

NARRATIVE MACRO-STRUCTURES **Logical and Cognitive Foundations***

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1. INTRODUCTION

1.1. It seems generally agreed upon that the structure of stories cannot adequately be accounted for in terms of their sentence structures alone. Notions such as “plot,” “scheme,” “theme” and “plan” have been used, both in classical literary scholarship and in structural analysis of myths, folktales and other simple stories, in order to denote more global narrative structures. At the same time a modest syntax of such “macro-structures” has been proposed, using such categories as “Introduction” or “Setting,” “Complication,” “Resolution,” etc. (cf., e.g., Labov & Waletzky, 1967). Similar categories have been used in structuralist work inspired by Propp.

It is the aim of this paper to show briefly that a more explicit account of such narrative macro-structures and their categories requires a logical analysis of action and action discourse. Furthermore it will be argued that such (narrative or other) macro-structures have “psychological reality” in that they correspond to cognitive plans for complex semantic information processing. Recent work in cognitive psychology and artificial intelligence has demonstrated, for example, that macro-structures are involved in our ability to summarize stories (Rumelhart, 1974; van Dijk, 1972, 1974a,b; van Dijk et al., 1975; Kintsch & van Dijk, 1975). More particularly, in this paper I would like to discuss the relationships between these formal, i.e., action logical, and empirical, i.e., cognitive, properties of narrative discourse. Although the results are partially valid for discourse and discourse processing in general, we will be concerned primarily with narratives.

* Contributed to a Symposium organized by the Linguistics Dept. of the University of Essex, England, February 14-16, 1975. This paper resumes and elaborates some main points from three longer articles: van Dijk 1974a,b and van Dijk, et al., 1975, to which we refer for further bibliographical information about work on narrative theory, action logic and cognitive (semantic) information processing.

1.2. It is not possible to give a complete account of the background of this discussion on narrative macro-structures, which is a broad interdisciplinary topic, actually treated – in different terms – in linguistics, anthropology, psychology and literary scholarship. Although perhaps interesting analogies can be found in classical poetics and rhetorics, the main impetus to a more explicit and systematic account derives from anthropological research into invariant structures underlying myths and folktales. In linguistics, these results have indirectly provided some of the arguments in favor of text grammars of various kinds. Although the more serious work in this perspective has been carried out mainly on syntactic and semantic constraints on sequences of sentences (pro-forms, topic/comment relations, connectives, etc.), it has been repeatedly argued that a proper text grammar should also specify rules for more global structures of discourse. This requirement is essential for a serious application of grammars in narrative and literary research. Provisional rules and categories for the derivation of global discourse structures have been formulated. Yet, it was not possible to specify the rules or operations relating these macro-structures to the sentential and sequential structures of the discourse. This led to the critical assumption that macro-structures either do not exist at all as a separate level of analysis or that they should be accounted for by theories of “performance,” e.g., in terms of cognitive structures or strategies.

1.3. In the meantime this a priori distinction between “competence” and “performance,” and hence the explanatory domain assigned to a grammar in transformational philosophy, has been attacked from various points of view, for example, in socio- and psycholinguistics (cf., e.g. Bever, 1970). It follows that there is no point in discussing whether macro-structures should be treated in the grammar or in cognitive models of language processing.

We should distinguish, however, between abstract rules and categories for the analysis or synthesis of discourse on the one hand, and the actual strategies used in the comprehension or production of speech. This holds both for sentences and for more complex linguistic structures as stories: We have implicit knowledge about the “necessary” structure of “ideal” or “normal” narratives, but at the same time make use of a set of “processing tricks” in order to facilitate the execution of the often very complex rules. Such strategies operate for a majority of cases and thus have hypothetical character: we simply assume, at least in many languages, that the first noun phrase of a sentence is the logical subject or “theme,” until evidence is given to the contrary. Similarly, we assume that the first human

agent mentioned in a story is an “agent” of the global narrative structure, e.g., the “hero.” This is not a rule, but an expedient interpretation strategy. Besides these and other methodological issues in recent psycho-linguistics, there has been a tendency to explore other aspects of the cognitive “reality” of grammar. After the original move from word-lists to syntactic structures of sentences, semantic or logical properties of sentences have been the object of experimental research. Thus, semantic (“underlying”) structure is indispensable in the morphonological and syntactic analysis of linguistic input; such abilities as recall and recognition of sentences are also primarily based on semantic structure. Once this step was made towards semantic information processing, and the related domains of knowledge storage and retrieval and problem solving, it was natural to consider whole discourses as experimental material. This development is rapidly growing and interesting results have already been attained.

