a and a may be raid to be 'identical', but they are discemable as different occurrences (e.g. as two TOKENS of the 'same', abstract TYPE). Similarly, we may say of any two objects that they have the same properties apart from being distinct in a spatio-temporal sense. In fact this is the most strict normal interpretation for expressions like 'identity' and `sameness'. Weaker, on this line, is identity of two distinct objects as identity from a given point of view, or IDENTITY FOR A DISCOURSE. That is, we may VIEW two written symbols, two chairs or two ideas as being identical, but closer (e.g. microscopic) analysis may reveal certain differences, which for the given occasion are neglected or ABSTRACTED from. Two uttered words may be phonologically identical but phonetically different, i.e. for the grammatical discourse they are identical (types), but they are different for a phonetic description.

[17] For a general discussion of identity, one of the main topics of logic at least since Frege, see especially Quine (1960, Section 24, 1961, Ch. 4). For identity in modal contexts see Hughes and Cresswell (1968, 192ff). One of the debatable points is the validity of $x = y$' $(x = y)$. To avoid unintuitive consequences of this thesis, *contingent identity systems* have been proponed which lack it, and in which identity in a world may be satisfied and non-satisfied in a different world >vi. This possibility, of course, is important aboye all in all *tense* contexts (cf. Prior, 1968, Ch. 7). Contingent Identity systems have been discussed by Kanger (1957). For identity in texts we may refer especially to Kummer (1971b) and — using a mathematical mode(— to Palek (1968).

For discussion of the implications of (modal) identity, see Hintikka (1970) and, again (the different issues treated here are closely connected and discussed often in the same papers), Linsky (1971). It has been primarily Ruth Barran Marcus who has been dealing extensively with the problem, see Barcan Marcus (1947, 1967, 1970). Referential identity in liguistics has been treated by the authors cited in Note 11, and by Dik (1968).

On the other hand we do not merely have weaker versions of distinct-identity but also of self-identity. Physically an object is never totally identical, at different TIME POINTS t_i and t_P which is particularly obvious for all animate objects, but nevertheless we will speak about the SAME chair, man, or university at different time points, even when all its constituting elements have been successively replaced. Many classical paradoxes have resulted from this possibility of considering a as the same object in its different physical or psychological FRASES. Also in this case the DEGREES OF IDENTITY go from strong to weak, but the important fact, again, is that the identity is assumed to be identity RELATIVE TO A GIVEN TEXT, and abstracted from the absence of `previous' properties or the presence of 'new' properties. Clearly, the notion of TIME or STATE plays an important role here. The notion of necessary (logical) identity holding in all worlds and hence in all state descriptions or time phases, thus, cannot be compared with the notion of CONTINGENT IDENTITY we here discuss.

The fact that the 'same' object may nevertheless have different properties in different states, or be assigned different properties from different points of view, implies possible differences in referring to/naming/describing this object; e.g. as ín the famous *Morning Star/Evening Star* example, where two different descriptions of two different properties denote the astronomically 'same' individual, viz. the planet Venus.

Now, the identity defining coherence in texts is based on these general principies: a *fortiori,* 'identity for a discourse' is 'identity in a text', in that extensional identity is one of the properties determining textual coherence. Let us consider some examples of identity relations in texts.

4.5.2. Consider, for example, the following texts:

(14)	A girl won the beauty contest.	The girl She	is my sister.
(15)	A girl won the beauty contest.	The girl She	must be very happy.
(16)	A girl will win the beauty contest.	(The girl She	will receive 5000 f dollars.

The initial sentences of these examples are ambiguous along the lines sketched aboye. This is clear from the subsequent sentences of the text: (14) refers to a particular girl, (15) to a non-particular girl, and (16) to a non-particular girl in a future state of affairs. In all examples we may grammatically continue either with a definite noun phrase or with an appropriate pronoun, each referring to the 'same' individual as the one in the sentence preceding it. Notice, however, that the identity is not strict: in the inítial sentences the oniy property assigned is *girl,* whereas in the second sentences we have the additional properties *sister, happy, will receive 5000 dollars.* Even if still further properties are assigned by new predicates or relations we will still consider the thus established discourse referents as identical individuals.

By embedding, transformationally, the preceding sentences into the subsequent sentences we get the following complex sentences:

(17) The girl who won the beauty contest is my sister,
(18) The girl who won the beauty contest must be very happy,
(19) The girl who will win the beauty contest will receive 5000 dollars.

The definite noun phrases 'the girl who won the beauty contest' are usually characterized as **DEFINITE DESCRIPTION** of a (unique) individual. But, again, these noun phrases are ambiguous: referring to a particular a non-particular and a future (possible) non-particular girl with the property of 'having won a beauty contest'.

We assume that (17)—(19) are derived from (14)—(16) because the noun phrases show the same ambiguities as the preceding sentences, and because the `definiteness' of the noun phrase does not oniy obey the principie of introduction : just as in (14)—(16) we may have definite noun phrases only if indefinite noun phrases, referring to the same individual precede. If this assumption holds we would have identical deep structures both for complex sentences with embedded restricted relative clauses and for textual sequences of sentences, and the consequence that the coherence principies for (underlying) sequences also hold for complex sentences. In fact this proposal is not new and has precisely motivated the use of (generalized) transformations in early generative grammar. We will not here discuss the further grammatical aspects of these transformations but focus upon the logical structure of the deep structure sequence on which they operate. [18] Now, the classical Russellian approach to definite descriptions such as *the girl who won the beauty contest* is by introducing a iota-operator defining uniqueness of terms, e.g.

$$(u)\ (girl\ (x)\ n\ beauty\ contest\ (y_i)\ n\ won(x, y_a))\ ,$$

contextually in a similar way as, we defined the uniqueness quantifier. The iota-operator merely states uniqueness (in a universe of discourse) but does not differentiate particulars and non-particulars. The interesting point is that we might probably dispense altogether with specific term-forming

[18] The grammatical aspects of (restrictive) relative clauses and descriptions have received attention in Smith (1969), Kuroda (1969) and the other papen in Reibel and Shane (1969). See also Karttunen (1971) and Kuroda (1971). Sandra Annear Thoinpson (1970) also derives relative clauses from sentential conjuncts in deep structure.

operators when we directly derive complex terms from preceding sentences, which directly transmits the differences between tne introduced `indefinites' to the following definites. This requires an appropriate apparatus to relate, logically, the two subsequent sentences (propositions). That is, in a rather strict sense we want that the variables of the second sentences are I by the same introducing quantifiers of the preceding sentences.

The simplest way to do this would be, e.g. for (14), something like:

(18) *(Ix) [(girl(x)* **A** *beauty contest(y_1) n won(x_1, y_2))* A *my sister(x)].*

However, this formula does not seem to adequately capture the meaning of (14): we do not introduce 'a girl who won a beauty contest and who is my sister', but 'a girl who won a beauty contest' of which further information is given in the subsequent sentence. In (14) and especially in (15) and (16) this further information does not further IDENTIFY the girl, since she has been identified already, but merely further SPECIFIES her properties.

When we want to state this further predicate in a new proposition, we might either — redundantly — use a iota-description: *(and) this girl who won the beaty contest...,* or we may use a new variable bound by its own quantifier. In that case we would need of course an identity statement for the variables, e.g. as follows:

(19) ... n *(1y)[girl(y)* A *my sister(y) n x* = y].

This would also adequately account for a possible subsequent sentence like *The beauty is my sister,* where a different referring phrase is used to denote the same individual. The rule making noun phrases definite, thus, is based on referential (extensional) identity, not on syntactic (lexematic) identity. This different sentence would be written as follows:

(20) ... n *(ly) [beauty(y)* A *my sister (y)* A *x = y],*

or in restricted quantification, putting the identity statement in the quantifier: `for the only y identical with *x':*

(21) *(Iy = x) [beauty(y)* A *my sister (y)].*

In this case the identity predicate in the restricted quantifier precisely defines the property of definiteness [+ DEF], selecting the definite article.

As a syntactic transformation rule, even of the logical system, we may normally omit identical propositions in conjunctions: *...p n q...p* ***...p n q...*** A *r...* Since *x=y we* may consider *girl (x)* and *girl* (y) as equivalent and delete (optionally) the second occurrence where this identity is stated. We then have:

(22) ... n *(Iy)[x = y A my sister(y)],*

or in restricted quantification:

(23) ... n *(Iy= x) [my sister(y)],*

which would be the underlying structure of *(and) She is my sister.* In this approach personal pronouns and definite articles have the same source. The same holds, then, for the relative pronoun *who* in the complex definite description (17).

The method of establishing identity relations between formula followed here has the disadvantage of requiring permanent introduction of new variables and corresponding quantifiers.

