

Narrative Discourse in Neurologically Impaired and Normal Aging Adults

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CHAPTER

3

A Neurosemiotic Perspective on Text Processing

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The notion of "text" is central to many neuropsychological studies attempting to understand discourse processing either in normal populations or in particular groups of neurologically impaired patients. In many of these studies, the term "discourse" is used as a synonym for "text," though neither term is theoretically defined. Instead, both terms have been used as vague umbrella terms, connoting any kind of verbal performance beyond the mere sentence level. Moreover, extremely different types of texts are subsumed under the general term "discourse": such divergent text types as jokes, stories, descriptions, indirect speech acts, idioms, and proverbs are often labeled either "discourse" or "text." To further complicate things, the manner of presentation of these different text types varies significantly in neuropsychological studies: Oral presentations are not distinguished from visual representations, and authentic communicative situations are not distinguished from hypothetical ones.

Consequently, insufficient attention has been paid to additional specifics related to any of these textual genres or to their manners of representation; to date, even the basic notions of "text" and "discourse" have not been clearly defined. This overall lack of theoretical specificity often makes it difficult, if not impossible, to interpret the results reported in neuropsychological studies.

Partly as an attempt to resolve this terminological fuzziness, this chapter explores the following topics:

1. relevant neuropsychological research on the role of the right hemisphere (RH) in text processing, since this hemisphere has repeatedly been observed to play an important role in discourse processing;
2. a general—theoretical discussion of the notion of “text,” focusing on the semiotic status of the text, that is, on its sign character, in order to provide a framework for categorizing the many text types discussed in the neuropsychological literature;
3. results of studies that attempt to define exactly what a text is, that is, what renders the text a text. In this context, the achievements and shortcomings of studies from various disciplines—text linguistics, psycholinguistics, or psychology of text processing, and neuropsychology of text processing—are reviewed.
4. relate more recent approaches in the field of text theory to neuropsychological findings in order to integrate them into a broader “neurosemiotic” interpretation. Particular attention is paid to the mental model theory of text construction and to the semiotic modeling of world knowledge involved in this process.

TEXT PROCESSING AND THE RIGHT HEMISPHERE

Neuropsychological studies on discourse and text processing commenced in the 1980s. Before then, neuropsychology had focused almost exclusively on language processing on a word and sentence level, not sufficiently taking into account that, under normal circumstances, communication involves larger contexts. Thus, neuropsychology paralleled earlier developments in both linguistics and psycholinguistics, which also shifted their initially lexical perspectives to an emphasis on sentence-based processing and finally arrived at the study of sentence sequences and complex texts.

Not until the late 1970s did neuropsychology begin to consider studies of text processing in brain-damaged people a fruitful subject for analysis. Following pioneering studies on text processing in left hemisphere-damaged (LHD) aphasics (Engel, 1977; Stachowiak, Huber, Poeck & Kerschensteiner, 1977), it emerged, rather surprisingly, that right hemisphere-damaged (RHD) patients displayed significant impairments

in the processing of more complex linguistic material, irrespective of the otherwise quite normally preserved linguistic competence in such persons. Thus, Moscovitch (1983) reported that RHD patients “seem to have no difficulty comprehending individual sentences, but they do have difficulty relating a sentence to a larger context” (p. 69), and Gardner, Brownell, Wapner, and Michelow (1983) noted that such patients “have seemingly normal syntax and phonology” (p. 172), but still are “markedly impaired in their ability to organize sentences into coherent narratives” (p. 183). By the end of the 1980s, “a growing body of research” revealed that “RHD patients, despite their largely intact linguistic skills, are compromised in their performance at the discourse level” (Weylman, Brownell, Roman, & Gardner, 1989, p. 582).

