

## A NOTE ON LINGUISTIC MACRO-STRUCTURES

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### 1. *Preliminary remarks*

1.1. Current linguistics Shows a growing interest for the gramatical description of texts or discourse. Text grammars of various types are being elaborated and it is expected that such grammars may be more adequate than extant generative sentence grammars, not only for the explicit description of discourse but also for the description of sentence structure. The main topics treated in this research are pronominalization, definitivization, definite description, referential Identity, relativization, topic/comment, presupposition/entailment, tense, sentential adverbs, etc.<sup>1</sup>

1.2. In this note I briefly want to argue that this interesting development in the theory of generative grammars is not essentially different from work done in sentence grammars with linear recursion. That is, text grammars specifying n-tuples of sentences, i.e. 'sequences', are equivalent with sentence grammars with initial rule schemata, provided that both contain a set of rules or constraints for inter-sentential relations and for the intrasentential structures which are function of tense relations. More specifically I claim that T-grammars are inadequate as long as they lack a component for the description of the global, over-all structures of a text, the so-called *macro-structure(s)*.

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x The present note is a shortened version of the paper "The Grammar of Macro-structures", read at the VII. Linguistisches Kolloquium, which was too long for publication in the proceedings of the colloquium. The original paper will be published elsewhere. Research reported here, in particular the psycholinguistic and psychological work, is in its initial stage, and should be considered as provisional heuristics for a sound theory of linguistic macro-structures. The discussion given here has a general and informal character.

1 It is not possible to cite all relevant references here. For an introduction and survey cf. Dressler (1972). Cf. also Ihwe (1972). The general framework for my discussion is van Dijk (1972a) in which further references are given, not only on text grammar but also on its informal roots and present applications in literary theory and the theory of narrative structures. Cf. also Petófi (1972).

1.3. Besides a discussion of the linguistic, and in particular the grammatical, relevance of macro-structures, I will give a brief survey of the psychological implications of the concept, in the light of recent work on cognition.

## 2. *Macro-structures and text grammars*

2.1. Text grammars are required to formulate the necessary and sufficient 'transderivational constraints' (Lakoff) holding in well-formed texts of natural language. They put conditions on underlying semantic representations, on lexical insertions, on syntactic structure and on phonological structures and determine the set of transformations of each sentence  $S_i$  in a linearly ordered sequence  $\langle S_1, \dots, S_n \rangle$ . I will assume that these conditions may be adequately given in some formal language, e.g. an extended modal predicate calculus, specifying the logical forms of the sentences of the sequence. Such a formal (semantic) system may be called a *text logic* and serves as a base component for a text grammar.<sup>2</sup>

This system, consisting of a syntax and its interpretation (formal semantics: e.g. a Kripke-type of semantics for modal calculi, though not only extensional but also intensional), will specify the required operators for the introduction and quantification of 'discourse referents' (Karttunen), the different types of 'referential identity' and other, weaker, sorts of semantic connection between individuals, the introduction of discourse predicates, the forms of both logical and contingent consequence and presupposition, the interpretation of modal (including tense) operators, etc. These properties of sequential base structures are input to the syntactic rules and transformations: topic-ccuant structures of sentences, pronominalization, article selection, tense formation, stress distribution and the like.

2.2. Omitting here the details of such a text logic and the specific grammatical aspects of intersentential and intrasentential constraints, together forming what may be called the 'micro-component' or the 'sequential components' of a text grammar, I will now focus on the more abstract and global structures of a text.

