

On Macrostructures, Mental Models, and Other Inventions: A Brief Personal History of the Kintsch—van Dijk Theory

Teun A. van Dijk
University of Amsterdam

It is not my habit to write scholarly articles with the pronoun "I." Instead, rather traditionally, I tend to hide myself and my weaknesses behind the authorial "we." Retracing and evaluating my unique, decade-long (1973-1983) collaboration with Walter Kintsch, however, requires a more personal style, in which the deictic pronoun "I" refers, of course, to me, and "we" to Walter and me.

Well, this is not quite true. Rather than to refer to him and me, as historical persons of flesh and blood (and sweat, no tears), the pronoun should rather be interpreted as my subjective person constructions of him and me in my mental model(s) of our collaborative episode(s). Such subjective representations in my episodic memory are, naturally, partial, one-sided, or otherwise biased, and fraught with social and cognitive imperfections. Which brings me to the nature of mental models, not only of episodes of scholarly cooperation, but also of other forms of discourse. Of all our inventions and fantasies, (situation, event, episodic or, generally, mental) models were for me among the most useful and enduring products of our cooperation on what we called the "strategic" approach to text processing. So, my brief history of our joint efforts pays special attention to these mental constructions, which play such a crucial role in understanding text as well as in other cognitive processes.

However, let me start at the beginning, which is first about me, then about some earlier attempts by others, then about us, and then about what followed.

TEXT GRAMMAR

For me, the beginning was "text grammar," a concept that I now use with some hesitation, if not shame. After all, although it was a good idea, it was a good idea like "democracy"—according to Gandhi—was a good idea: It existed in my theoretical mind, and only some fragments of it were formulated in terms of what pretended to be something like a grammar, for instance in my doctoral dissertation (van Dijk, 1972).

Originally, text grammar for me was a means toward a more lofty end: the account of structures of literature. Starting my academic career as a literary theorist (after a first degree in French language and literature), I soon found out that traditional or even "structuralist" (this was the late 1960s) approaches to literature were hardly explicit, if not impressionistic. With the great linguistic example of the time, Noam Chomsky, descriptive and explanatory adequacy should result from a set of rules, a *grammar*. I knew no persuasive arguments that explain why such grammars should not also be developed for texts as well, although for Chomsky and other syntactically oriented grammarians of the time such an endeavor had little to do with grammar (that is, syntax) as they first defined it. However, the way I saw it was that once we had a more general grammar of texts, the formulation of special rules that would "generate" literary text structures would be a piece of cake. Or, so I thought.

As usual with good ideas, they hardly came alone: Others in (mostly European) linguistics were working on similar ideas, and from then on these fantasies came to be known as *text grammar*, and somewhat later, also in the United States, they were known as *discourse grammar* (see, e.g., De Beaugrande & Dressler, 1981; Longacre, 1983). One crucial argument of the theory of such text or discourse grammars was that structures of sentences in texts influence structures of neighboring sentences. That is, grammar should be relative: Syntactic and especially semantic structures of a sentence need to be described and interpreted relative to those of other sentences in the text. After all, there were no serious reasons why, for instance, a pronoun in a next sentence would require a totally different theoretical account from a pronoun in a next clause of the same sentence. Why sentence-internal pronouns would require description within a grammar, and cross-sentential pronouns would be relegated to a theory of language *use*, or *performance*, made no sense, and would violate the principles of intuition, elegance, simplicity, and parsimoniousness. In other words, sentence boundaries may be syntactically real, but constraints on sentence structures of various kinds do not always stop at that boundary.

This was a fortiori the case for semantics, for which the sentence boundary was even less relevant: One may mean more or less the same thing by uttering one complex sentence or a sequence of sentences. And, more interestingly, some things had to be said in separate sentences, and could not be reduced to a single sentence—for instance, after a change of speech act, perspective, or level of

description (as in such pairs as, "It's cold in here. Could you please close the door?" or in, "John was late. In fact, he was always late"). Indeed, many notions that seemed to be relevant for texts were not even discussed in sentence grammars, or only in a rather ad hoc and inelegant way.

One of these notions was that of (semantic) *coherence*: Sequences of clauses, but also sentence sequences, intuitively "hang together." Such coherence seems to be the very core criterion of "textuality." Without coherence, a text would be nothing but an arbitrary sequence of unrelated sentences, much in the same way as a sentence would be merely an arbitrary sequence of words without a grammar. Once we had the basic criteria for this kind of linear, intersentential coherence between sentences (or rather, between propositions, because we are here dealing with semantic objects), we would also have a basic account of the nature of co-reference, textual deixis, and hence of pronominalization and other typical expressions (cohesion devices) that express underlying semantic coherence.

Although these ideas extended the scope of the grammar, they were in fact hardly revolutionary. Indeed, except maybe the notion of coherence per se, virtually all other theoretical instruments were still the same as those of sentential syntax and semantics. Obviously, this would not do. Sentences in a sequence might well *be* linearly (one-by-one) connected, but this was neither a necessary, nor a sufficient condition for what intuitively was felt to be textual coherence. Texts also have some overall unity, which makes sure that local coherence *between* sentences has some direction or continuity. So, the next step was to introduce the notion of *macrostructure*, namely, as a semantic structure that would describe, at a more global level, this overall unity and coherence. At the same time, the notion of macrostructure would be able to account for such important intuitive notions as topic, theme, gist, upshot, summary, and similar notions so abundantly present in everyday English, and *hence* apparently important in language use.

Incidentally, the notion of macrostructure had been used before, namely, by the prominent (then East) German linguist Manfred Bierwisch (Bierwisch, 1965). However, he used it to describe the conventional overall structure of stories—the kind of schematic (formal, categorical) structure I later called *superstructure* to distinguish it from the semantic macrostructure that defines the overall meaning of a text (van Dijk, 1980a).

At this point, current sentence grammars were left behind, because there was no theoretical concept in syntax and semantics that was similar to that of macrostructure. Macrostructures were related to their (local) *microstructures*, that is, to the propositions expressed by the sentences of the text, by mapping rules (e.g., those of deletion, generalization, and construction) that theoretically simulate the types of information reduction that characterizes the process of abstracting or summarizing a text.

In the early 1970s it was virtually impossible to sell outlandish products such as macrostructures to linguists, and even less to transformational grammarians.

Even my own text grammar colleagues in Germany (the Konstanz group), for whom formal theorizing was imperative in order to be able to compete with generative grammar (and be credible or persuasive as an alternative, serious grammar), macrostructures were still a rather strange element in grammar (see, e.g., Petofi & Rieser, 1973). However, intuitions about text structures proved to be too powerful, and leaving the rigid mold of the then prevailing theories of grammar, I went looking for allies elsewhere.

And that is how I met Walter.