Instead of repeating in each formula a new identity statement (which would probably grow more complex in each case: x= y, x= y = *z, x* =y= *z =u, etc.), it* is much more natural and easy to use **CONSTANTS/NAMES to** denote this identical individual. Actually, the very definition of the particular uniqueness quantifier contains this equation of x and n_i. The coherent progression principie stated at the beginning of this section says that any individual introduced in a text acquires the status of a particular. This is not paradoxical when we recall that particularity presuppoSes identification. We may say that any (actual, poSsible, etc.) individual introduced in the text is identified for the text by the introducing statement/quantifier itself; in intuitive terms: 'precisely that individual we just have spoken about'. Since particularity may be thus established, we have the possibility of substituting n_i for x in the following sentences. —

Sentence (14) would then be

(24) ... A ((girl (n_i) **A** my sister (n_i)) •

or

(25) ... A (my sister *(n_i)),*

where the constant would underly the pronoun *she.*

That the constant in the three sentences (14H17) still refers to particular and non-particular individuals followS from the way it is introduced: the introducing statements/quantifier DOMINATES (has as its scope) the set of sentences for which the identity condition holds, and in which, thus, n_i can be substituted for the variable of the quantifier.

The constant substituted for the x of *(ex)(...)* is merely a **DISCOURSE NAME** [19] for this non-particular or arbitrary individual, optionally characterized by

[19] `Discourse names' have been used by Keenan (1972a) who refers to Henkin's Completeness Proof for modal predicate calculi (Henkin, 1949). The principie of Existencial Specification (see Suppes, 1957) also makes use of constants as 'ambiguous names' in derivations.

its main distinguishing property: e.g. ***girL*** The procedure reminds of the principie of existential specification in logical inferences, which permits to use, temporarily, a constant as an `ambiguous' name for an existentially quantified variable, under some textual restrictionS. The Same holds, of course for non-particular singulars and, by definition, for particular singulars.

This is a principie underlying inference in **PROOFS.** Similarly, the introduction of constants, or **NAME INTRODUCTION**, is a principie underlying any coherent text.

The use of constants, of course, is not restricted to singulars but may also be applied to name **PLURALS"**, e.g. ***some x,few x, many x, most x, all x.*** As was remarked earlier these quantifiers do not quantify merely over general (sub)sets, e.g. as in ***SomelFewlManylMostlAll boys like football,*** but also over sets introduced in previous sentences of the text, as in

(26) Many girls participated in the beauty contest. Few girls} of them were pretty.

Few quantifies over the **GROUP** of girls introduced in the preceding sentence of the text. Assign the name n_1 to this group of participants and quantify over the constant: ***(Few*** n_1***, y)(...y...)*** and assign n_2 to the new subgroup. This procedure seems straightforward only if we consider groups as sets of individuals, of which **EACH** individual is, indirectly, `reached' by the predicate. When the group is taken as a whole it is normally quantified as a singular individual. Notice, finally, that in example (26) the introducing ***many*** clearly does not quantify over the set of all girls. Like most plural quantifiers, and in general for **MEASURE PREDICATES** ***(high, deep, expensive),*** it quantifies with respect to an expected NORM or **AVERAGE.** This norm, of course, depends on the rest of the meaning of the sentence and hence of our knowledge of the world. In restricted quantification notation we may use the relation ***For greater thanlmore than,*** and ***N as*** a numerical variable. The definition of ***many x,*** would then be something like ***(Many g, x)(...x)*** $=_{def}$(3g > ***N, x)(...x...). We*** will not further discuss the problems of plural quantification and we will retain the rule relevant for a text logic that all quantifiers in texts quantify over sets introduced in preceding sentences or presupposed by the text (as part of the lexicon or encyclopedia or as part of the pragmatical situation).

4.5.3. We have considered in some detail the relationship between quantification and identity in texts. Another important condition for this identity was, however, the identity of individuals IN **THE SAME** wORLD(S). That is, all

[20] For plural quantification see Rescher (1968, Ch. 10) and Altham (1971).

of our previous remarks presuppose that the MODALITIES of the subsequent sentences are kept constant. In general we cannot identify an individual introduced by a modalized sentence M.S,, and thus having its interpretation/ extension in world(s) w_i, w_i", ..., and an individual introduced by $M_i S_i$, where *M.,* possibly interpreted in a set of worlds w_i, where possibly w_i w_i, etc... Some concrete examples clearly show this principle:

(27) *Peter needs a secretary to type his paperS. She is graduated from tne University of California.

(28) *Perhaps John will visit us tonight. I am sure he will be here at eight o'clock.

(29) *Last night I dreamt that I met a very intriguing girl, named Lola. But this morning I discovered that she is systematically ignoring me.

From these examples we see that individuals of `intended', `possible' or `dreamt' world (or 'state of affair') cannot simply be identified with individuals of anotner, e.g. actual world. In (27) we may, however, continue to qualify the needed secretary, with *She must have graduated...* Similarly, in (29) my dream may assign all sorts of fantastic qualities to Lola. In (28) the *he* may not possibly be *John* since John will be *possibly* there, and he (an other man) *surely.* This is the general rule but there is a regular poSsibility to establish what may be called TRANS-WORLD IDENTITY in texts. Of course, this is true, trivially, for all sentences interpretable in all or several worlds. It is also true if the domain of individuals is world-independent. Finally, regular identity of individuals is possible in different `states' of the 'same world', i.e. all those worlds $w_{11}$, $w_{12}$, ... `compatible with' (`included in') a given world $w_1$: The John who will *necessarily come, may possibly come too* late. But also trans-world identity for non-compatible worlds is possible through the COUNTERPART-PRINCIPLE [21]. which states that any individual $u_i$ of a world $w_i$ may have its `counterpart' u_i in a world w_i. That is, there may be a real Lola of my knowledge of which I may also dream; which makes the following text coherent:

(30) Yesterday, I met a nice girl, named Lola. But tonight I dreamt that she detested me.

The pronoun *she* may refer only to Lola's dream-counterpart, which is nevertheless the 'same' Lola. Just as we may abstract — for a discourse — from certain properties of a given individual in itS different phases, we may establish identity based on WORLD-ABSTRACTION, i.e. between counterparts.

[21] See Lakoff (1968a) for the linguistic implications of the counterpart principie which has been introduced by Lewis (1968).

Notice, however, that the interpretation of the whole sentence must be world consistent. It does not **FOLLOW** that truth for a sentence in a given world entails truth ín a dífferent world. In (29) the second sentence presupposes that I know/have met Lola, but this presupposition — against the general rule — is not identical with, or a consequence of, the preceding sentence. We will discuss the modal compatibility of predicates and propositions below.

4.6. *Partial Identity, Inclusion, and Elements of Sets*

4.6.1. Whereas the identity relations studied in the previous section may be characterized as establishing a `static coherence', formalized as a series of constants, there ís another fundamental principie of coherence, determining the `progression' of the text. According to the introduction principie, for any individual to become a discourse referent it must *be* appropriately introduced by certain quantifiers. Now, this principie is not wholly **FREE**, that is, there are of course certain **CONSTRAINTS UPON (NEW) INTRODUCTIONS**. The general principie underiying these constraínts ís that any introduced individual must be related with earlier introduced individuals. Besides the (relative, contingent) identity relation, these relations may be of the general set-theoretic type: inclusion, element (member)-set, intersection, etc. Part of these relations have been mentíoned when we díscussed quantification over preví ously introduced subsets: one (of them), few (of them), many (of them), etc. In thiS case the predicates (or 'set names') remain identical, which may lead to deletion and pronominalization.

In other cases we witness part-whole relationships, where the part has a different lexical `narre' as the whole, e.g. *house-window, woman-eyes, course-student, etc.*

Now the general rule for such relations is that any individual having a specifiable relation with another already introduced individual is **PARTICULAIUZED** by this relation and hence definíte ín surface structure:

(31) There were many people in the room. The women were sitting...
(32) Peter bought a new house. The front door is of massive steel.
(33) John has a new secretary. Her eyes are driving hím mad.

These facts can be explained only if we keep following the introduction principie. In that case we introduce the new individuals by general rule, viz. **MODUS PONENS**, and a **SET OF POSTULATES**, lexical and encyclopedical, such that the textual existence of individual x follows contingently from the existence of individual y:

(V x) [9x ifrx], *(pa* F *ifra*

E.g. For each x, if x is a house, x has a frontdoor. Thus, when *house (x)* is stated we may infer (ey) *(frontdoor (y)),* and hence we have regularly introduced the individual. The fact that the deletion principie does not work here seems to indicate that it operates on a level where the general formula and its consequences have been deleted. That is, it only works between derived theorems/ sentences (we do not discuss the numerous grammatical problems of the ordering, forward/backward pronominalization, etc. involved here) 22.