It will be assumed, then, that the constraints mentioned above are necessary but not sufficient. The main grammatical reason for this hypothesis is that a linear account cannot possibly specify the semantic representations and lexical insertions 'on a longer term' in a text. Our linguistic intuition tells us that the semantic material of a text is organized also in more global patterns. That

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<sup>2</sup> For detail, cf. van Dijk (1971, 1972b).

is, the formation of semantic representations of sentences is not only determined by those of the immediately preceding sentences, but is constrained by an *mer-*an principle holding for all the sentences of a text, or part of a text. In still more intuitive terms: we *know* that the text is 'about' some subject matter and that the lexical items must, ideally, all be related, directly or indirectly, with this subject matter. Moreover, we *know* that the text as a whole may have some teleological properties: there may be different types of 'direction', 'orientation' or 'development', e.g. in narrative and in argumentation. To account for these important properties of *semantic coherence* a text grammar must have a device for constraining the set of possible (semantic) derivations for a given text. It would be immensely complex, if not highly redundant, to specify these *macro-constraints* in the generation of each separate sentence. Such an account would even be descriptively inadequate when the constraint would hold for most sentences of a text, not for all. A particular clear example of these phenomena are the global operators for modalities and pragmatic (performative) aspects: a text as a whole may be logically or contingently 'possible', but contain logically or contingently necessary sentences. Similarly, a command-text may contain assertions or questions. The important fact is that any mapping of pragmatic structures into semantic/syntactic structures of utterances requires an account of constraints both at the sentential and at the macro-level.

These informal arguments pertain to the possible forms of adequate text grammars. The theory of generative grammar, furthermore, requires that a grammar is empirically adequate, e.g. when serving as a basis of theories of performance or verbal communication. That is, a grammar must be a model of an idealized linguistic competence by providing the rules abstractly defining a set of linguistic abilities. In the next section I will enumerate a certain number of abilities which cannot possibly be explained by sentence grammars or by text grammars without a macro-component: processing of longer texts (production, perception, storage, recall) and operations such as abstracting, paraphrasing, etc.

2.3. Of any sound theory of linguistic macro-structures we would require at least the following:

- (i) there must be an adequate formalism to represent macro-structures, i.e. a syntax/calculus (categories, rules, transformations) and a semantics/interpretation;
- (ii) there must be explicit rules or transformations relating macro-structures with the sentential and sentential structures of the text; that is, we must know how macro-constraints actually operate;

(iii) besides this grammar of macro-structures the theory must specify the empirical basis of such a grammatical component and the different psychological and social phenomena of verbal behavior to be explained in terms of them; that is, it must be shown that, in some sense, macro-structures have 'psychological reality', e.g. in the form of some basic cognitive concept.

2.4. To meet these requirements we must, firstly, systematically speculate about the possible forms of grammatical macro-structures. In this respect the field seems entirely unexplored. The extant ideas about macro-structures and their forms mainly come from the theory of literature, the structural analysis of narrative and from cognitive psychology.<sup>3</sup>

Hardly any explicit account of macro-structures has been provided in these disciplines and their role for the formation of a grammar is thus restricted to the heuristic stage (postulating of relevant categories, intended interpretation of the formalism, psychological correlates, etc.).

The problem may be approached from two different angles: we either generalize existing grammatical formalism such as to account also for macro-structures and their relations with sentence structure or we try to give a formal/grammatical formulation of some ideas elaborated e.g. in cognitive psychology, that is we directly 'adapt' the form of the grammar to its empirical correlates. Although this last solution is not without thorny methodological problems, we may indeed try to build grammars which are closer to psychological theories of (idealized) verbal behavior. Actually, I will proceed along both lines: the formalism is abstract and general such as to account both for abstract underlying logical forms of texts (i. e. thus being part of the grammar) and for idealized cognitive processes.

2.5. Reasoning along the first line would run as follows: when we assume that macro-structures somehow restrict the set of possible semantic representations in a text, we may conceive of them also in semantic terms (I neglect, here, some specific types of syntactic and phonological macro-constraints, functioning

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<sup>3</sup> Under different labels the notion of 'macro-structure' has been discussed in several disciplines, especially in poetics. Cf. Ihwe (1972) and van Dijk (1972a). Especially in narrative analysis the notion has appeared often under such terms as 'plot' or 'story' (although as technical terms these have different meanings).