TEXTS AND PSYCHOLOGY

Why Walter? Why, indeed, psychology? The late sixties and early seventies had more to offer for text analysis in the emerging semiotics or in structural theories of narrative (Communications, 1966). However, semiotics was hardly explicit enough: It had provided ideas about narrative schemata and about the structural semantics of stories (Greimas, 1966), but there was nothing like the notion of macrostructure or, indeed, a general theory of discourse. A more general approach was necessary, and in order to prove the existence of macrostructures, the psycholinguistic mood of the time suggested looking for empirical evidence of grammatical structures in cognitive processing. So, if macrostructures were real, they also would have to show up in theories of text understanding.

In 1972, however, there was no ready paradigm to provide such theories of text understanding. Psycholinguistics was still wholly absorbed in testing the psychological implications of generative grammars, and of course did not talk about text or discourse (Jakobovits & Miron, 1967). After Chomsky's onslaught on Skinner, psychology itself was barely beginning to reject its behaviorist shackles, and the cognitive revolution was still in its infancy. Three of the books marking that watershed—namely, Lindsay and Norman (1972) and Tulving and Donaldson (1972), both appearing in the same year, and Anderson and Bower (1973), appearing a year later—had little to say about text processing: The terms *text* and *discourse* do not appear in their indexes.

Theories and experiments of understanding and recall of that time were still focused on lists of words or at most on sentences. Processing language was largely verbal learning, although problem solving, question answering, propositional representations and notion from rediscovered Gestalt theory already provided some of the theoretical instruments that later proved to be useful in the development of a cognitive theory of text processing.

Even Walter, in his extensive contribution to the Tulving and Donaldson book (W. Kintsch, 1972), did not yet go beyond the conceptual structure of lexical items and propositions, but translated the then-popular generative (sentence) semantics into a theory of memory representations. In sum, psychology in the early 1970s was still discovering the basic semantic units of language, understanding, memory and recall, and text was certainly not one of them.

Yet, the history of the cognitive psychology of discourse did have important forerunners who did speak about texts, and their work would soon be rediscovered by psychologists and the scholars in the then-emerging new field of artificial intelligence (AI) alike. Bartlett (1932), as is now recognized, was the most important and most influential of them all. Quibbling over theoretical sophistication and experimental adequacy instead of focusing on major new ideas, Anderson and Bower (1973) were reluctant to recognize the relevance of Bartlett's work, whereas Lindsay and Norman (1972) only referred to his book in their bibliographical recommendations. In that respect, they hardly followed the lead of Neisser (1967), whose *Cognitive Psychology* not only introduced the new cognitive paradigm, but also extensively discussed Bartlett's work, especially the soon popular notion of "schema," although without saying much about texts or semantics.

The hesitation in the new cognitive and semantic paradigms of the early 1970s to use stories and other texts as experimental materials or as objects of theoretical speculation also ignored other scattered but interesting work in the previous decades, sometimes directly influenced by Bartlett. Thus, already in the early 1940s, Cofer (1941, 1943) had done experiments with verbatim and "logical" learning of prose passages, as well as with long-term recall of stories. After another early study by Slamecka (1959), most other work on "learning from text," however, began to appear in the 1960s and early 1970s (see, e.g., Dawes, 1966; Dooling & Lachman, 1971; Frase, 1969, 1972; Frederiksen, 1972; King, 1961; Koen, Becker, & Young, 1969; Lachman & Dooling, 1968; Lee, 1965; Pompei & Lachman, 1967; Rothkopf, 1972).

It is not surprising that many of these studies came from educational psychology, the field that also later proved to be particularly receptive to studies on text processing, given the obvious need to understand the processing of textual learning materials. Indeed, our later article in the *Psychological Review* (W. Kintsch & van Dijk, 1978) would be most widely quoted in educational psychology.

Again, 1972 appeared to be a crucial year for these early ideas on learning from text to appear in the form of a book, namely, Freedle and Carroll's edited book on language comprehension and the acquisition of knowledge (Freedle & Carroll, 1972). Here, both "text" and "discourse" appear in the Subject Index, and several papers discuss text structures and processing extensively, such as those already mentioned by Frederiksen, Rothkopf, and Frase, as well as those by Chafe (1972) and Crothers (1972). Chafe's contribution in this book is especially interesting in light of later AI developments on the role of knowledge in text comprehension: He showed that many properties of discourse (such as pronouns and definite noun phrases) not only may presuppose previous information in the text but also systematic knowledge of the world. Similarly, Freedle (1972), following Dawes (1966), was among the first who explicitly aimed to study the comprehension of topics of texts, without presenting a theory of the textual nature of such topics, however (he abstractly associated topics with what he called "the set of possible alternatives"). Crothers (1972), in his formal account of text

structure, was much more explicit about the structure and the role of topics, and defined them in terms of hierarchical conceptual structures that resemble the outline of a text, and thus came close to the notion of macrostructure. Frederiksen (1972), also influenced by Dawes (1966), focused on a formal model of "veridical," "inferred," and "elaborative" information that results from text processing, thus focusing on the semantic structure of recall protocols.

In sum, in the Bartlett tradition, this book seems to be the first in the new cognitive psychology to explicitly think about the role of texts and their structures in comprehension and recall. Most explicit, as is the case elsewhere in psychology and linguistics, is the new propositional semantics for sentences. Typical textual structures beyond the sentence level are either ignored (in which case texts are simply treated as sequences of sentences or propositions) or still dealt with in more or less informal terms. Similarly, despite special interest in the structure of text recall protocols, this work still tells little about the kind of actual processing strategies and representations of text in memory. Making up for a lack of revolutionary new ideas, it is surprising to see how much these and similar studies, following the linguistic trend, were couched in arcane logical, mathematical, and graph-theoretical jargon.

THE PSYCHOLOGY OF TEXT PROCESSING

From this brief history it becomes clear that the early 1970s have been pivotal in the emergence of the psychology of text processing. Thus, the year 1972 was an important temporal point of crystallization, namely, when many of the earlier ideas appeared in book form. Incidentally, this was also true, more or less independently, in several related disciplines dealing with discourse, such as artificial intelligence (Charniak, 1972; Newell & Simon, 1972), linguistic pragmatics (Wunderlich, 1972), sociolinguistics (Labov, 1972a, 1972b), and the ethnography of speaking (Gumperz & Hymes, 1972). Apparently, sometimes the *Zeitgeist* can be pinpointed to a rather precise period of change.

In this context and against this background (that is, between 1972 and 1974), Walter and I, at first independently, discovered the mutual relevance of discourse and cognition. This is especially clear in Walter's first book, which deals extensively with text meaning (Kintsch, 1974). Whereas this book already refers to my 1972 dissertation on text grammar, I had little to say about the psychological nature of text grammars. Again, due to the influence of TG psycholinguistics, which always wanted to prove grammatical tales in cognitive terms, I had briefly speculated on the psychological nature of macrostructures. With little knowledge about the barely emerging cognitive psychology, I nevertheless had the inexplicable intuition to read and refer to the three most relevant books of that time to support my ideas (Bartlett, 1932; Neisser, 1967; but see also Miller, Galanter, & Pribram, 1960, a seminal but at first rather ignored book on plans and under-

standing, which provided abstract ideas—TOTE units, etc.—that later proved to be very relevant for theories of macrostructures and other structures of the organization of discourse).