One of the results relevant to our discussion is the experimental confirmation of the obvious assumptions that subjects cannot repeat longer discourses verbatim, do not recall or recognize the exact syntactic structure of the respective sentences, and do not recall all propositions of a longer discourse. It has been found that in reproducing stories, for example, subjects select certain propositions and/or combine the information from various propositions into one proposition, and that the selected and resulting propositions are stored in memory, recalled, and serve as recognition cues for the original propositions or sentences of the story. It has been shown also that our memory for coherent discourse is much better than for random sequences of sentences, and that we recall narrative (action) discourse and argumentative discourse, having specific causal and logical relations, better than descriptive discourse. These are only a few examples of cognitive facts which are well-known intuitively, but which require theoretical explanation. That is, we must construct an explicit model of the cognitive processes involved in the comprehension, storage, recall and recognition of such complex structures as stories. An essential feature of such a model must be a set of macro-rules, which determine our interpretation of a discourse at a level superior to that of sentence and sequence comprehension, and which explains how and which information can be “integrated” into “higher order” propositions.

This is a brief preliminary sketch of the developments and problems which are crucial to an empirical theory of narration. In such a theory the question of the abstract structure of narration is closely linked with the question of how we tell them and how we read and interpret them.

2. THE LOGIC OF ACTION AND ACTION DISCOURSE

2.1. Let us take the structural aspects of narrative first. A major assumption to be worked out, therefore, is that narratives are a type of “action discourse.” Before saying something about the *differentia specifica* characterizing our intuitive idea of a “story,” it is useful to know what action discourse is.

Assuming that we know what “discourse” is – which is a more general and not so simple problem – an action discourse is to be defined in terms of its referents, viz. action. This opens up a vast area of traditional and current research in philosophy, logic and the social sciences, which cannot possibly be included in the topic of this paper. We will simply take a narrow view of action and content ourselves with an abstract conceptual definition as, for example:

Action = *def* A change of state brought about intentionally by a (conscious) human being in order to bring about a preferred state or state change.

This is a simple and informal definition, but it covers considerable controversies in philosophy. One of the crucial problems, of course, is the notion of “intention,” which will be understood here simply as a “mental state.” The notion of “state” – or “possible world” – remains undefined: it may be any set of objects with certain properties. A change of state, or “event,” is a binary operation on states, linearly ordered in time. These specifications can be further formalized, if necessary. The definition as it stands, moreover, is merely characteristic for one type of “overt” and “active” action. We also act by forbearing a change of state (of our body), by letting things happen or by preventing state changes, i.e., events. Another important retouch to be made to the definition is that most actions do not consist of only one change of state (of our body) but an ordered sequence of more *basic* actions: opening a door requires several different movements, some of which are operated intentionally and consciously, like searching our pockets for the key. Similarly, the actions of “building” or “governing” are highly complex, consisting of a great number of other actions.

2.2. We are interested here not primarily in actions but in specific representations of actions, e.g., action discourses and narratives. A discourse is an action discourse if its respective sentences can be interpreted in terms of the optional or necessary sequential parts of actions as defined. This makes:

(1) Peter hit John.

- (2) Peter was angry with John. He wanted to punish him. Then he took his baseball bat, and hit John over the head. John fell down.

action discourses, whereas the following are not action discourses, but state event- or process-descriptions:

- (3) The sun is shining.
 (4) It is raining.
 (5) John fell down.
 (6) She kissed me in her sleep.

It must be stressed that actions are *intensional* objects. Their corresponding *extensions* are merely bodily doings, which require interpretation as a certain action. Moving a pen across a piece of partially imprinted paper can be interpreted as the action of “signing,” but also as the action of “making a contract” or “buying a house.” That is, the same bodily movements may be involved in different actions, and one action may be “covering” different bodily movements: I may dance, for example, in different ways. Hence difference of action must be determined from difference in intention. In everyday interaction, intentions are “inferred” from overt doings, according to a set of norms, rules or conventions. If we see somebody on the street acting strangely, we might ask “What are you doing?” although in fact we see what he is doing. With our question we want to know the intention underlying the “doing,” so that we can interpret it as an action.

In action discourse, thus, the description of doings, like in example (1) may be interpreted as an action if the further assumption is made that Peter hit John intentionally and with a certain purpose in mind, as spelled out in (2). Whereas the intention has the doing itself as its scope, the purpose places the action in a context. We accomplish most actions for a certain reason, and thus assume that the action will bring about directly or indirectly something we want to be the case: I open the door in order to be able to enter or leave my house. Many action descriptions provide information about these intentions and purposes. A discourse satisfying these constraints will be called a *full* action description. Discourses like (1) will be called *partial* action descriptions, in this case equivalent with a “doing description” of a global kind. A detailed doing description would contain a precise description of the (arm and body) movements of Peter and John. In normal situations such detailed descriptions have no function, and can be covered by one global doing/action description (hitting).

There are well-known examples from literature where a partial action description merely contains a description of the preparatory mental states (“stream of consciousness” novels).