A similar distinction between local and global structures of discourse is being made in the interesting work of Winograd (1972). Petöfi (1971) treats macro-constraints rather in terms of lists.

especially in literature: patterns of syntactic structures, e.g. 'coupling' metric schemata, typographical arrangement, etc.). That is, we take macro-structures to represent formally the 'global meaning' of a text. The 'local meanings' of each sentence, thus, depend on this global meaning. Since global meanings are also some type of semantic structure we may simply devise an appropriate semantic language for them. These structures may be represented by some type of *semantic phrase markers*, such that specific transformations may operate on them. I claim that such a form is more appropriate than e.g. *lists* of constraints (features, lexical items, operators) because these would lack an explicit structure and would not be consistent with the psychological facts (e.g. the cognitive restrictions of our mind). The hypothesis may take a still more interesting turn. We may assume that the abstract form of macro-structures is not different from the form of semantic structure of a sentence or proposition. Both may be formulated in the same formal language, e.g. an extended modal predicate calculus or natural (text) logic as indicated above. The psychological interest of this assumption is obvious: it would mean that we may use the same cognitive **device** for the processing of semantic macro-structures and sentence structures in texts. The main task, then, would be the formulation of the rules mapping the macro-structures into the sentential semantic structures of the text.

The formalism I have in mind need not be given in detail here and depends on the progress in current research on semantic structures and the elaboration of logics of natural language in general. The calculus would consist of a set of individual variables and constants (and possibly names and indices), predicate variables and constants, a set of connectives for the formation of complex propositions, a set of quantifiers of all types (including those for unique reference, particularity, etc.), modal and other sentential operators. On all points there would be essential differences with the elements of standard systems in logic, especially with respect to the connectives and the axioms and rules based on them (specific forms of conjunction, disjunction, 'entailments' of different types, etc.). Moreover, the set of arguments should be structured in some way, in order to be able to make their relations explicit (e.g. agent, patient, instrument, etc.). The semantics would follow in principle the extensional Kripke line, but would also need an intensional component for a sound interpretation of (higher) predicates, propositions, some operators (e.g. in belief and intention contexts) .<sup>4</sup>

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<sup>4</sup> For a discussion of some of the divergences between standard logic and a possible natural (text) logic, see van Dijk (1972a). For an introduction to the modal logical systems mentioned, cf. Hughes & Cresswell (1968).

2.6. The main difference with the derivation of semantic structures at the sentence level would be that these terminate in (pre-)lexical units. At the macro-level we may assume that the derivation merely contains abstract configurations of basis predicates (or features).

2.7. Having thus specified the underlying macro-structure of a text we must formulate the rules relating them with sentential structures. First of all, however, the structures may undergo several sequences of *macro-transformations*, e.g. deleting parts of the macro-structure or rather permuting the order of the macro-propositions, of which each will correspond with a coherent 'sub-text' or sequence of the text. Such macro-transformations are well-known from narrative texts (embeddings of new stories, flash backs, etc.).

2.8. The major problem of a theory for a grammar of macro-structures would be the formulation of the rules relating them with sentence structures. Since the latter depend on the macro-structure of the text we may indeed view these relations as *functions* of one type, i.e. as grammatical transformations. Their form would be a type of one-many mapping: several semantic units, e.g. lexical items, may be related with one (macro-)semantic unit. This last unit might be conceived of as the class abstract or hyperonym of the semantic units of the sentences. In this case lexical insertion transformations would not only be restricted according to the familiar selection restrictions but also with respect to the classes of admitted lexemes. The same would hold for the selection of tenses, =des and similar aspects of sentence structure. Similarly, the semantic relations within the sentence (e. g. *agent(x)*) may not contradict those holding in the macro-proposition. How these restrictions should be formulated is a subject for still wilder speculations which I better should omit here.