As soon as I read Walter's new book (W. Kintsch, 1974), I knew that the marriage of text linguistics and the psychology of text processing was imminent. Whereas many earlier studies were close encounters of the first kind, Walter's book initiated, for a broader public, the second phase of the courtship of the two neighboring approaches to discourse. Beyond the prevailing linguistic and cognitive semantics of the time, this monograph explicitly took texts as a major object of study for experimental cognitive psychologists (and not only as arbitrary materials of "prose recall" experiments). Thus, while retaining his earlier ideas of propositional structure (W. Kintsch, 1972), and still under the spell of TG semantics, Walter explicitly construed these propositions in a "textbase." This notion of a textbase had also been used by the Hungarian-German text grammarian ^{Petofi} (1971) in the first book on text grammar, but Walter probably did not yet know this work. Walter emphasized that psychologists should also proceed to take texts as the basic units of their studies. Many unsolved issues in linguistics and psychology, such as the resolution of ambiguity, could then be easily accounted for in a theory of texts: Problems arise because "linguists write sentence grammars instead of text grammars, philosophers analyze isolated sentence examples, and little psychological work has as yet been done with complete texts and proper contexts" (W. Kintsch, 1974, p. 11).

After this programmatic statement, Walter then goes on to specify the nature of a textbase in terms of proposition sequences made coherent by argument repetition, whereas macrostructures can be defined as higher order propositions subsuming underlying propositions. Despite his discussion of macrostructures, Walter largely focused on the microlevel of propositions, obviously the more concrete material evidence of text structure, both in psychology and in linguistics. Macrostructures are more abstract, and cannot be "seen" directly—unless in summaries or other expressions of abstract underlying structures—and are therefore less easy to pinpoint in an experiment: They must be inferred from texts.

Despite our enthusiasm for the program of a new psychology of text processing, this focus on propositional linkage due to argument overlap also produced our first theoretical disagreement. In my view, such overlap was indeed rather typical of discourse, but neither a necessary, nor a sufficient condition, and hence a derived property of more fundamental conditions of coherence. Instead of merely relating arguments of propositions, the entire propositions should be related by coherence links. However, Walter's experiments seemed to nicely confirm argument overlap, and I had only linguistic evidence and intuitions to offer (see also van Dijk, 1976).

The fact that in 1980 we dropped the practical] (while easily testable) argument-overlap criterion, also shows how sometimes successful experimentation may initially induce psychologists to keep looking for epiphenomena instead of

searching for deeper regularities, and how linguists and psychologists sometimes remain at odds when trying to explain discourse structures and their processing. After all, linguists have little to offer to empirically test their theoretical ideas: Many of their constructs may have no psychological processing reality at all.

Also, Walter soon convinced me that theoretical simplification is often unavoidable when running an experiment, if only for a feasible analysis of textual test materials or recall protocols. For instance, his practical method for propositional representations of texts worked nicely to assess text recall, but would probably be an intolerable simplification for formal philosophers and linguists, whose theories of propositional structures, however, were too complex and abstract to be used in practical experiments and analysis.

After the publication of his book, I had sought contact with Walter and made my first pilgrimage to Boulder, which initiated the beginning of nearly a decade of close collaboration. From the start, our discussions were exciting, stimulating, and fruitful (and that is not a typical preface formula): I went home with a lot of ideas about how to test some basic features of text grammars, or indeed, of theories of discourse more generally. Parallel to working on my next and last book on text grammar (van Dijk, 1977b), I thus started to do "memory experiments" with my own students (departments of literature have no labs), using stories from Boccaccio's *Decameron*, materials that were also used by Walter and later by others, simply because they were short and had canonical narrative structures. Our first paper, therefore, focused on story structures and recall (W. Kintsch & van Dijk, 1975). Interestingly, this paper was not published in English (although the English text circulated widely) but in a French version, which proved to be a major obstacle for referents: Many people who referred to that paper mentioned the (linguistic) journal *Language as* its source, instead of the French journal *Langages*, which also shows something about the practice of referring in psychological articles.

One major theoretical point of this more (in Walter's case) or less (in my case) experimental work was to show the relevance of narrative structures on the one hand, and of semantic macrostructures on the other hand: Subjects typically show not only that they actively recall only a fragment of the original stories (typically between 10% and 25% on immediate reproduction), but also that what they reproduce is not just a fragment of the earlier text, but rather a higher level, abstract version of it, that is, something that looks much more like a macrostructure of the text. Indeed, immediate summaries of a story (theoretically expressing the—subjective—underlying macrostructure) nicely predict what subjects will recall later. We thus had a much clearer picture of the relationship between texts, their semantic macrostructures, and the mental processes and results involved in understanding and recall (W. Kintsch, 1977b; van Dijk, 1979).

At the same time, besides macrostructures, narrative schemata (superstructures) play a role in understanding and recall. This hypothesis would soon spark the famous "story grammar" row, which opposed story grammarians such as

Mandler (1978, 1984), and AI approaches to stories formulated in terms of action structures, plans, goals, and related notions (see the discussion in the issue of the *Behavioral and Brain Sciences* about Wilensky, 1983; see the special issue of *Poetics* on this topic: van Dijk, 1980b).

Our theory around 1975 assumed that texts are processed in cycles, due to the limited size of the short-term memory buffer, and that in this way a text representation (or textbase) is gradually construed in episodic memory. This textbase, however, does not merely consist of a connected sequence of propositions, but also features a hierarchical structure of macropropositions, corresponding to the major and minor topics or themes of the text, as assigned to (inferred from) the text by the reader. Delayed recall, in that case, involves this textual representation, but in such a way that, in general, primarily the higher (macro) nodes would still be available, plus an incidental lower node if representing information that was salient for other reasons.

At the same time, however, something was still lacking: knowledge. In order to be able to establish links between propositions in the episodic textbase, and to derive semantic macrostructures, vast amounts of knowledge were involved and applied by the reader. It was at this time that also the first AI work on knowledge and text comprehension began to appear, so that we readily introduced notions such as knowledge frames, and later "scripts" into our theory (Schank & Abelson, 1977; van Dijk, 1977a). However, we did not further explore the nature of the representation or the application of such knowledge in text processing: It was simply assumed that in order to construct a textbase readers would activate relevant scripts or other knowledge structures to infer "bridging" propositions or macropropositions to establish local and global coherence. Walter, however, continued his earlier work on lexical memory, and continued to battle with the AI people on the nature of knowledge and lexical structure (W. Kintsch, 1977a).

Around 1977, the theory had developed up to a point where rather specific predictions could be made about text recall. Several experiments had *been* devised and carried out, also by Walter's students, and we were ready to submit a paper to a serious journal, which became the much-cited 1978 *Psychological Review* paper. The text being used this time was not a story but an (informal) scholarly paper from social psychology: "Bumper Stickers and the Cops." The paper was about a social experiment in California in which subjects that had Black Panther bumper stickers were more harassed by the police than other drivers. Again, both the macrostructure and the superstructure hypothesis were tested, and the theoretical predictions Walter had developed in a more or less formal theory were nicely confirmed (for other work along these lines, see, e.g., the special issue of *TEXT*; van Dijk, 1982a).