An action is successful if the world (including the agent's body) is changed according to the purpose of the agent. That is, "purposed state" and actual final state must be identical. If the world does not change or changes in a way different from the agent's purpose, the action is unsuccessful. If the final state is the one aimed at, but if it comes about not through the agent's action(s), the action may be called successful-by-chance. In fact, this means that the action itself, i.e., as it was intended, was not successful. The other possibility, then, is that the action/doing itself succeeds but without the required change in the world, e.g., due to unexpected other causes. Such an action may be called semi-successful (or weakly successful) because an intention has been carried out, although the ultimate purpose was not realized independently of our power. Such differentiations play an important role in the theory of law.

2.3. This brief account of action is necessary to understand the nature of narrative discourse and macro-structures. Consider again the difference between (1) and (2). Both are in a way descriptions of the "same" event, viz. of Peter's hitting John; but (2) also contains a description of the mental state, the purpose, an auxiliary action (taking an instrument) and the consequence of the action. In a sense we may consider (1) as a *summary* of (2). We see that we may obtain a summary of an action description by deleting a number of propositions. Of course, such transformations are possible only under specific conditions. The sentence "John fell down" would probably not be an acceptable summary of (2), whereas "Then he took his baseball bat..." may be adequate in some communicative contexts. The deletion is possible due to the logical and conventional structure of actions. That is, in the interpretation of summary (1) we supply propositions from our general knowledge of (types) of action. We know that hitting is usually intentional and purposeful, and normally done only if A is angry with B, and that the result may have serious consequences if the hitting is powerful and/or done with a heavy instrument. The latter fact would require perhaps a summary like "Peter hit John with a baseball bat." The proposition referring to the auxiliary action of taking the bat may also be deleted in that case because it is entailed by this summary. In other words, we may delete those propositions which denote likely or necessary consequences, which are presuppositions of actions or which are entailed by the summarizing propositions. Of course, this is only one example of a provisional transformation rule mapping action discourse on action discourse summaries. Note, incidentally, that, as we suggested, the same discourse may

have different summaries, whereas a summary may have several (if not infinitely many) source texts.

Each action description may be given at a certain *level of generality*. Thus, although (1) perhaps roughly summarizes (2), it may itself in turn be one single proposition in a longer discourse which, at a higher level, is resumed as “Peter and John were fighting.” Although the mapping rules may be different here, the general semantic constraint is that a summary is entailed by the discourse it summarizes. In terms of a logical semantics for entailment this means that in all possible worlds where the discourse is true, i.e., where its sentences are conjointly satisfied, the summary discourse is also true. The summary may, however, still be true if the discourse, viz. one of its sentences, is false, in case this sentence expresses a proposition which is not a necessary condition for the summarizing proposition. It may be false that Peter took a baseball bat, but still true that he hit John with another instrument; but it may not be false that Peter was moving a part of his body, because this is a necessary basic action for the action of hitting.

Now, our hypothesis is that a summary like (1) expresses a macro-structure of discourse (2). A summary, thus, is itself a discourse (type or token), whereas a macro-structure is an abstract underlying semantic structure of a discourse. With Occam’s razor in mind, we should ask why we need such an additional concept in semantics. The answer to this question is intuitively satisfying but not easy to formalize. Although a discourse like (2) is “linearly coherent” (correct pronouns, referential identity, connectives, etc.) it can be shown to form a coherent whole “globally” only if it has a macro-structure, with respect to which each sentence has a particular function, much in the same way as a sentence may be said to have a structure only if its words or phrases have a semantic/syntactic role or function with respect to other words or phrases or with respect to the sentence as a whole (e.g., “subject” of the sentence). Operationally, the presence of a macro-structure implies the possibility of summarizing the discourse. Formally, a discourse has a macro-structure if there is a set of propositions *M* such that *M* is entailed by the discourse sentences conjointly, or by an *n*-tuple of such sentences. We shall see below that such macro-structures have a very important cognitive function, viz., as plans for speaking and comprehension as well as for other cognitive abilities of high complexity, like action and interaction themselves. There is an interesting analogy suggested by the assumption that macro-structures are entailed by the set of conjoined sentences of the discourse, viz. the relation between

premises and conclusion in a proof or argument. Just as the conclusion, entailed by the premises in a formal proof, is somehow the “point” of the proof, pragmatically speaking, viz. that what we intend to show or demonstrate to a reader, the macro-structure, may be seen as the point of an action description or a story.

Formally, it may be proved that macro-structures are entailed by the discourse if we can prove, inductively, that each of the macro-rules, like the deletion rule mentioned above, is truth and meaning preserving. Since an action, by definition, “contains” a corresponding intention, an action description entails an intention description. Similarly, if an n-tuple $\langle a_1, a_2, a_3 \rangle$ of action propositions exhaustively describes the necessary component actions of some complex action b , then $\langle a_1, a_2, a_3, \dots \rangle$ entails b . This mapping is not based on deletion but on *integration or construction*, another important type of macro-operation.