An approach<sup>5</sup> more consistent with the text logical base of the grammar would be the following: we might take the macro-propositions as the basic *axioms* of a text. The different sentences would then be derivable, by the rules of a text logic, as theorems of the system. These must be mutually (linearly) consistent but at the same time consistent with the axioms. This analogy between formal systems and proofs on the one hand and textual derivations on the other hand is of great interest but will not concern me here. <sup>5</sup> It must be noted only that

<sup>5</sup> The analogy between texts and formal proofs has been noticed also by Corcoran (1968) and Keenan (1969). Indeed, from such a point of view proofs are texts of a formal language, in some sense comparable with argumentation-texts in natural language. The analogy is discussed at some length in van Dijk (1972a) and it is concluded that texts of natural language should be rather compared with systems of consistent theorems in a formal language, **where** each sentence to be derived/proved is a 'theorem' of that text, consistent with the previously derived sentences/theorems.

textual derivations, here, are rather of a logical form than of the traditional grammatical form, although, of course, the logical forms thus derived are the input to the usual rules of syntax and phonology.

### 3. *Macro-structures in psycho-linguistics and psychology*

3.1. As I indicated above the main reasons which have led to the assumption that grammars should contain a macro-component come from psycho-linguistics and cognitive psychology. That is, there are a number of linguistic abilities which cannot properly be explained on the basis of linear sentence or sequence grammars. The major argument in favour of this hypothesis is of a cognitive type: the organization of complex, 'higher' behaviour, and thus a fortiori of all types of verbal behaviour, is not linear or 'transitional' in character but is essentially based on global, rule governed strategies or *programa*. This is true both for processes of production and for processes of perception. Already in classical Gestalt theories this 'wholistic' approach to complex behaviour has led to more adequate explanations. Not only do we inductively generalize over given details, but also we construct hypothetical patterns with which details are matched. Similarly, in verbal behaviour our concrete utterances and interpretations seem to be programmed by abstract underlying rules and structures and not by probabilistic linear decision procedures, such as modelled e.g. by Markov-chains. These facts have been clear in particular since the cognitive psychological work on *plans*.<sup>6</sup> Plans are the abstract cognitive entities on which strategies of complex behaviour are based. Such ideas may seem familiar to linguists in the generative-transformational paradigm and, conversely psycho-linguistics has tried to correlate or even identify 'plans for speaking' with underlying (syntactic) structures of sentences.

3.2. In more recent developments of psycholinguistics, however, this identification of plans, or idealized cognitive strategies, with underlying syntactic 'deep structure', or in general the 'psychological reality' of such structures,

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<sup>6</sup> The main impetus to the study of plans in cognitive theory has been given by Miller, Galanter & Pribram (1960) which also discuss linguistic plans. Other notions, such as 'schema' were already present in Bartlett (1932). For an integration of the notion in a (re-)constructive cognitive theory, cf. Neisser (1967). For a brief discussion of plans as TOTE-units, cf. Miller & Chomsky (1963). Some further remarks in van Dijk (1972a, Chap. 9) and van Dijk (1972c), especially in relation with models of production and perception in literary theory.

have been criticized, or at least been made more precise. In particular it has been argued that there is more serious evidence that the abstract underlying structures processed are semantic in nature.<sup>7</sup> Especially the experiments on completion and memory have shown that cognitive/linguistic processes are semantically. Thus, the precise syntactic structure of a sentence is not stored in memory, only its basic semantic structure. Similarly, completion test for sentences show that 'semantic context' is a more important factor than syntactic category.<sup>8</sup>

does not mean that there is no syntactic programming at all. The very fact that syntactically well-formed nonsense strings are better recalled than syntactically ill-formed nonsense strings or simple lists, seems to strengthen this hypothesis. The conclusion one might draw would be that syntactic plans are determined by underlying semantic plans, and that syntactic plans are typical short-term strategies devised for each separate sentence (again I neglect the existence of more global 'stylistic' plans on this level which may determine the syntactic structures of several sentences in a discourse).