As predicted, the overall macrostructure of this scholarly text was recalled best, whereas its abstract genre schema helped recall. Interestingly, especially in immediate recall, subjects also recalled a number of salient details. For instance,

the fact that one of the people who was often stopped by the police was described as a "blonde girl" was one of those seemingly irrelevant "details" of the text my subjects in Amsterdam remembered quite well. After longer delays, however, that detail was also forgotten. The moral of that finding was that macrostructural (topical, important) information is indeed crucial for understanding and recall, but that also other factors may influence attention, prominent representation, and, hence, recall. That is, information may be salient, well-organized, or better retrievable for other (social, personal) reasons, such as remarkableness, vividness, or other vague criteria that need better theoretical analysis.

THE THEORY OF STRATEGIC TEXT PROCESSING

After the success of the 1978 *Psychological Review* paper, it was time to write up our theory of text processing in a more ambitious and extended form—in a book. So many elements of the theory never got a detailed discussion in the earlier papers, and a book would give us the opportunity to do just that.

In the meantime, however, our core theory was also undergoing significant change. We were both feeling that the theory up to 1978 was too "static," too linguistic: Propositional text representations in memory were hardly different from the abstract semantic representations of sentence and text grammars, and the only difference with a formal description were some necessary elements of the process model: Processing in short-term memory, assumptions on the size of the short-term memory (STM) buffer, and cyclical construction of a text representation in episodic memory. Also, of course, the role of implicit information in understanding (derived from knowledge scripts) was a genuinely psychological dimension.

However, such an approach was too neat, too structuralistic, and seemed to reflect too little the actually ongoing mental processing. A proper theory of text comprehension and production would have to embody the more dynamic, ad hoc, online, tentative nature of understanding. Instead of rules (e.g., for the account of macrostructure derivation), therefore, we needed more flexible ways to represent the process. We thus introduced the crucial notion of *strategic* processing: an online, context-dependent, goal-driven, multilevel, hypothetical, parallel, and hence fast and effective way of understanding.

Thus, for each partial process involved—such as decoding surface structures, analyzing syntactic structures, interpreting local and semantic meaning, establishing (co-)reference, and interpreting speech acts, among other things—various strategies would be needed to effectively do such a specialized job. The same would be the case for the activation and application of knowledge in the construction of the meaning of the text. That is, the strategic approach at the same time presupposed a modular conception of processing.

The various strategies would be monitored by the specific goals of the reading (or production) process, and hence by contextual (interactional, social) informa-

tion. Readers should be expected to make mistakes, if only to account for garden-path sentences, and for other likely mistakes they would make, online, when reading the respective words and sentences of a text. All this would make the theory much more flexible, more psychologically valid, although at the same time theoretically more fuzzy. Instead of precise rules, we now needed complex, more or less strategic operations being fed by information from knowledge scripts, representations of context, various textual levels, and so on. When processing syntax, semantic, pragmatic, or other information would help, and vice versa. Modularity, thus, did not imply independence of respective processes involved.

This vastly complex process could only be centrally managed by a mental supervisor, that is, a Control System that would coordinate the various tasks being accomplished at the same time, that would do the bookkeeping of the information being activated and deactivated, and that would match the ongoing processes with the overall goals of the process, such as those of understanding and production. The Control System would also take care of another theoretical problem: If the STM buffer is limited, say to seven plus or minus two units of each level of analysis, then it is hard to imagine how STM itself would not only be busy decoding incoming talk or text (letters, sounds), analyzing syntax or assigning semantic and pragmatic interpretations, but also at the same time deriving macrostructural propositions (topics), schematic structures ("this is a story," "this is an argument," etc.), macro speech acts, contextual information (overall goals), and so on. With our understanding of the limitations of STM, we could not imagine how STM could handle all these tasks. Therefore we assumed that all control tasks had to be taken care of by a different system, which would guide the process—metaphorically speaking—"just below the surface" or "across the horizon," and be less conscious *than* the actual processes being worked on. However, such control information would need to be immediately available, and activated as soon as it was needed for STM processing (e.g., when problems arise or questions are asked that pertain to the control process: "What are you doing?"). Although this control system plays such a central and prominent role, we were unable to provide a detailed description of its precise internal structures or of the management processes involved. As far as I know, no other theorists have been working on the precise nature of such a system, either theoretically or empirically. Here is one of the many unfinished elements of our theory that needs further attention.

For the book we also abandoned the local theory of coherence based on argument repetition, which in light of theoretical advances was no longer tenable, and had been criticized from various points of view. Instead, we further focused on propositional coherence, namely, as a relation between whole propositions, of which argument overlap is a special case.

Our major example, discussed throughout the book, was a news article: a text on the situation in Guatemala published in *Newsweek*. This article was analyzed systematically, and its understanding by real readers was explicitly simulated for

all levels: syntax, local semantics and coherence, macrostructures, schematic superstructures, and context. In addition to our earlier focus on comprehension, we also added a chapter on text production, which would at least tentatively fill another major lacuna of the theory.

I had proposed to extend the theory also to what was increasingly becoming known as "social cognition," that is, with a component that would account for opinions and attitudes (van Dijk, 1982b). So far, the theory of text processing was rather narrowly cognitive, and hardly any social contexts, or specific sociocultural information beyond knowledge, was involved to account for understanding. However, when people read a news report in a weekly like *Newsweek*, opinions, attitudes, ideologies, emotions, norms, and values are involved. Readers may evaluate the miserable situation in Guatemala, and it is plausible that processing and recall are also a function of such and other social cognitions shared with other readers (e.g., an anti-U.S. point of view, a pacifist attitude, etc.).

Although Walter found all of this quite likely, his caution made him veto this hazardous extension of the theory, for which we had neither theory nor experimental data. We already had more than enough complex and at times hazardous hypotheses and ideas to defend in the book. Going all the way would probably make the book less credible. For me this was fine, but it meant that something was still on the agenda. So during the 1980s, I have, though from a different perspective, tried to develop some of these ideas on the relations between discourse and social cognition; these are crucial to understand real discourse understanding, namely, as a function of the mentally represented social position of the reader(s).

MENTAL MODELS

One of the key concepts of the new theory was the notion of a *situation model*. A model, as we saw it, is a construct in episodic memory that represents the event or situation a text is *about*. That is, for the first time, we would build in a true referential dimension. Texts no longer would be interpreted relative to reality, but to the subjective representation of a fragment of reality in the reader's mind. The overall goal of text understanding in that case would no longer be, as we had assumed until the end of the 1970s, the construction of a textual representation (textbase) in episodic memory, but rather a model of the event or the situation referred by the text. The textbase would merely represent those meanings expressed by the text—those relevant for local, online understanding—but real understanding would involve the construction of a new model, or the updating of an activated old model. Such models would of course be subjective: It would feature personal associations, inferences, and fragments of other models (i.e., previous experiences). Hence, the model of a text would be personal, ad hoc and unique, and define one specific interpretation of one specific text at a specific moment.