4.6.2. At this point it becomes clear that a pure EXTENSIONAL (set theoretic) approach becomes awkward. Already in the postulates mentioned aboye the structure and tales for predicate logic appear: the introduction of new individuals is based on intensional relations between predicates and between propositions, and involve such relations as presuppositions and consequence. Moreover, many identity relations, normally leading to definitivization or pronominalizations, are not based on strict identity of individuals, but on inclusion, co-membership or in general identity of properties, e.g. in *I wanted to buy some apples. But they were sold out,* and in *Take tare of your wallet. Peter always tries to pick it from his closest friends.* Here the individual apples I would have bought are probably not identical with those sold out, but only a subset of them, whereas in the second example we may pronominalize although there is no strict identity but merely co-membership or `identity' of a particular wallet with any wallet. We will not pursue the details of these possible set-relations, but focus on `intensional' coherente in texts, viz. relations between predicates and propositions.

4.7. *Intensional Coherence*

4.7.1. Texts may be coherent not only because their sentences refer to identical individuals or because they establish relations between these individuals, but also because there are relations of identity, similarity, inclusion or consequence between the properties or actions of these individuals or between propositions in general. We will call these relations INTENSIONAL [23].

When we want to maintain the description of textual relations at the pure extensional level, we may, of course, say that identity of a property of or a

[22] For discussion and reference, see van Dijk (1972, Ch. 2), Lakoff (1968a) Langacker (1969), Karttunen (1971) and Postal (1971).

[22] Although we distinguish between intension and extension, especially in the description of natural language, this distinction is not without problems, nor do we trust that intensions and meanings are similar or identical things. See Carnap (1957) for general discussion. Especially Quine (e.g. 1960, Ch. 6) and Camap (1957) advocated the reduction of intensions to extensions. For modal intensions see Marcus (1967) and Montague (1968, 1970a, b). Lewis (1970) constructs intensions as functions from indices to extensions (following Montague). For criticism of the extensionalist stand, see e.g. Prior (1971), Ch. 4)

relation among one or more individuals can be expressed by co-membership relation of the same set of n-tuples, defining extensionally such a property or relation. However, such an interpretation of properties and relations both logically and linguistically leads to serious problems. The properties/relations characterizing exactly the same set of n-tuples would in that case be indistinct ; `thinking' and `speaking' probably would have the same extension, although being different in meaning. The extensional definition of adjectives or adverbs would pose still greater problems. Finally, extensions for sentences are traditionally defined as truth-values (truth, falsity, applicability, or the like), but two sentences of the same extension (truth value) hardly ever have identical meanings, even *when* they are true in any world, as is the case for tautologies. We conclude that this sort of relationships in text are most adequately constructed as intensional, without excluding a priori the relevance of some extensional aspects of intersentential coherence, such as presupposed or entailed truth value of sentences.

4.7.2. Not only verbs, adverbs and sentences represent **INTENSIONAL OBJECTS** [24]. but also a set of nouns and noun phrases. Thus, of the particular beauty contest in our earlier example we may say that *the girl who will win* it refers to a non-particular in a future state of affairs. But the definite expression *(the) girl who wins a beauty contest* does not seem to refer to any particular or non-particular at all, and rather seems to refer to a complex property, which may be assigned to a particular or non-particular individual. Intensional objects of this kind may nevertheless serve aS arguments in a text, for which the usual principies hold. We may regularly continue *...normally receives a great sum of money,* and subsequent sequences may have, regularly, pronounS like *she,* which seem to require referential identity of the individuals. We may say in such cases that such expressions are interpreted as individuals of abstract or constructed worlds, established by the text itself. The `winner of the game' for example is an entity constructed by the discourse formed of the rules defining the game. The statements of such discourse are general or universal and accompanied with necessíty operators. In any world/situation ín which the game is played 'the winner of the game', as an abstract expressíon, haS an `instantiation' in a particular or non-particular winner, which was merely a **POSSIBLE** winner of the game, whereaS the intensional `winner of the game', **NECESSARILY** wíns ít, by definitíon.

Intensional objects may be conceíved of as `names' of classes, so that their

[24] See also Note 23. Intensional' and in particular `possible objects' are also topics in the general discussions in logic mentioned aboye. See Hughes and Cresswell (1968, p. 197). They have been treated as 'individual concepts' by Carnap (1957). For defense, see Scott (1970) Lambert and van Fraassen (1970). For attack: Quine (1960, 245ff).

interpretation in related non-abstract worlds may be the universal quantifier and a conditional: *for all girls: if they win a beauty contest, then they receive a great sum of money.* In the same text, as we saw earlier, this general statement may be followed by a particular statement stating that the condition is satisfied for a (non-) particular individual, from which may follow a conclusion : *Sheila won a beauty contest, therefore Sheila receives much money.* Such coherence relations are actualized primarily in generalizing, argumentative and scientific discourse, and obey the general rules for identity between arguments noun phrases or rather between individuals, of which constructed individuals, like possihle, imagined individuals are just a subset, with the specific property that the worlds in which they are interpretable are also constructed by the discourse.

In a very general way this fact even seems to hold for the abstract LEXICAL MEANINGS of the words of a language. The intensional object `girl who wins a beauty contest' does not differ in this respect from the intensional object `girl', interpretable as name of a class, or as property, or in some vague philosophical terco as 'universal particular', or something similar. This can most easily be seen from such equivalences as *sculptress—woman who makes statues* which make up the (traditional) dictionary. The restrictive relative clause defines precisely the subset of the set of `women' or `girls' for which the intensional object can be used as a name. We will simply consider them as properties or attributes, and not consider the philosophical and meta-logical prohlems related with the distinction between individuals, properties, classes, classes of classes, etc., but try to discover the characteristics of intensional relationships in texts.

4.8. *Intensional Identity. Predicates.*

4.8.1. Arguments or noun phrases in texts are submitted a general principie of introduction and progression defined on extensional identity or other set-theoretic relations. It may be asked whether such principies e.g. of introduction and progression, also determine the PREDICATE COHERENCE in texts. Apart from the predicates `naming' the identical individuals *(a girl... the girl...)* predicates in general do not seem to be kept constant. That is, in surface structure `new information' is usually provided by the predicate phrase of the sentence (including verbs, auxiliaries, nouns, adverbials, etc.). If this general rule is not followed, i.e. when the predicate (verb phrase) is kept constant and the subject-noun phrase differs, this is usually either assigned contrastive stress or submitted rhematization transformations (it *is... who, etc.).*

Nevertheless, there are many constraints limiting the introduction of predicates, especially the properties of combined predicates and their mutual relations (selection restrictions). Certain predicates, thus, presuppose the explicit or implicit introduction of other predicates, e.g. the predicate `speaking' presupposes the predicate 'human' when assigned as properties to one individual. Tnese facts are well-known from recent research in linguistics, and need no further comment here. These principies underlie not only the introduction but also the progression of predicates. Just as `things' are related, so are their properties and the relations expressing events, actions and processes. That is, in general, certain predicates presuppose others or have others as their possible or necessary 'consequences'. Tnese fundamental relations will be dealt with in the next section.

Predicate identity is based on the same general philosophical principies as identity of individuals : identity is `relative identity', i.e. identity conventionally accepted for certain types of discourse. 'Water', `communism', `scientific', etc. are predicates representing intensional objects which may differ for different discourses, situations and language users. These facts are well-known and will not concern us further here. Let us consider some concrete examples in order to discover what logical principies, if any, characterize predicate identity in texts:

(34) John will go to Amsterdam this summer. So will John.
(35) Peter has forgotten his records. And so have I.
(36) Do you go to the movies tonight? No I will not go there.
(37) Jurij often plays chess. But he does not like it.
(38) Jurij often plays chess. But I do not like that.

Parts of the verb phrase are understood to be `present' in the meaning of the subsequent sentences but transformationally deleted in surface structure, where they are represented by *so, it, that, Mere,* etc. This deletion requires some principie of deep structure identity, for which we should provide the logical form.

The (complex) predicates repeated in (34) and (35) seem to be `go to Amsterdam this summer' and 'have forgotten (...) records', which seem to be ABSTRACTED from the preceding sentence, e.g. as follows *go (—, Amsterdam, this summer),* which as a complex predicate is assigned to John in a following sentence: *[go (— , Amsterdam, Mis summer] John.* Instead of the dash replacing the non-occupied argument place, we may use a variable and use the abstraction operator *lambda: [(2x)* (go *(x,* Amsterdam, this summer)] forming a predicate, with a meaning of 'the property of x such that ...*x*...'. The subsequent sentence takes, thus, the following form.

[(2x) (go (x, Amsterdam, this summer)] John.

In a similar way we may make predicates of any part of a sentence.