3.3. Now, in my opinion the concept of plan has not been fully exploited in the description and explanation of verbal behaviour. Whereas under the impetus of generative grammar psycholinguistic experiments have clearly shifted interest from word- or sound-based experiments to phrase- and sentence-based experiments, it would be a natural development to pay attention to the cognitive processes determining the production and interpretation of discourses of all types (oral and written, monologues and dialogues). The real importance of the notion of plan would be manifest above all when it would be used to explain how speakers of a language are able to handle discourses consisting of thousands of sentences without considerable effort (e. g. in the reading of a novel). These and similar abilities should be considered as central in verbal communication and as an highly important basis for social interaction in general. Even most dialogue discourses in ordinary conversation consist of more than one sentence, and it is impossible to memorize each sentence verbatim. For longer texts this is not only true for surface structure but also for the semantic structures of the

<sup>7</sup> This plea from psycholinguistics for semantic deep structures has been given in many recent articles, e.g. in Campbell & Wales (1970), Johnson-Laird (1970). This assumption is primarily based on memory tests; the influence of semantic structure upon recall, of course, was known in earlier work, e.g. Marks & Miller (1964), Sachs (1967).

<sup>8</sup> Cf. Light & Carter-Sobell (1970). Previous studies, e.g. Johnson (1965) already stressed that phrase structure rules had a positive influence upon recall. In general the effect of context (verbal, non-verbal, syntactic and semantic, sentential and textual) may be concluded to be a decisive factor. Cf. Bruce (1956), Treisman (1964), Kaplan & Carvellas & Metlay (1971).



individual sentences. In perception, apparently, we abstract and/or generalize over such semantic structures of individual sentences. That is, we form a 'global idea' of what has been said by constructing global semantic plans. Conversely, in production we first must form a global semantic plan for our discourse in order to be able to speak coherently. In still more intuitive terms: we select a subject matter and intend something to say something 'about' it.

3.4. There are a certain number of experiments which seem to support this still rather vague hypothesis. In memory tests for discourse, e.g. narratives, it was shown that the 'central idea' or the 'plot' of the text was recalled, even after several years, but that the sentences and their meaning were forgotten after some time.<sup>9</sup> What is recalled, in fact, is a sort of **abstract** or **summary** of the text. Of course, there will be individual differences between the 'summaries' stored for the same text by different subjects, depending on previous knowledge, interests, attitudes, expectations, and other psychological and psycho-social factors. The important fact is **that** and **how** it is possible to construct such 'global abstracts' for highly complex discourses. Conversely one may safely predict that subjects will be able to relate a given summary with a certain text when requested to determine of which text of a given set of texts it is a summary. Other recent work seems to confirm that sentences, both in texts and in lists, depend on macro-structures. Sentence recall is markedly better when their meaning is part of some global idea.<sup>10</sup> This work is interesting but lacks a serious

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<sup>9</sup> The pioneering work on recall of (narrative) discourse has been done by Bartlett (1932). Johnson (1970) has repeated these and similar experiments from a more linguistic point of view, demonstrating that recall of discourse depends on the 'structural importance' of some linguistic units. It is obvious that concepts like 'structural importance' should be defined in the framework of a serious theory based on a formal text grammar. Cf. also Rothkopf (1971).

<sup>10</sup> I may refer especially to some recent papers by Bransford and some others: Bransford & Franks (1971), Bransford, Barclay & Franks (1972), Franks & Bransford (1972), which seem to be direct confirmations of the macro-structure hypothesis although the notion 'general, or abstract idea' is not very explicit in these experiments. In earlier work 'context' has often been characterized in similar terms. Bruce (1956) for example speaks of a 'unity of character through common reference to a particular sphere of interest' (p. 123). Shipstone (1960), referring also to Gestalt theory and discussing the rule notion of generative grammar, stresses the importance of abstract recoding of complex material (p. 266). Of course these facts have been known and studied in information theory already, in which abstraction and generalization is interpreted as necessary information reduction. Neisser (1963, 1967), finally, argues that all linear (sequential) models of information processing are inadequate and that structures are processed as 'wholes' (1963: 314).

linguistic (grammatical) basis, in that no explicit account is given of the vague notion 'general idea'. A grammar of macro-structures would just provide this account.