Most importantly, models would feature the activated and instantiated information derived from knowledge. Indeed, the resulting model of a text would be much richer than the representation of the text itself, which would merely express relevant new information, and some pointers to old or otherwise known information (e.g., in the form of presuppositions, expressed or signaled by, e.g., definite anaphors, relative clauses, or sentence order). In other words, the text and its episodic representation are merely the tip of the vast iceberg that constitutes the model, featuring bridging propositions, fragments of personal knowledge, fragments of general social knowledge, and so on. Thus, models are the ideal interface between shared social information such as knowledge, on the one hand, and the personal, unique semantic interpretation or production of a specific text, on the other hand.

Models for us had many uses. We listed at least a dozen independent arguments concerning why models were indispensable. Thus, models were also necessary to explain what most psychologists had ignored, and what was crucial in a theory of discourse: reference, co-reference, and referentially based coherence. With a model, all this was easy, elegant, and transparent. Texts are simply interpreted relative to a model. Argument overlap, hence, was no more than a strategic surface expression of underlying continuity of discourse referents in a model. This use of the notion was of course hardly new in logic and formal linguistics: Formal semantics had introduced possible worlds and models some time ago, though in very abstract terms, in which model structures consist of sets of individuals, and other elements needed to interpret sentences relative to a formal model. Some of these ideas were soon also applied in the formal interpretation of (some) discourse structures, such as anaphora (Kamp, 1981; Nash-Webber, 1978; Stenning, 1978; see also van Dijk, 1977b, 1987b).

The functions of models were many. Thus, they also allowed us to put some distance between propositional representations of texts and memory and intuitions about possibly analogical representations of textual information people may have stored. That is, once one has the notion of a model, one may also explain how it is that after a period of time people no longer remember whether they have read about an event, seen it on TV, or actually participated in it. Whatever the mode of perception, the results in all cases would be a model of the event. Also, models allow a much better understanding of how spatial information is processed and stored. (See also recent work in Van Oostendorp & Zwaan, 1994.)

The introduction of the notion of model implied that for the first time we had a starting point for processes of production. Comprehension theories are not only easier because we can manipulate input texts, and then measure the results of understanding by recall protocols, question answering, priming, or other methods. For production, it was never quite clear where to start with lexical items, knowledge, or semantic meaning representations. With the text-independent notion of a model, talk and text production begins with a representation of a personal experience (as in a story), or other specific, personal knowledge about the world,

represented in a model. Indeed, the point and intention of much informative communication is to convey our models to others, or to realize models expressed by others, as is the case in commands, plans, recommendations, instructions, or similar discourse types and speech acts.

Finally, as suggested earlier, models are also the missing link between texts and general, socially shared information such as knowledge. That is, whereas scripts are about stereotypical or prototypical events and episodes, and hence feature general and abstract information (typically represented by variables), models represent concrete, specific events, and hence feature constants representing specific people, places, or time. What was usually referred to as knowledge instantiation could now be formulated in terms of specifying general information as particular information in a model. Conversely, learning would involve processes of generalization and abstraction based on (sets of) models, thus linking episodic memory with semantic memory. This view suggests that besides specific models of unique situations, people probably also have generalized models in episodic memory: These may be personal, and hence feature specific individuals (for instance myself), and at the same time abstract from specific time, place, or circumstances (as in the models I have of my daily work or weekly shopping).

As with other useful theoretical concepts, the idea of mental models as the basis for textual interpretation was discovered more or less at the same time by Johnson-Laird, whose book *Mental Models* (1983) appeared in the same year as our *Strategies of Discourse Comprehension*, but who had already published earlier articles on models (Johnson-Laird, 1980). However, Johnson-Laird had other motivations, goals, and uses for these models, which, in line with his earlier work on inferences, especially served to explain otherwise strange contradictions between logical and psychological inferences. Furthermore, Johnson-Laird did not specifically focus on discourse comprehension (but see Johnson-Laird & Garnham, 1981).

Thus, although there were many differences in the ways we used the notion of a model, the fundamental idea was the same. Both Johnson-Laird and I were obviously inspired by developments of model theories in formal semantics and linguistics, which also began to find their ways into theories of formal discourse structures, as I (imperfectly) had tried to provide in my 1977 book. I remember having written an unpublished note for a conference in Paris in 1981 in which Johnson-Laird also participated, and whose work on models I still had not seen. This note was about "text representation and world representation" in a psychological theory. Although the basic idea of models was there, I still had no idea how rich and useful the notion of a model would eventually become in the theory developed with Walter soon after that.

Indeed, at first Walter was not readily convinced by these premature ideas to introduce a totally new form of representation in our theory. Rereading the hundreds of letters that constitute our contacts of that time (long-distance cooperation has the advantage that one has a record of it in the form of letters), I

found the following, poetic passage in a letter from Walter of December 12, 1980, reacting to my "text-world" paper:

My first reaction to this paper was something like a shock. I sat outside in the noonday sun, which was so strong that both dog and cat had retreated into some shade; only I, being considerably older, was still soaking up the warmth; everything was utterly quiet, except for some birds rummaging around in the dead leaves under the trees. In the midst of this pastoral scene burst this manuscript, stepping right into the middle of the learning issue. This is, of course, acknowledged as a fine problem, but hardly anybody dares touching it these days. Wasn't it too presumptuous?

On the other hand, of course, it is certainly the case that you are talking about real problems. Are we obliged to hide them, just because we can't properly solve them? Just as a little breeze came up which drove the cat and me inside, I realized that I was shocked for mailing. What you do here is merely to say that such-and-such are the outlines of a problem that is very important; take note psychology, and start worrying how to solve it.

After his initial shock and hesitation, Walter, practical as ever, then goes on to propose how "world representations" in memory might be modeled and experiments run to test it. At the same time, he warns against the notion of "pictures" of the world.

This was typical of our cooperation. I might come up with a crazy idea, or one of these other linguistic inventions or objections, and Walter would think, hesitate, and see the useful elements in the idea. Then he would propose how to deal with it in a way that would be acceptable to psychologists. More than that, once the notion of a "situation model" became part of the theory, he came up with many of the arguments as to why it was so useful; and I had introduced it primarily to account for coherence, (co)reference, and as a bridge between social knowledge and semantic representations of texts.

The success of the notion of mental models was considerable. In different branches of cognitive science and psychology it was being used more and more, also because it allowed nice links with formal approaches to language and discourse, AI representations of "reality," and so on. Soon, also the first experiments were carried out to test some concrete predictions of the model, for example, by Morrow and his associates, who nicely showed that information close together in the text, but already "old" or "distant" in a mental model (e.g., when in a story the storyteller continues to talk about Mary when it has just been said that Mary left the house) was more difficult to retrieve than information about individuals still "present" in the now-active model (or model fragment) (Morrow, 1986, 1990; Morrow, Greenspan, & Bower, 1987). Also in British psychology, much interesting work was done on text understanding making use of the notion of a model (Garnham, 1987). One of the theoretical differences was/is that for Walter and me it was clear that models were needed besides textual repre-

sentations (which have their own role in understanding and production), whereas others only admitted models as interpretations of discourse.