3. THE STRUCTURE OF NARRATIVE

3.1. Narratives are action discourses of a special type. They have additional constraints. A first set of constraints is *pragmatic*: narratives or stories are told, in a certain communication context, for a certain purpose. A general principle, holding for assertions in general, is that the speaker assumes that the hearer does not know that the events denoted by the discourse occur (in some possible world). More specifically, a narration, i.e., the act of uttering a narrative discourse, is an appropriate speech act if the actions or events told about are more or less spectacular or if the narrative discourse is itself spectacular. This means that the events do not occur in most normal possible worlds. Further definition and formalization of these pragmatic constraints will be omitted from this paper. We shall focus upon the semantic properties of narratives.

3.2. A first feature of the abstract structure of narrative discourse is that in general more than one action is described, and the sequence described is causally or rationally connected. Moreover, event descriptions and state descriptions may be part of the narrative, the latter, as we saw in (2), mainly to describe initial and final states of actions or events. However, not any action discourse denoting an action sequence is a narrative. Given some initial state, an action or event must take place which is unexpected, surprising or dangerous for the persons involved in the course of events. These are vague pragmatic and psychological conditions, which may however be made more precise. The core of a proper narrative is the action

or set of actions following this earlier event or action, which is usually called the “complication.” The central set of actions, or “resolution,” are those actions of an agent to prevent the necessary unwanted consequences of the complicating event, which may lead to failure or to success. The rules involved here are recursive: after a first success new complications may arise, leading again to success or failure. Finally, a narrative may have an “evaluation,” in which the attitude of the speaker-narrator is given about the events, and a “moral” in which the consequences (or “conclusion”) are drawn for present and future actions of the speaker, the hearer, or agents in general.

This is all well-known, but the status of the categories involved should be considered. Clearly, the categories do not necessarily dominate single propositions or sentences. An initial state (setting or introduction) description may vary from zero to a great number of propositions. The same holds true for the events and complex actions involved, for which each initial mental and bodily state, doing, manner, result and consequence description may be specified. If we accept such n-tuples of propositions as determining one category, e.g., *Introduction* or *Complication*, we should call such categories “macro-categories.” More particularly, they define the function of a part of the text with respect to the text as a whole.

Furthermore, n-tuples of propositions may be taken as arguments of mapping rules having macro-propositions as values. If these rules preserve the global narrative functions, it follows that a summary expressing such a macro-structure must also be a narrative. If none of the functions is vacuously satisfied (i.e., dominates at least one proposition in a macro-structure), there must be at least three propositions underlying a summary of a narrative discourse. For example:

- (7) (i) Yesterday I drove to Rotterdam.
- (ii) It was very foggy.
- (iii) I did not see the truck before me.
- (iv) At the last moment I slammed the brake.
- (v) I was so scared that I couldn't drive for an hour.
- (vi) Next time I won't drive when it is foggy.

This rather artificial summary faithfully follows the narrative macro-categories. Some of the propositions in actual summaries in normal conversation may however be deleted, for example, as follows:

- (8) Yeah... last time I drove to Rotterdam it was so foggy that I nearly hit a truck..

The hierarchical structure underlying (7) and (8) is then something like:

The categories used are provisional, and partly from Labov & Waletzky (1967) and Rumelhart (1974). The rules defining this tree are somewhat different from those of these authors.

Only part of the relations between the propositions has been given. *Narr* stands for narrative. The *Moral* is a conclusion drawn from the story and in some personal sense is implied by it, much as in a practical syllogism. The provisional *Story* category is what is actually “told,” whereas the *Episode* denotes the events told about occurring in the setting given in the *Introduction*. The curled arrow connective denotes “is a reason for.” The *Evaluation* is a mental consequence (and its consequences) of the actual happening. Its pragmatic function is to draw attention to the important or spectacular character of the *Happening*. The single arrow denotes causal implication. The rest of the graph is straightforward and follows from the discussion above.

This is all roughly in line with current narrative theory. Our problem is the relationship between the discourse and the macro-structure expressed by the summary. The difference, first of all, lies in the final categories, where the full discourse may have n-tuples of propositions:

<I left the house, took my car keys,
opened the car, started, left town... > = I drove to R

There are other differences. The structure in (9) defines a simple narrative. Since the *Story*, *Episode* and *Happening* are recursive, the narrative may be also complex in macro-structure. Still, in a longer discourse we may have stories which are not at the same level as other stories, but are for

example, part of the *Introduction*, defining part of the setting of the “main” *Episode*. A formal distinction between “major” and “minor” events of a narrative is not easy to make. One possibility is to compare the *consequence sets* of such events. Formally, then, an event described is more important if it has more and/or more serious consequences for an agent, i.e., if it is maximally (in-)consistent with his highest ranked preferences (e.g., stay alive, become rich, etc.). In our example, not seeing a truck in time during a fog, due to its possible mortal consequences, is a more important event than, say, loosing one’s car keys in most situations (see section 4.5.).

Finally, it should be noted that not only n-tuples of propositions may underlie the macro-categories. In some cases, unordered sets of descriptive sentences, which may be selected from all over the discourse, may be resumed by one descriptive proposition (e.g., A is rich), which is part of the setting description, or part of the *Evaluation* (A was sad), in which case the source propositions have their precise syntactic position after the *Resolution*-part of the discourse.