3.5. Although there is undoubtedly much work which indirectly supports these assumptions, serious work with discourse in psycholinguistics is rare. Yet, there are numerous aspects related with the production and perception, and in general the processing, of such complex linguistic material which may elicit highly interesting experiments and research designs. By way of conclusion I will briefly and very tentatively list some important properties of textual performance open to serious psychological tests. I thereby focus on the macro-structural aspects of texts not on the abilities of establishing micro-coherences between subsequent sentences.

a) one of the most interesting ways to characterize the psychological properties of macro-structures is a systematic study of their *acquisition*. It is well-known and has been demonstrated that children are able to produce narratives of simple events only after having mastered the rules of sentence formation. Coherent narrative texts do not seem to be produced much before the age of six, although the perception of a macro-structural 'story' in longer narrative is easier than the production of such a story. This is true also for older children and adults: trivially, it is easier to read than to write a novel. The linear execution of macro-structures in narrative is at first based on temporal structures between events (*and then...and then...and then*) -in an earlier stage there will probably be an incoherent listing of events being part of the larger event told about. Later causal relationships will be acquired and still later the rules based on deductive and inductive inference (generalizations, explanations, predictions, etc.). These are well-known facts in cognitive psychology and would predict that the ability to process descriptions precedes the ability to process stories which is followed by the acquisition of argumentation. The traditional tests to get some insight into the relations between macro-structures and the sentences of a text would be e.g. to analyze the structure of narratives re-told, recalled or originally produced by Children after being presented with a story told to them, pictures, a film, or after being involved in some form of interaction (play, etc.). The interesting fact to test, then, would be the varying of the story as a function of the earlier story, event or pictures. Thus, it may be tested in which degree macro-structures may still be formed when parts of the story, film or real events are deleted or permuted, or when linearly incoherent, but globally

coherent sequences are shown. It may be predicted --according to my hypothesis that macro-semantic and micro-semantic rules are identical -- that macro-structures as such are not difficult to construct, but that their execution or formation with respect to sequential structures is difficult because it requires highly abstract deductive (particularizing) and inductive (generalizing) abilities.

b) similar tests may be elaborated for the study of the converse processes in speech *pathology* of all kinds. It is expected that the complex macro-micro rules of production are easily disturbed, such that subjects will produce well-formed sentences but without macro-structural coherence, or, having a macro-structure, not being able to produce a well-formed linear structure. Similarly, in perception pathological disturbances will first affect the ability to read longer and complex texts.

c) in *memory* tests it will be useful to give a precise account of the structure of the given texts with respect to their recalled summaries; it is expected that texts containing themselves parts of their summaries (e. g. as introduction or conclusion) will be better recalled; similarly, for texts having same sort of 'logical' (temporal, causal, inferential) structure consisting of visualisable descriptions. It will be interesting to test in detail how stored macro-structures of different texts may interfere with each other, which is very important for our insight into the formation and change of opinions and attitudes. In the same perspective falls the study of the influence of surface devices (stylistic, rhetorical) upon the formation of macro-structures.

d) these and similar aspects of recall are of course basic for any serious theory of *learning*, and many experiments in this field seem to presuppose notions of macro-structure by indicating the role of patterning, summarizing and recurrence of those lexical units and propositions directly manifesting the basic underlying global meaning, etc.

e) in general it is important to know how diverse tasks are performed with texts with very similar macro-structures but highly differing sequence structures, and conversely, and at what levels the ambiguity of texts may be established;

f) finally (this list is far from exhaustive and only contains some very general remarks) it is very important to explore the processes of *reasoning* with, in and on the basis of texts. Clearly, all argumentation is textual but in this perspective it is interesting to know **how** argumentation is programmed by macro-strategies of different kinds; more in particular we may compare the structure

of whole argumentative texts and their summaries on the one hand and possible inferences (propositions, other texts) on the other hand; e.g. may a single proposition/sentence contradict a whole text?

It is obvious already from these general remarks -- concrete and detailed tests and test designs should be elaborated -- that the abstract notion of text and in particular the notion of textual macro-structure plays a central role in the organization of our verbal and in general our cognitive behaviour. An explicit text grammar formally specifying such structures provides a sounder basis for the study of such behaviour than current grammars.

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