There was one major point where all model theorists so far failed to deliver the goods: No one had any clear and explicit idea about what such models looked like. We knew what they should do, we knew a lot of their functions, and what was probably in them (like representations of our personal knowledge about persons, objects, events, and situations), but how such information was to be represented, we had as yet no clue. With Johnson-Laird, and others, we agreed that some model information might be analogical, but that opened the well-known Pandora's box of visual versus propositional (or other abstract) representations that had inspired earlier theoretical disputes in psychology (Paivio, 1971). Also, using the terco *analogical* begs the question of representation formats, and may lead to more questions than it answers. So, despite their central role in text processing, we still know very little about the internal structures of models, as well as about the detailed strategies of their construction, change (updating), activation, de-activation, and other processes relating them to the rest of the memory system. I come back to the problem of model structures later.

The limitation of cognitive psychology to knowledge-based processing also implied another restriction on the view of models. That is, as I remarked about the processing of our *Newsweek* text about Guatemala in the *Strategies* book, what was lacking in the model were other forms of personal beliefs—that is, *opinions*. Readers of that text not only represent what is going on in Guatemala (following the textual leads persuasively expressing the "preferred model" of the writer), but also have evaluative beliefs about that situation. That is, in the same way as they bring to bear general knowledge about civil wars and oppression from their scripts or frames in semantic knowledge, they also activate and apply socially shared attitudes and ideologies, for example, about the role of the United States in Central America. The concrete personal opinions that result from the instantiation of such group attitudes are also part of the readers' model of Guatemala, so that models can also be seen as the interface between personal and social cognitions, and between individual and group-based understanding of a text. Possibly, models might even feature a representation of personal emotions, such as hate, fear, or jealousy. If so, this would nicely explain the well-known finding, already familiar in Proust's *A la recherche du temps perdu*, that emotions sometimes may be used to retrieve specific models about past events (Bower, 1980).

Finally, people not only construct models of events they read or speak about, but also of the communicative events they are engaged in. An ongoing conversation, reading the newspaper, or watching TV are such events, and while processing the information these discourses are about, language users also activate, construct, and continually update the *context model* of the present communicative situation in which they participate. Such special situation models are relevant because they represent the context, including speakers or readers, the author or

the listener, the newspaper one reads, the goals of the interaction, and other pragmatic information relevant for understanding and production. Context models, thus, are in turn the interface between event models and the concrete text: what speech act to select, what style to use, what event model information to express or what to presuppose (given the knowledge of the reader/hearer, also represented in the context model), and so on. In other words, whereas much of the meaning of texts is controlled by the event model, much of the variable surface structure of the text will be monitored by the context model. Unfortunately, Walter and I had no idea either how to represent context models and their interactions with event models, and how context models influence the actual semantic and formulation strategies in text production, or the biased interpretation of texts in understanding, that is, as a function of the contextual position of the reader. This was another of the fundamental questions we had to leave open for future research.

All these theory fragments, experiments, and the writing of the respective chapters of the *Strategies* book obviously took a lot of time. Ideas for chapters going back and forth over the ocean (e-mail at that time was not yet operative—although in our correspondence I saw that we briefly used a precursor system called Plato), and finally Walter retreated to the Stanford Institute for Advanced

Study and I took the opportunity of a stay in Berkeley to commute to Stanford in order to discuss the finishing touches of the last version.

As with all the discussions we had during my trips to Boulder, and Walter's occasional visit to Amsterdam or Austria, our debates were always exciting. Unlike much experimental work in psychology, my own work in text grammar and discourse analysis was usually a rather isolated activity, with only occasional close collaboration with others. So, my joint work with Walter was also a rather new experience in jointly producing ideas and a book. Despite our differences of theory, our frequent working sessions were mutually inspiring and very productive. It is only due to this *ferro* of close cooperation that I learned so much about the psychology of text processing, if not about experimentation. Discussions would often continue at home with Eileen Kintsch, who after her earlier work in linguistics and German began to make a career in psychology herself, and whose many comments and hospitality made my trips to Boulder more than just a business trip to see a colleague. Soon, she also became a co-author of some of the work at Boulder on story comprehension (Poulson, E. Kintsch, W. Kintsch, & Premack, 1979).

FINAL EPISODE: NEW DOMAINS AND APPLICATIONS

It is now 10 years ago that our book *Strategies of Discourse Comprehension* appeared. Although I sometimes see *references* to it, I have been unable to follow the relevant psychological and related literature in order to see its academic fate.

Checking our citation scores, I see that even 10 years later dozens of our citations are still based on this common work.

In the meantime, and as usual, I have moved to other domains of research, trusting that hundreds, if not thousands, of psychologists over the world would continue to work on the psychology of text processing. Increasingly interested in the social and political dimensions of discourse, I turned to the study of news in the press, and especially to the analysis of the reproduction of racism and other forms of inequality through discourse and communication. However, also for this research I have immensely benefited from my earlier work with Walter, and our theoretical framework has served me to formulate research questions in these new areas that otherwise would have remained vague. Let me therefore finally summarize some of my own applications and extensions of our theory in these new areas.

News Analysis

As is often the case in the humanities and the social sciences, everyday phenomena tend at first to *be* ignored by scholars. Such was the case for everyday interaction and mundane conversation in sociology and for everyday memory in psychology. It is also true for the genre of text most adult citizens (in rich societies) are confronted with daily and most intensively: the news reports of our newspapers. In a series of studies, I therefore turned to a systematic analysis of the structures of news reports, and to the processes involved in their production, comprehension, and uses by the readers (van Dijk, 1988a, 1988b).

Obviously, processes of news production and comprehension not only involve social interaction of journalists and news actors, or patterns of communication more generally, but also cognitive processes. Thus, in the daily production of news reports, journalists are confronted with the formidable task of processing large numbers of source texts from other media, informants, interviews, press conferences, press releases, phone calls or documents, and of reducing that vast amount of information to the relative short news report one reads in the paper. The mental strategies involved in this routine process of information reduction obviously need to make use of macroprocesses of information reduction: Just like the reader of the newspaper, journalists also must reduce many input texts to a manageable story, which is in fact a relevant combination of the journalist's (subjective) macrostructures of the input texts.

Also involved are the mental models of news events journalists construct and update on the basis of the source texts they process. They combine new information with already-present information about the same topic or issue, and thus daily update their models of important social and political events. As is argued in somewhat more detail later, these models may be unique, ad hoc, and personal, thus representing the personal experiences and opinions of the journalist. But they also feature instantiations of general knowledge, beliefs, attitudes, and ide-

ologies, namely, those shared by other journalists of the same newspaper, or by other (mostly white, male, middle-class) citizens. Thus, the mental basis of each individual news report is an event model that is strategically (i.e., depending on the constraints of the context model) expressed as a news text. Conversely, the structure of a news text reveals the combined influence of the underlying structures of event and context models: Headlines and leads express the (subjective) macrostructures of the models—the information the journalist finds most important, relevant, interesting, or otherwise newsworthy—and similar remarks may be made about the major news actors and their actions, as well as their evaluation by the journalist. Thus, different news accounts are socially and ideologically variable versions of reality as they are represented in underlying models of journalists. This way of framing the well-known problem of truth or bias in news reports allows the formulation of research programs and analytical techniques that go beyond the traditional approaches to news and the media.