In the last two sentences a part of the sentence and a whole sentence is repeated as a direct object *it (that) in* the subsequent sentence. Now, to 'what' individual does *it* refer in this case? This cannot be the sentence or part of the sentence (as indirect quotation, etc,), but must be some EVENT or ACTION, which apparently may be quantified upon. In (38) we find both readings: *that* may represent the `activity of playing chess' (in general) or the 'event(s) of Jurij's playing chess'. Since the whole sentence expresses such an event we would need a manner to quantify over this event so that it may regularly be introduced and repeated, e.g. by EVENT SPLITTING as proposed by Reichenbach[25]: *(Ev)([Jurij plays chess] v, often),* where *often,* temporally qualifying the whole event may be considered as an argument of the event predicate. Another, more interesting possibility, is to consider the temporal adverbials as quantifiers or operators of the event. They strikingly parallel the pluralistic quantifiers: *no(body)-never, some(body)-sometimes, few-sometimes, many-often, all-always.* This approach is always possible of course when we use restricted quantification (over time points), e.g. (V *time, x) (ev) ([...]* v, x).* A similar notation may be followed to represent the topological aspect of the text.

According to the introduction quantifiers we have used earlier we may regularly introduce particular and non-particular events, both singular and plural. ev would stand for non-particular singular events, e.g. *Once John will come back,* and */v* for particular singular events: *One day John carne back. It was on November 13, 1945.*

Finally, we would not merely need quantification over times, places and events but also over properties or actions expressed by the predicate, that is over a part of the sentence, not over the whole sentence. In that case we might, with Davidson[26]. try something like *(ex) (win (girl, beauty contest, x)* A *Past (x)),* or *(Many time, x) (play (John, piano, x)),* but it is not obvious what relation there might be between girl, beauty contest and the event of winning, since winning is this relation itself. It must be the event itself that has the property such that a girl wins the beauty contest. The abstraction operator suggests itself here, e.g. as follows: *[(Ax) (girl (x) n beauty contest* (y_1) *n win (x, yi)] z,* but this would qualify a non-particular *z* having the same property as x. Heme we need a quantification of the predicate itself *(Jf) (ex) [(wins (x,* y_a*)) f n girl (x) n beauty contest (*y_a*) n Past (f)].*

[25] See Reichenbach (1947, p. 247)

[26] For treatment of quantification of events or actions, including a criticism of Reichenbach's analysis of events, see Davidson (1967). See in general von Wright (1963), Binkley *et* al. (1971), Hilpinen (1971), Rescher (ed.) (1967).

Following the rules we may now introduce the predícate constant by $f=F$, such that we would have ... *like (I, F)* in (38), where the particular activities of Jurij are disliked. In case playing chess in general is disliked we would need generalization over the previously introduced particular activities : (Vf)) *[(playing (x, y))f... A (Vg) [(g =f) n (playing (x, y)) g A —like (I, g),* where the identity statement as before generates the pronoun *it* or the anaphorical demonstrative *that.*

From this brief discussion of quantification and identity of predicates in texts it has become clear that altnough little is known in this area, the general principles are those already discovered for first order individuals. Quantification of predicates does not seem problematic: *one, two, many, journeys* does not seem more natural than *once, twice,..., often going to Paris.*

The very fact that in natural language we may use higher predicates viz. adverbs, to assign properties to such first order properties and relations is sufficient reason to quantify over them. The same is true for whole sentences, or rather for the intensional object PROPOSITION which may be verbalized as *the fact that* ... and be submitted quantification and identity. In the next section we will further analyze these textual relations between whole sentences/propositions.

4.9. *Propositions, Presuppositions, Consequences, Connectives*

4.9.1. A text logic would not be a logic if it would not specify relationships between propositions. In logic these relations are established with formation rules for complex propositions operating with dyadic connectives on the one hand, and with transformation rules defining derivability of proposition P_i from $<P_1, P_2,..., P_{i-1}>$ in a derivatíon (proof) on the other hand. P_i is in that case a LOGICAL CONSEQUENCE OF or ENTAILED BY $<P_1, P_2, P_{i-1}>$, its premisses, if it cannot possibly be false when its premisses are true. We will use the arrow (-->) to indicate this consequence relation : $P_{i-1} \rightarrow P_i$ having as meaning 'P_i is the logical consequence' of, (necessarily) follows from', or is `entailed by' P_{i-1}'. With this relation is usually defined the (logical) PRESUPPOSITION relation between propositions or sentences, which has intuitively the following meaning: 'P_i presupposes P_{i-1}, if the truth of is a necessary condition for P_i to have truth value (e.g. to be true/false, satisfied/non-satisfied, applicable/non-applicable, etc.)'. We use the double arrow between two propositions (or between two sets of propositions): P_i meaning 'P_i presupposes P_{i-1}'. The formal definition of presupposition is as follows:

(39) *Pi-.1); for (P, —> P) A (—.P)*

that is, a sentence is presupposed by another sentence just in case it is entailed by the another sentence and entailed by the negation of the other sentence. Thus the sentence *The girl who won the beauty contest is my sister* presupposes $\{^{Me}_{a}$ *girl won the beauty contest,* because it is a logical consequence of the first sentence and also of *The girl who won the beauty contest is not my sister.*

4.9.2. These notions, though not yet very current in standard logic, are well-known, especially in the philosophy of language and recent linguistics. They are interesting enough to attempt to construct a proper PRESUPPOSITION LOGIC[27], roughly determining the conditions under which a sentence has truth value.

Now, if we look at the example given aboye we see that a presupposition of a complex sentence with a definite description containing a restrictive relative clause is identical with the proposition underlying the relative clause. Earlier, we argued that this clause may be derived from a linear sequence of propositions in which the relative clause, hence the presupposed proposition, would precede the 'main clause', i.e. the presupposing proposition. If this assumption is correct a PRESUPPOSITION LOGIC IS EQUIVALENT WITH A PART OF TEXT LOGIC, since formally, the set of presuppositions of a proposition is a subset of its preceding propositions in a text. This does not mean that these must be realized in surface structure. P-receding propositions are also those which are consequences of preceding propositions. Other presuppositions of the sentence given as example would be: *there is a (one) girl, there is only one beauty contest, one girl won the beauty contest, it is possible that a girl wins a beauty contest, beauty contests have winners,* etc.... which are in part presuppositions of the presupposed propositions (the embedded relative clause). This seems to make (some) presupposition(s) TRANSITIVE:

$$((l'_i \quad {}^{1)};) \text{ A } (P_i \quad P_k))\ {}^{.--1}\ (P_i \quad P_k)$$

which follows from the transitivity of the consequence relation.

One of the disadvantages of tne traditional definition of presuppositions is that it presupposes TRUTH of sentences. In the first place, it would be more adequate, in that case, to speak of `truth in the world of knowledge of the speaker', i.e. of ASSUMED TRUTH: I may have had wrong information about

[27] A *presupposition logic* has been constructed by Keenan (1969, 1971, 1972a, 1972b). This system — though based on logical presupposition (and entailment) — features some devices and methods which we consider important also for text logic, of which presupposition logic in our view is a proper sub-system.

For presuppositions in general, see Strawson (1952) and—in linguistics — Gamer (1971), Lakoff (1970, 1971a, b). See van Dijk (1972, Ch. 2) for a text grammatical treatment.

the beauty contest, which makes the presupposition factually false, though it is `true' for the speaker.

Another problem is that there seems to be no mechanical desision procedure to define the set of presuppositions of a proposition: *John knows he is arrogant* presupposes *John is arrogant* but *John believes he is ill* does not presuppose *John is 111* or might even presuppose *John is not ill.* That is, some verbs have direct object propositions as their presuppositions others have not. In texts this problem is easier to solve since merely the propositions PRECEDING a proposition are presupposed. Others follow a proposition if they are in the scope of the verb/predicate of such a proposition *(say, believe, pretend, assume, etc.),* i.e. when they are interpretable only in a world constructed in a previous proposition.

In general we will say, then, that a sentence of a text is derivable only if its presuppositions have been previously derived, which makes presupposition a well-formedness condition for texts. Earlier, we saw that these conditions are both intensional and extensional : there must be introduced discourse referents, e.g. *girl* and *beauty contest* and an identity relation between *girl* and *girl* in the subsequent propositions underlying our example sentence. Furthermore, intensional conditions determine that *The boy who won the beauty contest is my sister* is anomalous — has `zero' truth value — since the (lexical) presupposition of *boy (x) is male (x),* where *sister (y)—> female (y),* which would make x= y a contradiction. Hence the further condition that the set of presuppositions of a sentence must be CONSISTENT.

4.9.3. Besides the two logical relations of logical consequence (entailment) and its specific variant, presupposition, it might be interesting to introduce some other important inter-sentential relations in texts, e.g. the 'converses' of these logical relations. The intuitive motivation for postulating a set of much weaker relations in a natural logic is the following. Relations such as logical consequence (entailment) are the principles underlying formal (deductive) derivability. This means that the conclusion derived from a set of premises is somehow 'contained' in its premises. In a natural text this may mean that a preceding sentence, e.g. as a presupposition, is, in a sense, 'contained' in some of its following sentences. Hence the divergente (if not converseness) of the notions follows from' and lextually follows'. This is obvious when we realize that it is a principie of textual derivations that any following sentence adds new `semantic information' to the text. As we saw aboye this may regularly be done by the introduction of new discourse referents or discourse predicates. We now may want to characterize formally such sentences with respect to the preceding sentences, in order to make explicit such intuive notions as 'progression', 'expansion', or the like.