The characterization of narrative structure given here is very fragmentary and informal. The principal aims were the following: to show that narratives are action descriptions; that narrative categories can be defined in terms of action and event logics; that narratives have a macro-structure with the same functional relationships as the whole discourse; to show what rules relate the action discourse sequence of propositions with the macro-propositions; and what constraints differentiate narratives from action descriptions in general. We shall now turn to the empirical foundations of the narrative theory sketched and see what role is played by narrative macro-structures in telling and understanding stories and in making summaries of stories.

4. COGNITION AND NARRATION

4.1. When we realize how complex the morphonological, syntactic and semantic rules of a grammar of any natural language are, we may have reason to be impressed by our ability to produce and understand grammatical sentence~. We may be more impressed still when we realize what is additionally required in order to be able to understand discourses like complex stories. In order to relate, at a modest level, two subsequent sentences, a whole set of meaning postulates, propositions from our world knowledge and corresponding deductive and inductive inference rules are used.

More specifically, we are obviously further able to decide whether some

sentence(s) is part of the *Introduction* or the *Complication* of some story, and that some events described are more important, relatively speaking, than others. In addition, we are able to construct propositions “resuming” sets of other propositions. Similar abilities operate in the understanding of stories. How is this possible, that is, how is it done?

4.2. The psychological facts are clear: we can repeat only a short sentence verbatim and that only immediately after presentation; otherwise we can give a semantic paraphrase, i.e., repeat the propositions. With very long sentences and discourses this ability surpasses our memorial capacities too, depending on the “content” and relations of the original proposition sequence. Yet, although we may perhaps “forget” some of the propositions, directly after presentation, we are able to repeat many of the original propositions of a narrative, but much less if the set of input sentences is random or unordered.

To obtain more insight into these problems, and in order to test the macro-structure hypotheses, we have carried out a number of simple recall and summary experiments (van Dijk et al., 1975). The main objective was to study performance with complex, longer discourse, because most experiments with discourse were carried out with texts with a length of less than a page (400 words). To keep the treatment of the data and the results within manageable limits we took a very short story by Boccaccio, viz. no. II, 4 from his *Decameron*, in a rather old-fashioned Dutch translation. The sentences of this version were very long and complex and could not possibly be recalled verbatim or in the original syntactic structure. The story was about 4 pages long (1680 words). Subjects in the various tests – which will not be described in detail here – were high school boys and girls about 17 years old who were placed in different groups for the different tests in order to keep the results independent.

The first two tests were simple recall tests, one with written presentation, the other with oral presentation. Immediately after presentation subjects were required to reproduce the text as precisely as possible – without taking account of the exact wording of the original. The situation was not a laboratory but a classroom, and the task was given as a normal class exercise in Dutch. No precise timing of presentation/reading and reproduction was possible for the individual subjects. Reading took about ten minutes, and reproduction about 30 minutes or more, so that some subjects did not finish the task before the class was over. There were no significant differences between the written and the oral tests in the first

reproduction, although it was striking that the numerous proper names, of the hero and of the several places, towns, lands and seas, were better recalled after oral representation. The mean length of the reproductions was 55 propositions, of which about 5 did not occur in the original. The original text was divided into 184 "propositions," which were in fact simple clauses rather than strictly atomic propositions, which would have made the list much longer. The scoring procedures therefore could not be perfect, because many of the reproduced propositions were only partly identical with the original ones. The total number of different propositions recalled was about 150: i.e., about 30 propositions did not occur in any of the protocols of the 35 subjects (taken together from the two tests). Hence, from the 150 about a third was averagely recalled by the individual subject. Deviations from the mean were sometimes considerable: some subjects recalled more than 80 propositions, others did not produce more than 25.

Now, one of our main questions was, which propositions were recalled most, and why, and which propositions were rarely recalled or nonoccurrent, and why. The answer to this question was expected to lie in the structure of the input text, and it was abstracted from individual differences between the subjects (although such differences may be important. See Paul, 1959). The number of propositions recalled by more than two-thirds of the subjects was about 18, which is a 10% fraction of the original. Not recalled or recalled by less than a third, however, were about 90 propositions – half of the original. Yet the 18 most frequent propositions produced a fourth of the total recall and the less frequent ones also merely 25% of the total recall. Hence the mean probability of this set of 18 propositions is about five times as high as that of a set of 90 others. Some of the 90 propositions have a probability approaching zero, whereas some propositions of the set of 18 have a probability approaching 1. These differences are significant and require explanation.

These differences were even more clear in a second trial after two weeks. The proportion of propositions occurring in no protocol had doubled. The other values were diminished by about a third to a fourth: the total number of different propositions recalled; the mean number of propositions recalled per subject; and the number of propositions recalled by more than a third of the subjects. In both trials most of the subjects correctly recalled the order of the propositions: not more than 10% omitted a significant part of the story or changed the order of events.