Similar remarks may be made for the other side of the communication process (i.e., reading, understanding, and memorization of news reports by the readers). In the 1980s, an increasing number of experimental studies have paid attention to the details of the cognitive processes involved in this important domain of research, and some of these studies also make use of our work (Bruhn Jensen, 1986; Graber, 1988; Gunter, 1987; Robinson & Levy, 1986). Invariably, readers or viewers of news recall very little in (uncued) immediate recall and even less in delayed recall. Most of these findings can rather straightforwardly be explained in our theoretical framework: Readers recall on the basis of their subjective models of events and not on the basis of some kind of text representation, and of these models they have mainly access to the higher level macrostructures. This process is in turn influenced by preexisting specific knowledge ("old" models), by general sociocultural knowledge about the issue in question, as well as by shared, group-based social attitudes and ideologies. Finally, reading and understanding news is of course monitored by the context model of the ongoing communicative event, featuring recipient goals and interests and opinions about the newspaper or television program. Although many questions still need to be answered, the main processes of reading, storage, and recall are rather well-understood.

The Reproduction of Racism

Possibly even more relevant, especially in the framework of increasing racism in Europe, is the study of the ways ethnic or racial prejudice, discrimination, and racism are reproduced in Western societies. Many of the structures, processes, and institutions involved in this process are social, political, and cultural. However, from the start I have emphasized the role of discourse and cognition in this process. That is, prejudices and racist ideologies do not come about spontaneously, and are not merely confirmed by observation of, and participation in

discriminatory or other interethnic interaction. They are acquired also through discourse and communication. Thus, in a series of research projects, I have studied the structures and strategies of everyday conversations, textbooks, news reports, political debates, and scholarly and managerial discourse, and how these persuasively influence and are controlled by the minds of members of the majority (van Dijk, 1984, 1987a, 1991, 1993a).

This again requires an analysis of the relations between discourse and cognition. Fortunately, due to my work with Walter, I had learned much about such relationships. Thus, in order to analyze racist stories or news reports, I now knew these should be derived from models, in this case of perceived, experienced ethnic events (van Dijk, 1985a). Similarly, the well-known social-psychological processes of group categorization, polarization, overgeneralization, and other ways to process information about other groups, could now be reformulated in terms of the relations between input discourses, models, and more general social cognitions, such as ethnic and racial prejudices. That is, it is now known (at least more or less) how racist readers go about understanding ethnic issues and events, or how the media contribute to prejudging readers in the first place. Obviously, the processes involved here are extremely complex, but at least there is a framework in which they can be studied with some precision.

Social Cognition and Ideology

Racism is one prominent form of group power and dominance. In the same way, other forms of social inequality, and the processes of their social reproduction, may be studied. Again, discourse and cognition are involved, although such a subjective or "mentalist" approach to racism and social inequality is often felt by social scientists to be reductionist. I obviously do not agree at all. The rather widespread misunderstanding among many social scientists is that psychology is only "individual" psychology, which leads to the understandable rejection of an approach that ignores the fundamental social dimension of dominance and inequality.

However, if one focuses attention not merely on general properties of human cognition, but on social cognition, there is no reason to see such an approach as individualistic. On the contrary, just as discourse is social so also is the mind: Knowledge and other beliefs are formed, changed, and used in social situations, about other groups, social issues, and societal structures. In my most recent work on critical discourse analysis, which focuses on the discursive reproduction of dominance and inequality, therefore, I emphasize the fundamental, mediating role of social cognitions such as group-based and sociocultural knowledge, attitudes, group goals, ideologies, norms, and values (van Dijk, 1993b, 1994).

Indeed, such social representations and the mental strategies that manipulate them are needed to relate acts and interactions (including discourse) of social members with social conditions and sociocultural structures and institutions—for

instance, newspapers and the media, journalists as a group and profession, and newsgathering routines, on the one hand, with concrete news reports on the other hand; or structures of racial dominance and racism, on the one hand, and individual acts of everyday discrimination against minorities on the other.

A more detailed study of this well-known missing link between the macro- and microlevel of societal analysis shows the relevance of a combined sociocognitive and discursive approach (van Dijk, 1990). New developments in the study of social cognition (see, e.g., Fiske & Taylor, 1991) provide some of the background for these analyses of the links between discourse and social cognition. Again, models play a central role in such an analysis because they relate individual and personal experiences with general, socially shared beliefs, which are in turn related to group goals, ideologies, the moral order, and the interests of different groups and institutions that give rise to such shared social cognitions in the first place. A sociocognitive account also emphasizes (and analyzes!) the well-known sociological fact that social reality for social members is relevant only in so far as it is subjectively construed by them, that is, as a function of (shared) social representations in the mind. Thus, a systematic analysis of social and public discourse might show how to reconstruct individual members' models, as well as the general social representations that control many of their structures.

In sum, in my later work, models continued to play a central role in the account of many social phenomena, such as the production and reception of news in the press, the reproduction of racism and other forms of inequality, or as part of a theoretical account of the process of the "manufacturing of the consent" in [critical] political studies (Herman & Chomsky, 1988). Thus, power, political socialization and cognition, agenda setting, public opinion, prejudices, and many other issues in the social and political sciences can be much better understood if we recognize the relevance of the cognitive interface between individual actions (discourse) and societal macrostructures such as groups, group relations, and institutions. Models are the core of that cognitive interface, because they underlie individual experiences and action, while at the same time embodying the instantiations of general, shared social representations.

One other notion regularly appearing in these new studies is that of *ideology*. Although widely studied in the social and political sciences, vagueness and disagreement about the nature of ideology are rife. Rejected as merely meaning coherent (political or social) belief systems, or as merely denoting negative (biased) forms of consciousness, most proposals in this area replace one vague approach with another, although all seem to retain at least some aspect of the truth.

In a new project that aims to explicitly link discourse and ideology, I propose to examine in detail the structures and processes of ideologies seen as the basic systems of social cognition. Just like attitudes, group goals, norms, and values, ideologies are both mental and social. They are not individual, but shared by the members of a group. Their function is to provide coherence to the system of

social cognitions, and to relate systems of social cognitions with the goals, interests, and social-political conditions of the group sharing that ideology. Despite undeniable personal and contextual variations (to be accounted for in terms of event and context model), at least some internal coherence in social cognitions is needed, given the vast complexity of relevant social attitudes. To develop and apply relevant social attitudes (e.g., about abortion, multicultural education, or the civil war in Bosnia), social members need an organizing system that monitors the many mutual links between different attitudes (e.g., *between* those about abortion, and those about the freedom of women), as well as between attitudes and the interests and goals of the group(s) to which social members belong.