Take for example logical consequence or entailment. Thus a sentence *Yesterday it rained the whole day* entails *It was raining yesterday afternoon.* Similarly, *We gave a party last night* entails *We had guests last night,* also by lexical definition. In both cases it is not possible that the antecent is true and the consequent false (when uttered the same day, by the same speaker, etc.). In a text the entailing sentence may follow, e.g. as an `explanation' of a previous sentence: *We had guests last night, because we had a party,* or to provide more specific information: *John will arrive tomorrow. He will arrive at 5 p.m. (tomorrow). We may* say that these following sentences are **COMPATIBLE WITH** their preceding sentences, that is, they are not necessarily false when their preceding sentences are true. Not all sentences compatible with preceding sentences entail these, of course: *John carne at 5 o'clock is* compatible with but does not entail *Peter carne at 5 o'clock,* according to the definition, but incompatible with *John was sleeping at 5 o'clock.* Similarly, there are other possible following sentences entailing the same preceding sentence(s).

Now, we will use the term **POSSIBLE CONSEQUENCE** to denote the members of the set entailing a given sentence. We therefore provisionally define this relation as a converse of logical consequence:

(40) p-+ q for q—>p,

where `-y' means 'has as a possible consequence'. Truth in this case is disjunctive : we may have guests either because we have a party and/or because we have dinner, and/or Whereas logical consequences are deductive, possible consequences have an inductive character.

We here touch the general **LOGIC OF CONDITIONS** (cf. von Wright, 1971). Thus, the truth of *We will have a party is a* **SUFFICIENT CONDITION** for the truth of *We will have guests,* whereas, conversely, the latter sentence is a **NECESSARY CONDITION** for the first sentence. These relations are defined by von Wright (1971) with an additional **CONTINGENCY CLAUSE:**

(41) $Sc_{(p,}\ q)=d_{d}N(p \dashrightarrow q)\ \&\ Mp\ \&\ M\,q,$
$Nc(p, q).\ N(q — p)\ \&\ Mq\ \&\ M\,p,$

where *N* stands for logical necessity' and *M* for logical possibility'.

4.9.4. With the relation of possible consequence we may define the corresponding relation of **POSSIBLE PRESUPPOSITION.** Thus *We will have party is* a possible presupposition of *We will have many guests,* because it is a possible consequence of this sentence and of its negation. Hence the following definition:

(42) $q\ b.p$ for $(p\ q)$ p ---) $q)$

where stands for 'is a possible presupposition of'.

From the definítions we see that the converses of both the logical and the possible presuppositions are possible consequences. In other terms we may say that the possible consequences of p are the **ADMISSIBLE EXPANSIONS** of p, when p is given (has been derived) in a text.

4.9.5. In natural texts sentences may follow each other under still weaker conditions as those mentioned in the previous paragraphs. Take for example the perfectly coherent pair *John was walking in town. He met an old friend,* where no direct relation of entailment obtains and hence possible consequence seems undefined. Still, intuitívely we know that the first sentence is a possible condition for the truth of the second sentence, but this condition is not sufficient (or necessary). Another condition would be the presence of the old friend in the same town, and the presence of both at the same place in that town. Similar remarks hold for a paír like *We had a party last night. Peter got drunk.* The only feasible way to describe such coherence relations is to account for **INDIRECT POSSIBLE CONSEQUENCES**, defined with a transitivity relation; DEF : q is 'indirect possible consequence' of p iff q *is* a possible consequence of r and r is a possible consequence of p. In many cases, in addition, entailments must be inserted, where the possible consequences hold for the logical consequences of a given sentence. Thus, in the first example given aboye *He met an old friend* has as a possible consequence (admissible expansion) *He met an old friend in town,* which in turn entails *He (John) is in town,* which has *John was walking in town as* a possible consequence. A similar derivation would hold for the second example.

Notice that we get **INDIRECT POSSIBLE PRESUPPOSITIONS** as soon as a sentence ís an indirect possible consequence ofp and of *—p.* This is actually the case in the first example given, since the first *sentence* is also a possible indirect consequence of *He did not meet an old friend. It* is this very weak sort of presupposition which normally defines the 'possible conditions' or `sítuations' which make textual progression coherent.

An other interesting fact is that indirect possible consequences may be symmetric. John's meeting an old friend may also be a possible consequence of his walking in town (and not, say, of his sleeping at the same time). We are close, then, to the current (non-logical) notion of 'consequence' when notions of time and cause are involved (see below).

4.9.6. In fact the relation 'possible consequence' is the weakest of the contingent relations between propositions in natural texts. In the same inductive perspective we may of course introduce such important relations as PROBABLE CONSEQUENCE (CONTINGENTLY) NECESSARY CONSEQUENCE and, hence, PROBABLE PRESUPPOSITION *and* NECESSARY PRESUPPOSITION. In that case our definitions would contain additional contingency operators of probable and (contingently) necessary modalities. Thus the sentence *John has shot himself a bullet through the head* is an (indirect) possible consequence of its probable consequence *He was immediately dead,* whereas *Harry dropped his book is* a sufficient condition for its C-necessary consequence *The book fell down.*

4.9.7. The SEMANTICS of these relations seems rather straightforward. If p has q as its possíble consequence, then ín at least one world (situation) truth of p contingently entails truth of q, or, ín other tercos ifp is true then q is not necessarily false, from the perspective of a certain world or index w_j. Similarly, we may interpret probable consequence as truth of q *in* most worlds (situations) where p is true (satisfied), and necessary consequence as truth of q in all worlds (situations) where p is true, again with respect to a given world e.g. in the contingent actual world with its specific psychological, biological and physical laws (of possibility, probability and necessity). Thus, in the last example of 4.9.5. the sentence *The book fell down* would be false if *Harry dropped Me book* is interpreted in a different world, e.g. in the real world of outer space, or in a dream world.

4.9.8. After this very provisional discussion of some of the relevant relations between propositions (as a whole) in a text, some remarks are in order. A crucial problem, firstly, is that the set of possible consequences of a given sentence may well be infinite, which would make the logic infinitary. The only way to specify such a set would be a recursive definition based on the lexicon and the semantic tales of grammatical derivations, otherwise we would be obliged to specify a Set of all inductive relations characterizing our knowledge of the world. This problem, of course, is not specific to a text logic but a major problem of linguistic semantics in general. The logic itself may only provide a set of relations (constants) and the conditions for their interpretation in some model. We *thus,* secondly, must realize that in a natural text logic the intersentential relations as characterized aboye depend on the `meaning' of the sentences. In all our examples formal derivability hinges on different types of semantic entailment as specified in meaning postulates or lexical definitions. Thus we may infer the presence of (and hence the introduction of the discourse referent) `guest' only if the definition of `party' includes it; the same is true for the inductive inferences characterizing contingent consequences. This does not mean, however, that a text logic would not contain a serious syntax, otherwise it would not be a logic at all. We may of course set up a calculus where relevant theorems may independently be proved. Thus necessary consequences entail probable consequences which entail possible consequences. Further the main principles of modal calculi would hold in this system.

The main problem is whether the different modifications and extensions of the system affect these main principles of 'sound inference'. It is still not very clear, within (non-standard) logics, how 'weak' or how `strong' relations as entailment should be in the calculus. Thus, it might well be that IN GENERAL such systems as Anderson and Belnap's (1962) pure calculus of entailment (system E), in which the well-known paradoxes of strict implication are not derivabie, would turn out to provide a more appropriate basis for a text logic of natural language, but that the principles leading to these paradoxes are admitted in logics used to account for argumentation and proof in more RESTRICTED (particular) sets of texts, e.g. in mathematics and in philosophical logic. The same may hold for systems in which the axiom of necessity (❑ *p* n *p)* would not hold, or in systems (e.g. of Prior) in which *Op* and Op are not interdefinable. In any case the relevance of such systems, e.g. in belief or action contexts must receive detailed attention before a serious text logic can be build up. In the previous paragraphs we merely wanted to suggest that textual coherence is based on a number of relations between propositions which seem to defy even the weakest principles of such non-standard systems.