These two tests served as the background for the five main tests carried out on the summarizing abilities of subjects. The designs were roughly as

follows: The first test had a simple “summary” task: “Give a summary of the presented story, i.e., reproduce what you think are the most important events.” Second, the original text was presented in four chunks representing the four major event clusters of the story, and the task was to give a summary of each chunk after presentation, and to give a summary of the whole afterwards.

The second set of summary tests were intended to study interference of a story with a previously presented summary. First, subjects were asked to reproduce the summary as closely as possible, after having heard the whole story. Second, a false summary was given, in which the order of events was changed and two new propositions inserted in order to make the new summary “logical”; subjects were then asked to give a correct summary of the text. Third, the false summary was given, then the story, and then subjects were asked to reproduce the false summary.

Again the precise designs and results are not relevant here, merely those qualitative consequences for a theory of macro-structures in (narrative) discourse.

The “normal” summary task first showed that most of the subjects were unable to write a concise summary. An optimal summary would have at least 15 and at most 30 propositions including the title. The summary we had constructed for the second summary tests contained 23 propositions. The subjects, however, had a mean of 31 propositions, with considerable deviations (running from 14 up to 48). In comparison with the recall tasks, though, the reproductions were of course significantly shorter: a real selection had been made. Similarly, the total number of different propositions occurring in the summaries was also significantly smaller, viz. about 100. It should be noted that this was also the case for the second trials of the recall tests which is an initial indication for the similarity between immediate summarizing and delayed memorizing. The number of propositions used by more than two-thirds of the subjects was 10, whereas 17 were used by more than half of the subjects.

The “chunked” recall test was much more like the recall of the total story: 144 (out of 184) different propositions were used by the group, of which 38 were used by more than two-thirds of the subjects. The most striking finding here, however, was that in the final summary to be given for the whole story, the subjects consistently produced very brief summaries, viz. of an average of 12 proposition~ only (and low deviations). The total number of propositions used here was only 50; no proposition was recalled by more than two-thirds, and 8 of them were used by more than half of the subjects.

Reproducing a summary after presentation of the story itself is, of course, apparently easy. And indeed most subjects ($\geq 2/3$) correctly repeated 16 of the 23 propositions of the summary, with a mean of 17 of the 23 per subject on a liberal scoring criterion, 8 on a strict scoring criterion. The given summaries, however, were considerably longer, with an average of about 25 propositions in each. Hence, propositions were taken from the story itself and judged to have occurred in the previously given summary. Indeed, one or two propositions intentionally left out of the presented summary (although without significantly changing the logic of the story) had been faithfully supplied by most of the subjects from the story itself, which means a significant retroactive inference of the subject's own implicit "summary" of the story with the summary as presented.

Quite different again were the results of the task in which a correct summary had to be given after a false abstract. First of all, as in the first normal summary task, the number of different propositions was again about 100, of which about 20 were used by most of the subjects. These summaries were also of an average length of 37 propositions.

Reproducing, finally, a wrong summary proved to be rather difficult, although in fact only the order of two episodes had been changed: the crucial end of the story being correctly summarized. As in the previous tests, although all propositions occurring in the wrong summary came back in the group, and 15 were used by more than two-thirds, there was not a single correct reproduction (under a liberal score) and only one nearly correct one. Although many subjects had in fact perceived the difference in order, the underlying logic of the false order as given by the new propositions in the false summary were not recalled and most subjects made one or more serious errors. This was not the case in the previous test where a correct summary had to be reproduced. There, all but one summary were structurally correct.

4.3. What conclusions then can be drawn from all these data? First of all, there was a strict convergence between the propositions occurring mostly in recall and those selected for summaries. That is, what was recalled best was indeed the information judged most "important" in the summaries. Second, in all tests at least one-sixth of the propositions had become inaccessible for all subjects, whereas one-tenth were used by nearly all of them: i.e., there was at least a central core in what was judged important information. The probability of these propositions occurring in a recall was at least five times as high, and in a summary 10 times as high as that

of the “unimportant” propositions. Similarly, these propositions come back in second trials, whereas much more is lost of the less important propositions which were still recalled in the first trial. In fact, as we said, protocols of second trials after two weeks were very much like the summaries given directly. It might be expected that this fit would be more striking after a third and further trials, as was the case in Bartlett’s (1932) experiments.

Another conclusion seems to be that, indeed, recalls and summaries of longer stories have different properties than those of shorter or less complex materials. In the chunked summaries twice as many propositions were recalled in (total) by more than two-thirds of the subjects as in the simple recall test.

Furthermore, there is clear interference between a story and a correct or false summary. Proactively this interference seems less strong than retroactively when an incorrect summary is given: the information processed last is reproduced best, which is a well-known fact in verbal learning. This may be further caused by the fact that the “central” information constructed from a whole discourse is more firmly stored, than that from a summary of the important information alone.