Ideologies have precisely that role. At present, I surmise that they are probably built up from basic sociocultural units, such as norms and values that represent the social and moral order of a society or culture (e.g., equality, freedom, etc.), as well as by self-group schemata that represent the social position of the relevant group. This construction of ideologies is a function of processes of selection, emphasis, and construction that are biased by group goals and interests. It will be the task of the new project to spell out these structures and strategies of the ideological organization of the social mind, and to explain, thus, how discourses (indirectly) express, signal, form, or confirm such ideological systems. One way to do so is to make explicit the links between mental model structures and the social cognitions that underlie the personal opinions of such models, more or less in the same way as personal knowledge may be studied as a function of more general, sociocultural knowledge.

Despite vast numbers of recent studies on social and political cognition, and despite the enormous amount of work on attitudes in traditional social psychology, most of the relevant structures and strategies involved here are still unknown. Here are other challenging tasks for joint projects of cognitive and social psychologists, sociologists, political scientists, and discourse analysts, and more generally for a social extension of the currently rather narrowly conceived field of cognitive science.

On Models and Model Structures

Let me finally return to mental models. I have argued that although it is pretty well known what theoretical role and tasks they have or should have, psychologists are more or less groping in the dark about their precise internal structures. Walter and I, Johnson-Laird, and others working, theoretically or empirically, with the notion may have had some general clues about such *model structures*, but these were no more than well-educated and, especially, rather vague guesses. Thus, unlike episodic text representations consisting of propositions, models are assumed to also feature analogical information, whatever this may mean in a precise representational language. It was mentioned earlier that when I first developed my own idea of models, I metaphorically spoke of "pictures of events,"

a terminology resolutely rejected by Walter. Yet, if analogical structures are involved, one needs to somehow find, first of all, the theoretical language in which to speak about such structures without somehow reducing them again to propositions or other objects that are verbalized in natural language or translated into some kind of formal language. Eventually, maybe developments in the neurophysiology of the brain might come up with suggestions that can provide ideas for such a language of analogical representations (e.g., in order to explain model memories for faces, persons, objects, places, and other visual information).

If I leave aside for a moment this complex and at present unsolvable question, I may nevertheless make some suggestions about the nature of model structures. As a discourse analyst, I tend to search the evidence for such structures in their expression (i.e., in text and talk), the kind of evidence most psychologists also use, albeit indirectly, in their experiments. Thus, semantic structures are traditionally represented by propositions of which the respective arguments have various roles or functions, such as agent, patient, experiencer, object, and so on, which are in turn syntactically expressed or signaled by word order and different syntactic categories.

If it is assumed that at least the basic principles of such functional semantic structures are more or less universal, they may be interpreted as evidence of an underlying model structure—that is, as semantic coding in natural language for the schematic structure of an underlying model, consisting of a limited number of fixed categories. The relevance of such a model schema resides in the fact that people are forming and updating thousands of models each day, of each of their personal experiences and events (and of discourses of such events). This means they need a very fast, flexible, effective, and strategically relevant schema by which to mentally represent such events, or rather, the *structure* of such events.

For instance, in the representations of actions, it is necessary to represent the persons involved in the action and their roles (e.g., as agents, etc.). Similarly, for the representations of settings of such events, categories are needed for time, place, distance, space, as well as of objects and their relational role(s) in the event. Note that the content of the models is then filled in by instantiated information derived from frames, scripts, or other schematic structures of persons, objects, and actions, as they are available in the general knowledge system. In other words, much of the functional semantics of sentences may be based on, and explained by, the functional, categorical structure of underlying models.

However, not only sentences describe (or prescribe) events, actions, or situations. Discourses, such as stories, news reports, or conversations do so as well. That is, whereas semantic sentence structures may give clues about corresponding microstructures of models, structures of discourse may yield clues about the local and global structures of models of complex events. That is, a car accident, going to the movies, or a civil war are events usually described by several or many propositions (although they may, at higher levels, be summarized by macropropositions). Thus, local coherence relations between propositions may express re-

lations of temporality or causation that may be assumed to order event structures in models. Similarly, the order of propositions in sentences or texts may be interpreted in terms of distance versus proximity, whole versus parts, direction or movement, and other basic properties of complex models. It was argued that models also involve personal opinions, that is, evaluative beliefs, which are multiply coded in topics, local semantic relations, the lexicon, style variations, and the rhetoric of texts. Similarly, sentence and discourse structures may express or signal relevance, importance, and other relations between people and the events they witness, participate in, or read about, and hence represented in mental models. We have seen that argument continuity in discourse signals underlying identity of participants in concatenated micromodels that form the overall model of an event, as does tense for temporal relations (see the work by Givón on these links between discourse grammar and cognition, e.g., Givón, 1989a, 1989b).

Note though that the links between event models and discourse are indirect, and a function of the many factors represented in context models, such as goals, interests, impressions or "face," and mutual knowledge and opinions of the discourse participants. To wit, when many of the white interviewees in Amsterdam and San Diego in my earlier project on conversations on ethnic minorities routinely told the interviewers "I have nothing against Blacks [Turks, immigrants, refugees]," such statements need not be interpreted as a straightforward expression of true opinions in their models. Rather, they are a socially and interactionally constrained expression of norms and values applied to, and represented in the context model of, the present situation, that is, as a disclaimer within an overall strategy of positive self-presentation. How do we know that? Well, one clue is that such statements are invariably followed by *but* and (only) negative opinions about the others (van Dijk, 1987a). In sum, a discursive approach to the study of the structures of models obviously needs to take into account the interactional, the social, and the cultural constraints of text, talk, and their underlying event and context models.

In other words, besides investigating the fundamental psychological constraints on the general structures of models and the strategies of their formation and change, systematic discourse analysis may yield hints about actual models as they are used and expressed by language users (for suggestions about a large variety such discourse structures, see, e.g., van Dijk, 1985b). Just as cognitive psychology provided many insights into the nature of discourse structures and their processing, it might be useful to take explicit grammar and discourse analysis seriously in the quest for the properties of model structures.

CONCLUDING REMARKS

As may have become obvious from the last paragraphs, I tend to finish (and sometimes begin) with speculations, programmatic statements, and other fantasies. These are all products of the mind. They are all strategically manipulated

by cognition and persuasively formulated to entice the more adventurous of my colleagues. I realize, however, that it is a long way between speculation and testable and applicable theories. My cooperation with Walter has shown me how this is done, and how one may persuade skeptical colleagues of one's new proposals.

To conclude this brief and incomplete personal history of our theory and our cooperation, I would like to say that the obvious success of the psychology of text processing in cognitive and educational psychology and related areas is not only due to the urgency, the relevance, and the interestingness of the topics involved. Also the originality and the quality of the work of the many women and men who developed this domain have been decisive. There can be no doubt that for over 20 years Walter Kintsch has been one of the inspiring leaders of that group.

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