4.9.9. Finally, we may consider the problem whether the important CAUSAL relations are either identical with previously defined relations among propositions or definable in terms of them. These cause-relations are crucial in many coherent texts, e.g. in *John is a(So) he will not come tonight.* Without being able to resume here the vast philosophical work in the domain of 'cause' [28], we will provisionally say that a *causes b just in case a is a* SUFFICIENT CONDITION for *b;* in symbols : *a÷›b.*

Notice furthermore, that not sentences cause each other but events, actions, state of affairs, etc. CAUSE RELATIONS, may be said to hold between propositions, i.e. between intensional objects representable by such expressions as *the fact that ...*

[28] For 'cause', and in general for relations between actions and events, see the references in Note 26. For a inodal treatment, see Follesdal (1971); see the philosophical work of Chisholm (e.g.1969). Further theearly treatment of Burks (1951) and the survey of Rescher (1968, Ch. 4).

Interpreting cause as a type of possible/probable/necessary presupposition we are in line with the conditional treatment as proposed by Rescher and by von Wright (1971). Given the conditions for semantic connectedness our symbolism presupposes that when *q* is an effect of *p,* we imply that *q* when *p* (e.g. written as *plq). We* will not further elaborate here the textual aspects of conditional consequence and cause.

In the example given aboye *John is ill is* a possible presupposition of his not coming, since he may not have come for other reasons, this possible presupposition is also a possible cause. The second sentence is a possible consequence of the first, since John's illness may have had other possible consequences. The set of (possible) causes, then, is a subset of the set of possible presuppositions, which also includes e.g. *We will have a party (tonight),* which is not a cause of John's absence. Similarly, the set of effects is a subset of the set of possible consequences, although very often effects are probable or necessary consequences. My death is a probable consequence of the shooting of a bullet through my head, and if my brain functions cease this necessarily causes my death, i.e. my death is a necessary consequence.

Only causes which are unique with respect to a consequence may be said to be `necessary', in the sense of physical or psychologicai inference.

Another basic property of cause is **CHANGE**, i.e. a relation relating two **DIFFERENT STATES.** A proposition p causes a proposition q if causation entails a difference in state description. The constraint here is chronological, a change of states entails a change of time, such that $t_1(s_1) < t_2(s_2)$. This aspect must be present in the tenses, or rather time-repreSentations, of the related propositions. A (direct) cause is **IMMEDIATELY PRESUPPOSED** by a consequence-effect e_i if there is no effect e_2 preceding e_i and following the cause.

This brief discussion of causation is, of course, insufficient, and it is difficult to propose some non-trivial but simple definition of the concept, and it would be wise to admit the cause relation as a primitive in the system.

4.9.10. The relations between propositions discussed in the preceding paragraphs require some remarks on the **CONNECTIVES** of text logic. Earlier we argued that the usual truth functional constants of standard logic are in many ways different from the connectives between sentences or clauses in natural language.

In general, natural connectives relate propositions which are each others possible presuppostion and possible consequence, that is which are `meaning dependent' from each other. Furthermore, the general formal principies of such relations, viz. commutativity, associativity and distributivity are not always valid, although they may hold in argumentation, in which a certain degree of meaning is reduced.

We will introduce the following basic natural connectives:

(1) conjunction: p A q; satisfied only if both p and q are satisfied.

(2) disjunction: p y q; satisfied if p is satisfied,
satisfied if q is satisfied;
non-satisfied if both p and q are satisfied,
non-satisfied if both p and q are non-satisfied.

(3) ***condition: p q;*** satisfied if both ***p*** and ***q are*** satisfied,
non-satisfied if ***p*** is satisfied and ***q*** is non-satisfied,
zero (non-applicable) if ***p*** is non-satisfied.

(4) ***cause!' consequence' (effect)***
p q; satisfied if both ***p ad q*** are satisfied,
non-satisfied if ***p*** is satisfied and ***q*** non-satisfied,
non-satisfied if ***p*** is non-satisfied and ***q*** is satisfied,
zero if ***p*** is non-satisfied and ***q*** is non-satisfied.

Although there is considerable work left to be done in this domain, we will provisionally assume that all other natural connectives are definable in terms of the given primitives and negation. The provisional truth tables given here are merely intuitively based, and there are much more aspects involved, especially in `condition', which are not merely truth functional but also intensional.

— Consequence effect is definable as a converse of cause.

— Concession is definable in terms of negation and cause: ***Although my sister is very pretty, she did not win the beauty contest,*** where is a probable causation, ***p*** is satisfied but not ***q.***

— Contrast, partly as for concession, partly negation of preceding predicates.

— Purpose is definable in terms of causation, but with the same problems of `intention', `want', etc.

We will not try to make these brief characterizations explicit. Let us notice merely that the conjunctions in natural language do not always cover these basic and/or derived connectives: ***then,*** not always expresses condition, ***or*** not always exclusive disjunction, etc. Actual use is very confusing in this domain, which seems to indicate that the rules involved are highly complex.

4.10. *A Provisional List of Derivational Principies of Text Logic*

4.10.1. Let us briefly list the main principies of inference in a text logic. These rules will be given in an informal and tentative way and the list is not intended to be complete, but has an heuristic function for the derivation provided in the next section.

4.10.2. A first set of rules contains (at least some of) those holding in standard logical systems, with the **GENERAL CONDITION OF SEMANTIC CONNECTION** between the formulas, laid down in the following prnciples:

(1) INTRODUCTION (INT). For any individual to become a **DISCOURSE REFERENT it** must be introduced with one of the introduction operators of choice for (particular or non-particular) singulars or plurals.

For any predicate to become a **DISCOURSE PREDICATE it** must be assigned to an n-tuple of discourse referents (n >1).

(2) IDENTITY (I). Formulas are connected extensionally if their variables/constants/names refer to the same (singular or plural) discourse referent. Formulas are connected intensionally when their predicates denote identical properties or relations.

Relations of identity may be called **STRONG** SEMANTIC **RELATIONS.**

(3) RELATION (R). Identity is one (strong) type of set of **(WEAKER) RELATIONS** between formulas. Again, these are extensional or intensional.

Formulas are in general related (semantically) if their individual variables refer to discourse referents or classes of discourse referents d_i and $d_{i'}$ and if $d_i e d_{i'}$, $d_{i'} e d_i$, $d_i c d_{i'}$, $d c d_i$, $d_i n d_{i'}$ (where the element relation is intended also to cover part-whole relationships of any type).

Formulas are related if their predicate variables/names refer to properties or relations of/between discourse referents and if the classes they name include each other or intersect, that is, if these formulas either entail each other, logically presuppose each other or are related by possible (probable, necessary) relations of (contingent) presupposition and consequence (including cause/effect, etc.).

Any individual or predicate variable/constant referring to an individual or property (relation) related to a discourse referent or discourse predicate is counted as **INTRODUCED** by this relation. Individuals or properties thus introduced define **RESTRICTED INTRODUCTION,** whereas the introduction defined in (1) is **FREE.** Predicates introduced in possible (probable, necessary) consequences are called **POSSIBLE** (probable, necessary) **PREDICATES.**

(4) MODALITY. The principles as specified in (1)--(3) hold under the regular modal constraints : relations (including identity) may hold only within subsets of possible worlds (e.g. in the various states of an actual world w_o) whereas other (sets of) worlds must relate individuals througb the counterpart or copying principie. This principle may introduce individuals or properties in a given world. A crucial condition for modal consistency is **TENSE RELATEDNESS** (and for that matter **PLACE RELATEDNESS)** submitted to the mentioned introduction principle and to a principle of progression for event predicates.

4.10.3. Inder these general conditions of relatedness between wff's or propositions the following general rules hold both for logical and lexical (and contingent) connectives:

(1) MODUS PONENS (MP):

$$p \bullet q,\ pi\text{-}\ q,$$

(where • is: conditional, presupposition and consequence).

(2) UNIVERSAL INSTANTIATION (UI):

(d x) (g (x)) g (a).

(3) EXISTENTIAL, PARTICULAR, NON-PARTICULAR GENERALIZATION (EG):

g (a) *1- (ex) (g(x)) y* (3 *x) (9 (x)),*
g (n) I- (I x) (g(x))

(4) PARTICULAR INSTANTIATION (NAMING) (PI):

(I x) (g (41- g (n)

(5) EXISTENTIAL (NON-PARTICULAR) SPECIFICATION:

(3x) (g x)F- g (n),
(ex) (g x)l- g (n)

4.10.4. As a metatheoretical principie of the system we assume a LAW OF DIFFERENCE saying that no derived theorem (sentence) may be identical with the immediately preceding theorem. S_i S_{i-1}.

4.11. *Example of Natural Derivation*

4.11.1. Let us finally illustrate the foregoing remarks by describing a text, or rather the semantic representation of its sequence of sentences, by the we have so far discussed. That is, we will try to indicate for each sentence the rules which make it derivable in the text.

As an example we take a short fragment of English prose, viz. the opening lines of a well-known crime novel: James Stuart Chase's *No Orchids for Miss Blandish* (new ed. 1961).