Apparently, summarizing a text is easier when other summarizing tasks have already been performed for chunks of the story, as if summaries of summaries have been made. It might be that this “second order” summary is close to what will be recalled of the story after a long delay of say several months.

Finally, it seems that subjects do not easily discriminate between their own “summarizing interpretation” of the text and an interpretation given by the experimenter. At least they unconsciously “correct” an original summary according to what they have found important.

4.4 Although these are only a few conclusions drawn from the data, we clearly need theoretical explication of the various phenomena in more qualitative terms; that is, the very big differences in probability of the different propositions to be produced in recall or summary, require prediction based on their semantic structure and their structural function in the original story.

One of the hypotheses used to explain similar experimental findings has been put forward by several recent studies, e.g., Meyer (1975) and Kintsch (1974). Constructing a hierarchical tree of the discourse according to dependency relations between propositions based on “rhetorical” categories such as “explanation,” “specification,” etc., it was predicted that the

propositions highest in the tree would be recalled best. This hypothesis was confirmed by the data, independent of the location of the relevant propositions in the text.

There are several formal problems here: no explicit rules, syntax or semantics, have been given for the assignment of propositions to such hierarchical categories and structures. In fact, the determination of whether a sentence is an "explanation" is based on our linguistic and logical intuitions which themselves precisely have to be explained. Yet, this is the direction to turn towards, especially since convergence of judgments in such structural descriptions was very high.

There is, however, one more serious difficulty. In shorter texts we may perhaps select, for recall or summary, the propositions or clauses of the text itself. In that case, a structural description of the text will place high in the hierarchy exactly those propositions which recur most frequently. However, as soon as the discourse is longer, the precise selective reproduction of the story becomes more difficult. In our experiments there were several cases in point. In a sequence in which a woman salvages the hero from the sea, there is a description of how she cares for him in her home. This sequence is not reproduced in the recalls or the summaries, but the sequence as a whole is faithfully summarized, in the recalls as well, by one proposition which does not occur in the original discourse. Clearly, the subjects have mapped the sequence on a proposition which they have constructed themselves. Thus, not only summaries but also recalls must involve (re-)constructive semantic processes, as Bartlett hypothesized. It only follows that a structural (hierarchical) description of a discourse may predict recall of shorter texts and only after relatively short intervals.

It seems correct to assume that subjects indeed rank propositions, during interpretation, according to their structural dependency relations. At the same time, however, sets of propositions or n-tuples of propositions, possibly of different ranks, may be integrated, by substitution transformation, into one proposition. We might make the assumption that recall and summarizing are much more related than would be predicted in models without macro-structural rules. More distinctly, we may sharpen up the well-known hypothesis that from all complex information a "schema" is constructed, and that recall is organized around this schema. Assuming that the underlying structure of a summary is roughly such a "schema," it becomes clear why the propositions consistently used in recall are exactly those of the summary. It would be easy to confirm this hypothesis in a recognition test, where propositions consistent with the summary would be easily "rec-

ognized” as having occurred in the original discourse even though they haven’t.

4.5. Finally, the criteria on which macro-rules and summarizing rules are based, should be made more concrete: i.e., what sort of propositions are either forgotten or integrated into other propositions; what sort of propositions are selected or constructed from others?

First of all, for narrative discourse the propositions recalled best are action propositions. In case there is one major agent, these describe actions of this agent. This fact is consistent with the assumption that both the summary and the macro-structure of a narrative are also narratives, and follows from the theoretical description of narrative as a type of action discourse. State descriptions are mostly simply deleted or integrated into action descriptions, e.g., as presupposed or entailed information. This is a general tendency, which must be made more specific. Let us therefore give a list of the major summarizing rules, assumed to represent the major cognitive macro-operations:

1. Names are generalized and substituted by indefinite descriptions or variables:
e.g., “a man,” “somewhere in Italy,” “in an Italian village.”
2. Location descriptions are deleted or integrated:
e.g., “in a (beautiful) village.”
3. Full identifying propositions are reduced to arguments (i.e., noun phrases in summary sentences) :
e.g., “there lived a rich man...” ~- “a rich man...”
4. Summarizing propositions in the text are deleted, as is all redundant information.
5. All preparatory actions which are not presupposed by other propositions of the story are deleted.
6. Propositions denoting emotional states are deleted.
7. Propositions denoting mental planning (intentions, purposes) are deleted if they are identical with the description of the actions planned.
8. All paraphrasing propositions are deleted (see rule 4).
9. Qualifications and comparisons of actions are deleted if entailed by the action descriptions.
10. Propositions denoting possible alternative courses of events or actions are deleted.
11. Propositions denoting conventionally following consequences of action are deleted.
12. (See rule 5.) Component actions which are not presupposed by other actions are integrated into a global action description for the sequence.
13. Non-reducible actions which are not presupposed by following actions are deleted.