Since the text itself is a surface manifestation of its abstract underlying structures, from which it is derived by grammatical transformations — which we will not themselves treat here — , we rewrite the fragment as an ordered set of 'basic propositions' which are more closer to the semantic propositions we want to generate.

(Let us concede, furthermore, that the fragment in question rather examplarily follows the 'normal' rules. In many other pieces of prose many specific transformations and/or literary rules apply which make the surface structure deviate from the more regular structures.) We will limit the detailed derivation to the first few propositions, and even here not all aspects of derivation can possibly be considered.

4.11.2. TEXT: *No Orchids for Miss Blandish,* Ch. 1 (ed. 1961, p. 7).

S_1: It began on a summer afternoon in July.s2

S2: [(This) July {was/is} a month of intense heat, rainless skies, and scorching, dust laden winds.
S3: At the junction of the Ford Scott and Nevada roads [54] there stands a gas station and lunchroom bar.
S4: The Nevada road cuts Highway 54. [55]
S5: [Highway 54] is the trunk road from Pittsburg to Kansas City.
S6: [The gas station and lunchroom bar are] a shabby wooden structure with one gas pump.
S7: [The gas station and lunchroom bar is] run by an elderly widower and his fat blonde daughter.
S8: A dusty Packard pulled up by the lunchroom a few minutes after one o'clock.
S9: There were two men in the car.
S_{10}: One of them was asleep.
S_{11}: The driver [56] got out of the car.
S12: [The driver was called/named] Bailey.
S13: [The driver was] a short thickset man.
S14: [The driver had] a fleshy brutal face and restless, uneasy black eyes and a thin white scar along the side of his jaw.
S15: [The driver] His shirt was frayed at the cuffs.
S16 [The driver] He felt bad.
S17: He had been drinking heavily last night.
S18: [And] The heat worried him.
S19: He paused to look at his sleeping companion.
S20: [His sleeping companion {was}] called Old Sam.
S21: [The driver] shrugged.
S22: [The driver] went to the lunchroom.
S23: [The driver] left Old Sam.
S24: [Old Sam] snored in the car.
S25: The blonde was leaning over the counter.
S26: [The blonde] smiled at him.
S27: [The blonde] She had big white teeth.
S28: [The teeth] reminded Bailey of piano keys.
S29: She was too fat to interest him.
S30: He didn't return her smile.

4.11.3. *Derivation*

S_1 *It began on a summer afternoon in July.*

Logical Form (LF):

(Ey) [begin (n₁, y) A *summer afternoon in July (y)* ^ *PAST* (y)1

Derivation :

(i)	*(ex) (event (x))*	INT (in S_o; e.g. : t_o *I tell you about ...) INT (WORLD: Fiction).*
(ii)	(Vx) *(ey) (event(x) begin(x, y)* A *TEMP(y))*	LMP (lexical meaning postulate)
(iii)	*(event (n1))*	PI
(iv)	(ey) *(begin* (n_1, y) A *TEMP (y))*	MP((ii), (iii))
(v)	*TEMP* (y)	(iv)
(vi)	*PAST* (y)	INT (TENSE: $t_1 < t_0$)
(vii)	*(3y) (TEMP (y) '-+ summer afternoon in July (y))*	POSS CONS
(ix)	(ey) *(summer afternoon in July (y))*	MP ((v), (vii)) Int.
(x)	LF(iii), (iv), (vi), (ix)	

S2 *[July* $\{^{is}_{was}$ *] a month of intense heat, rainless skies, and scorching, dust laden winds.*

LF:

[(2x) [HA VE (x, y) A *(intense (heat)) A HAVE (x, u) sky(u)*
[(2.k) WITH (k, 1) A *rain(1)»u* A *HAVE (x, y)* A *[(2p) (scorch (p, q) ANIMATE (q) A laden with(p, r)* A *dust (r)11)] month(a).*

Derivation :

(i)	*(Vy) (summer afternoon in July(y)--> in July* (y))	ENTAILMENT, R
(ii)	(e.Y) *(JulY (Y))*	MP ((i), S1)
(iii)	*(Vy) (July (y) —> month* (y))	LMP
(iv)	*(ey) (month* (y))	MP((ii), (iii))
(v)	month (a)	PARTICULARIZATION I (with *month* entailed by SI)
(vi)	*(ez) (summer (z))*	S1, R(SI)
(vii)	*(Mz)(summer(z)--> (hot (z))*	PROB CONS; M : for most
(viii)	(3*f*) *(hot (f) intense (f))*	POSS CONS
(ix)	*(Mz) (— 3* v) *(summer (z) --+ HAVE (z, y)* A *rain(y)))*	PROB CONS

(x)	*(Mz) (3u) (summer (z)-9* *-9 HAVE (z,* u) A *wind (u)))*	POSS CONS
(xi)	*(3u) (wind (u) hot (u))*	POSS CONS ((vii), (x))
(xii)	*(3u) (wind (u) n hot (u) -* scorch(u, p)* *ANIMATE (p))*	PROB CONS
(xiii)	*(3u) (wind (u) n hot (u) -* laden* *with (u, q)* A *dust (q))*	PROB CONS
(xiv)	*(9) (9(summer $_q$ (month July))*	ENTAILMENT
(xv)	*[(1x) (9x)lmonth* (a)	ABSTRACTION (v)
(xvi)	LF	(xv), (vii)-(xiii)

Main rules in the derivation of S3 - S30 (formulas abbreviated).

S_3	(i)	INT (PLACE of event)	(Vx) *(sy)(event(x)-9 HAPPEN* *(x, PLACE(y)))*
	(ii)	POSS CONS I (indiv.)	*(ey) (PLACE(y) (junction* *(u, y) (y)* A *road(u)* A *road(v))*
	(iii)	POSS CONS I (indiv.) NAME: n_1	*PLACE -' BUILDING* *road -9 gas station & lunchroom* *bar*
	(iv)	PROPER NAMING	*Ford Scott (road)* *Nevada (road)*
S_4	(i)	POSS CONS	*(ex) (3y) (road(x)* A *road (y)* *-9 cut (x, y)*
	(ii)	I (indiv. & pred. (name))	*Nevada road*
S_5	(i)	POSS CONS	*(ex) (road (x) trunk road(x))*
	(ii)	PLACE (Direction) INT	*FROM...TO (x, y)*
	(iii)	PROPER NAMING	*Pittsburg (x), Kansas City (y)*
S_6	(i)	I (PLACE)	*nl*
	(ii)	POSS CONS	*(ey) (gas station & lunchroom* *bar(y)-+* *(shabby...) (y))*
	(iii)	LMP	*(ey) (gas station(y)--+ HAVE* *(y, gas pump* (z))
S_7	(i)	I (PLACE)	*nl*
	(ii)	NEC CONS	*(ex) (run(x, n_1)*
	(iii)	PRESUPPOSITION	*HUM (x)*
	(iv)	I (indiv.) NAME: $x=n_2$ $y=n_3$	*(ex) (elderly widower(x)* A *(ey) (fat blonde girl) (y)* A *daughter (y, x))*

S_8	(i)	PROB CONS	S_3-S_6: *(Vx) (3y) (road(x) ON (x, y) -+ car (y))*
	(ii)	MP INT (indiv.) NAME: n_4	*(ex) (car (x))*
	(iii)	PROPER NAMING	*Packard(n_4)*
	(iv)	PROB CONS	*dusty (n_a) (dust* (S2))
	(v)	I (PLACE)	n_ι
	(vi)	POSS PRED	*pul! up (n4)*
	(vii)	INT (TIME)	*a few minutes past one o'clock (t_i)* POSS CONS *(afternoons* Si)
S_9	(i)		n_4
	(ii)	POSS CONS	*(Vx) (car (x)* A *(3y) (HUM (y)-+ IN (y, x))*
	(iii)	INT (indiv. PERSON) NAME *y =n_5*	*(ey)* (two men *(y))*
S_{10}	(i)	R (element) INT NAME: *x=n_6*	*one of n_5 : (Ix) (xen $_5$)*
	(ii)	POSS CONS	(Vx) (man (x) asleep (x))
S_{11}	(i)	LMP	(Vx) *(ey)(car(x)-> HAVE (x, driver (y))*
	(ii)	MP, I (indiv. PERSON) NAME *y =n_7*	*(Ey)* (driver *(y))*
	(iii)	I (PLACE)	n_4
	(iv)	POSS PRED	*get out of (n_7, n_4)*
S_{12}		PROPER NAMING	*Bailey (n_7)*
S_{13}	(i)	POSS CONS (pred. INT)	*short thickset man (n_7)*
	(ii)	NEC CONS	*(Vx)(HUM(x)--> HAVE(x,(face (y)* A *eyes (z) n jaw (u))*
	(iii)	POSS CONS (I (pred.))	*jleshy brutal(y) restless uneasy(z) thin white scar along the side of (u)*
S_{15}	(i)	PROB CONS	*(W x) (e y)* (man *(x)*-+ HAVE (x, shirt (Y))
	(ii)	POSS CONS	(3y) (shirt(y)^.frayed at the cuffs *(y))*
S_{16}	(i)	I (PERSON)	n_7
	(ii)	POSS PRED	*feel bad (n_7)*
S_{17}	(i)	I (PERSON)	n_7
	(ii)	INT (WORLD)	(MEMORY: *heavily (drink(n;)* EVENT) POSS CONS *last night (ti)*