14. Time indications are deleted or substituted by variables.
15. Atmosphere and weather descriptions are deleted except if they denote events causing major actions.
16. Descriptions of "normal" courses of events or actions are deleted.
17. Descriptions of the way actions are performed are deleted.
18. Descriptions of bodily states are deleted or integrated in a modifier (adverb, or adjective).
19. Direct or indirect description of dialogue is deleted.

Although these very informal rules are derived from our experimental data, they seem to hold for many types of stories (cf. the summary-rules used by Rumelhart, 1974). Closer inspection of the rules shows that not all descriptions are deleted nor all actions retained. What is notably present is the description of the main purpose of the agent-hero, i.e., the final state he wants to bring about through his actions. In a summary this is necessary in order to interpret each main action as purposeful towards the realization of that state. In a more positive way, the theory predicts that those action descriptions are not deleted which are directly presupposed by following action descriptions in the discourse. State descriptions remain present if they are direct reasons for major actions.

"Major actions" have the following properties: (i) they are "serious," i.e., if they succeed they lead directly or indirectly to the purposed goal of the agent; if they fail this goal cannot or can only be attained through other major actions; (ii) they are not obvious causes or consequences of other major actions; (iii) they prevent the negative consequences of other actions or events, i.e., those actions and events incompatible with the final goal. These conditions hold for actions of both the agent, his co-agents or his opponents. Similar conditions can be formulated for "major events": they must cause or solve a serious predicament of the agent(s). State descriptions remain if they denote the state desired by the agent.

Of course these rules and conditions are only a first step towards an algorithm producing a macro-structure and hence a summary for a given story.

4.6. The rules, conditions and specific constraints sketched above have been formulated in order to account for our ability to process complex information. That is, they indicate how a selection is made of "important" information and how important information is constructed from sequences of details. For narratives this is possible because we have implicit knowledge of the underlying logic of events and actions, and of the probabilities determining co-ur,e, of actions or events. That is, we know which actions

or events lead to a purposed goal and which do not, and which actions or properties could have been different in a sequence without altering the major actions of the sequence.

Such abilities and knowledge do not of course exit for the interpretation of stories alone but have more general cognitive nature. They underlie the execution of our complex actions and are properties of practical "problem solving," i.e., the necessary conditions to attain a certain goal.

In the same way, we possess the ability to construct a macro-structure and hence to give a summary of argumentative and descriptive discourses, an ability which in turn determines or reasoning and perception.

In all cases the processing of complex information is determined by such cognitive macro-rules and -categories, which have often been called "plan" or "schemes"

It should however be noted that these abstract rules and the semantic processing models built on them are generalizations and idealizations. If the rules involved are very complex, we use more simple strategies in order to have quick hypotheses concerning the global structures involved. These specific strategies will not be treated here, and little experimental work exists about such strategies for complex semantic information processing like understanding or telling stories.

Furthermore, the fact that we recall mainly the macro-structure of a story and those details which can be inductively inferred from it, does not mean that we do not occasionally recall some striking detail of an event or action, or its description. From our experiments we learned that some metaphorical locution came back in nearly all protocols. It is not easy to explain such a phenomenon. It may be assumed however that such striking details are separately stored in episodic memory, which is distinct from semantic or general fact memory. We recall the main events of a story because they are central to the structure of the story itself, whereas a striking detail is separately recalled, as a "perceptual input trace," because it is significantly different from our expectancies about normal courses of events or normal ways of speaking. The macro-structure of a story may after a long time itself become such a "striking detail" with respect to our general knowledge of story plots, much in the same way as we recall striking experiences of our past. This processing at several memory levels is an explanation of our factual memory for stories.

4.7. The theoretical remarks made in this paper pertain to story comprehension in general. However, in very complex literary narrative, further

constraints are necessary. In that case we may have a set of further transformations applied to the underlying macro-structure: the logical order of the events is changed; necessary conditions or consequences are deleted; or descriptive detail may dominate the action descriptions. The interpretation of such literary narratives, however, follows the more general cognitive rules of narrative processing. Thus, it is well known that in retelling the transformed plot of a literary narrative, we normally produce it in its normal action-logical order. Similarly, missing conditions and consequences are supplied by our general knowledge of conditions or consequences of action. We read and process the literary narrative as a *narrative*. We process it as a *literary* narrative by focussing attention on the structural deviations from everyday narrative: the way places, agents and objects are described; the manner of the performance of the actions; etc. This specific cognitive ability is based on rules and conventions of different (literary, esthetic) systems. One such convention is, for example, the fact that in folktales the complication category often recurs 3 times, which is not an inherent property of narrative, but a general esthetic principle of repetition.

Although further research is necessary into the cognitive properties of literary discourse processing, it may be assumed that our (trained) perception of specific properties is always based on our matching with "normal" structures and rules. This seems to be the case in the interpretation of deviant sentences in modern poetry as well as "deviant" macro-structures in modern novels. This reduction is in fact a cognitive necessity: we have but one sort of semantic knowledge and memory, and all interpretation, of both literary and non-literary information, is based on it.

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