			INT (TIME) (PLUPERFECT) $< t_i$
S_{18}	(i)	ENTAILMENT NAME $x = n_8$	(S_1-S_2) *heat (x)*
	(ii)	PROB CONS (CAUSE)	n_8 **cause** *worry* (n_7) PATIENT (n_7): *him*
S_{19}	(i)	I (PERSON)	n_7
	(ii)	POSS CONS	*pause* (n_7) PRESUPPOSITION: *MOVE* (n_7) (S)
	(iii)	POSS PRED	*look* (n_7, n_6)
	(iv)	NEC CONS	*companion of* (n_6, n_7) (S_9)
	(v)	I (pred).	*sleep* (n_6)
S_{20}		PROPER NAMING	*Old Sam* (n_6)
S_{21}		POSS CONS	*shrug* (n_7)
S_{22}		POSS CONS, I (PLACE)	*go to* (n_7, n_1) n_1: *lunchroom*
S_{23}	(i)	I (indiv. pred.)	n_7: *the driver*
	(ii)	POSS CONS	*leave in* (n_7, n_6, *P14*)
	(iii)	I (PLACE)	n_4: *car*
S_{24}	(i)	I (PERSON)	*n6: Old Sam*
	(ii)	I (PLACE)	n_4: *the car*
	(iii)	POSS CONS	*sleep* (n_6) -> *snore (n6)*
S_{25}	(i)	I (Indi v., pred.) (PERSON)	n_3: *the blonde(girl)*
	(ii)	POSS CONS	*leaning over* (n_3, *counter(x)*)
	(iii)	NEC CONS	*(Vx)* (lunchroom (x) --> HAVE (*x*, counter(x))
S_{26}	(i)	I (PERSON)	n_3: *she*
	(ii)	POSS CONS	*smile at* (n_3, n_7)
	(iii)	I (PERSON)	*n7: him*
S_{27}	(i)	I (PERSON)	n_3: *she*
	(ii)	NEC CONS, INT ($y = n_9$)	*(W x)* *HAVE (x, (teeth (y))*
	(iii)	PROB CONS	*(V y)* (teeth *(y)* --> white (y))
	(iv)	POSS PRED	(3y) (teeth (y) **big(y))**
S_{28}	(i)	I (OBJECT)	n_9: *teeth*
	(ii)	POSS CONS	*remind* (n_9, n_7, *white piano keys(x))*
	(iii)	I (pred.)	*white* *[(Ay) (piano keys (y))] (teeth)*
S_{29}	(i)	I (PERSON)	n_3: *she*
	(ii)	I (Pred.)	*fat (S7)*
	(iii)	I (PERSON)	n_7: him

	(iv)	PROB CONS	*Fati — Have interest in* (n_7, n_3)
S30	(i)	I (PERSON)	n_7 *: he*
	(ii)	I (Pred.)	*smile* (S_{26})
	(iii)	POSS CONS	*return to* $(n_7, \textit{smile}, n_3)$

4.11.4. *Comments*

4.11.4.1. Some comment is in order after this **QUASI-LOGICAL DERIVATION OF A SEQUENCE.** In the first place it is very important to recognize that the transformations are necessary but not sufficient constraints to make of a coherent **SEQUENCE** a coherent **TEXT.** Tnat is, we may derive a sequence with all the particular coherence relations without deriving structures which would be `functional' in a more global structure. In the case of our text it seems difficult to **PROVE** that the fragment is a coherent part of a (crime) story. Some macro-constraints would in that case apply to the derivation as a whole. Satisfied would be the constraints of Time- and Place-introduction, Event-introduction and the introduction of 'actants' (dramatis personae) and their specific qualities, e.g. `meanness' of the gangsters introduced here. In the non-analyzed following pages of this novel, for example, the **PLAN** for part of the subsequent events is manifested, viz. 'The robbery of the rich Blandish girl necklace'. It is not possible here to make explicit these (interesting) relations, between micro-structure and macro-structure.

4.11.4.2. The most frequent rules used in this fragment have been IDENTITY, POSSIBLE PREDICATE CONSEQUENCE}' INDIVIDUAL INTRODUCTION, ENTAILMENT, MODUS PONENS, (PROPER) NAMING and PARTICULARIZATION.

Formally these rules seem rather satisfactory, although they are not yet fully explicit, as valid **PRINCIPLES OF NATURAL INFERENCE.** Problematic in this respect is the crucial notion of 'possible consequence' — and the 'possible individuals' or 'predicates' it introduces — sine it seems to be based on our knowledge of the world, and hence non-formalizable. Take the lemma (iv)—(xiv) in the complex derivation of **S2:** is the fact that "if `something' is summer then `something' is hot" a fact of the semantic structure of the language for which this statement would be valid, or merely a representation of an empirical fact? Much depends on our conception of the **LEXICON**, without which, apparently, no derivation can be serious. The entailments, definitions (lexical meaning postulates) must be there defined, as well as the set (if any) of basic predicates of the language and their relations with the meanings of complex lexemes. One of the ways to see possible consequences of a proposition is to say that a possible consequence is a member of the set of propositions which is **CONSISTENT** with a given sentence S_i, its (i-1)-tuple of precedíng sentences and theír consequences. Consístency in this situatíon is not independent of **TIME/PLACE** in the text. What has been presented as a true/satisfied statement may not, without specified transition marker for performatives, truths, modalities, etc. be contradictory with a preceding sentence. In our example we have only briefly accounted for **TENSES** in the text which is regularly the **PAST TENSE** (in general in narrative texts, see S_0), and the pluperfect in case events in question are represented ***(he had been drinking heavily last night).*** Notice, finally, that merely some basic aspects of the **LOGICAL FORM** have been derived. The further mapping of such structures onto syntactícal and phonological structures is a next, rather obscure, chapter of text grammar. We hope to have shown that logico-semantic structures in a (textual) sequence may be accounted for by a natural logic, called **TEXT** LOGIC, having strong resemblances with a (mathematical or deductive) logic, with the important difference that some of its rules are inductive and based on lexico-semantic structures of natural language. At the moment we do not see a way fully different from the one attempted aboye for a logic of natural language.

5. SUMMARY

(1) It is assumed that the base of text grammars contains, or consists of, a type of 'natural logic', called ***text logic.*** This logic must specify the semantic representation or logical form of sentences and ordered n-tuples (sequences) of sentences, and the rules of natural derivation holding between sentences in a well-formed, coherent text. These rules are taken as the local transderivational constraínts of T-grammaticalness. Global transderivational constraints are not discussed here.

(2) In a general discussion about the relationships between formal and natural languages and their logics a list of characteristic differences is given, which at the same time is a program for an empirically adequate natural logic, which, though based on an extended modal predícate calculus of higher order, must satisfy a number of formal and empirical requirements much too complex to be followed in the near future.

(3) A non-trivial analogy is established between (systems of) proofs and texts in natural language. Notions such as `derivability', 'premisses', consequence', etc. may be generalízed such as to hold for all types of text. In particular, sentences of a text are to be viewed as theorems derivable by a set of natural derivation rules from an ordered set of axioms, definitions (meaning postulates), derived wff 's and previous theorems/sentences.

(4) In order to be able to operate these rules require appropriate propositional structures, e.g. of description, naming and quantification, representing

singular individuals and identity relations. Quantifiers ranging over particular and non-particular (arbitrary) singulars are íntroduced and defined in order to complete the fundamental *system of discourse referent introduction.* Referential (extensional) identity is characterized with a naming procedure, introducing constants in the derivation. These are supposed to underly the pronouns of the text. Definite descriptions and the restrictive relative clauses they may contain are derived from a linearly ordered sequence of propositions for which the mentioned rules of introduction and identity are valid. Besides these rules for extensional identity for individuals and similar rules for partial identity, membership, inclusion and part-whole relations, rules for intensional coherence between predicates, modalities and propositions are specified. Characteristic of a text logic, thus, are not only logical relations of presupposition and logical consequence but also more inductive relations such as possible, probable and contingently necessary presupposition and consequence, for which some provisional tables of satisfaction are given.

The semantics of the text logic must be adapted to be able to interpret the required specific properties of its syntax: restricted quantification, singular and plural quantification, different dyadic constants and modalities, quantification of properties and relations, etc.

(5) Finally, the initial fragment of a natural text (a crime story) is derived in some detail to illustrate the principies and the rules provisionally given earlier.

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