One of the first studies of discourse processing in RHD patients was conducted by Delis (1980); in this study, subjects were asked to arrange the mixed-up sentences of stories. The results revealed that the RHD patients made significantly more errors than normals in arranging the sentences. The author arrived at the conclusion that “processes attributed to the right hemisphere play an important role in the production of coherent discourse” (p. 40), though he was not able to isolate the specific processes involved. He also concluded that patients with RH insults are “unable to establish or maintain a stable mental representation of a situation—one that simultaneously keeps in perspective all of the situation’s dimensions and nuances” (Delis, 1980, p. 42). This interpretation is basically in line with subsequent findings that the “ability to integrate complex units into a coherent whole appears to be a deficit of RHD patients” (Delis, Wapner, Gardner, & Moses, 1983, p. 48). Similarly, Wapner, Hamby, and Gardner (1981), arrived at the conclusion that RHD patients “had difficulty both in integrating the elements of a story and in appreciating the ‘narrative form’ of a story” (p. 27). Foldi, Cicone, and Gardner (1983) also found that, while able to recall important facts, RHD patients “have difficulty in apprehending the overall structure of the narrative” (p. 80), that is, that these patients may have problems appreciating the framework of a narrative text. Quite convergent results were presented by Brownell, Potter, Bihrlle, and Gardner (1986) who also found that RHD patients “are able to process individual sentences, but they are unable to combine information across sentences as is required for normal comprehension” (p. 311). The authors assume that the patients’ behavior results from an inability to make intersentential connections; they conclude: “Where normal listeners are concerned to weave a coherent interpretation of an entire discourse so that each component jibes with the broader reality, RHD patients are often stuck with, or are satisfied with, a limited and piecemeal understanding” (Brownell et al.,

1986, p. 319). It would be a lack of correct linguistic inferencing then, which is responsible for what Baker (1986), on the basis of her own studies, calls the "lack of coherence which typically marks the narrative discourse performance of right brain damaged individuals" (p. vii).

In light of this research, a number of important questions arise. The predominant question is: Is there some kind of "additional" competence which, in addition to "linguistic competence" as such (if we assume "linguistic competence" exists) is a prerequisite for the processing of text and discourse? It goes without saying that an answer to this question would have important implications for neuropsychology as a whole and for the theory of text processing, in particular.

Although the answer to the question of the specificity of different text types cannot be answered in one chapter, further groundwork can be laid for its eventual solution by discussing the general notion of text, keeping in mind, as a starting point, that there is some right hemisphere involvement in text processing, which seems to go beyond the level of basic linguistic competences and which is necessary for the construction of coherent texts. The following section, then, examines and clarifies the theoretical status of the term "text" from a semiotic perspective.

THE SEMIOTIC STATUS OF THE TEXT

When using the term text, we usually intend to refer to verbal texts alone. In the contemporary humanities, however, there is a tendency to understand the term text in a broader and more encompassing manner. According to this understanding, a text is no longer a verbally realized text only; rather, it is "any coherent complex of signs," as Mikhail M. Bakhtin (1959-61, p. 297) phrased it. Verbally encoded texts thus represent only part of the texts of a culture in general; rather, a movie, a cartoon, a cave painting, and many other cultural manifestations may be regarded as a text, as well. Consequently, not only linguistics, but other disciplines, too, such as archeology, ethnography, science of art, and others, may deal with texts in this broad understanding of the term.

To make these different notions of text comparable to each other, a general theory is needed which includes both the specifics of each text type and the traits common to all text types. Based on the assumption that all text types display a specific sign character, it seems quite reasonable to assume that **semiotics**, the general theory of signs, sign systems, and the conditions of their usage and development, might provide a general theoretical framework. A semiotic approach turns out to be useful with regard to verbal texts as well, as soon as one accepts text processing to be more than the mere object of text linguistics.

The semiotic approach to verbal texts adequately takes into consideration the important cultural dimensions of a text. What is meant by this distinction is that a text, as a cultural phenomenon, comes into being only by way of the particular cultural code underlying it. Consequently, two readings of the term text must be distinguished, as far as verbal texts are concerned: a linguistic and a cultural understanding. A distinction is thus made between an utterance and a text—a distinction which might at first seem counterintuitive, since we tend to regard any utterance as a text in the everyday understanding of this term.

We will not deal with the cultural dimension of texts in detail. Instead, we will focus on linguistic texts as one particular type of cultural text. At least one major problem remains unsolved, then, right from the beginning: How can the semiotic status of the text be explained if a verbal text may be either *only* an utterance, in one case, or a text, in another case? Bakhtin (1959-61) offers the following solution: According to him, two poles must be distinguished in a text; one of these two poles presupposes a commonly known system of signs, or an underlying "code," which is also called a "language." Within a text, everything that is repeated (repeatable) or reproduced (reproducible), corresponds to the "language." Bakhtin (1970-71) himself would call only that discipline which studies the codes of various sign systems, semiotics. The search for the invariant codes underlying different sign systems is the object of only one branch of semiotics, however, namely so-called "code-oriented" semiotics. There is a second tradition in semiotics which studies what Bakhtin calls the second pole of the text. It might be termed "process-oriented" because it focuses on the process of generating an utterance. A basic assumption of this direction of research is that "each text (as an utterance) is individual, unique, and unrepeatable" (Bakhtin 1959-61, p. 105). Process-oriented semiotics thus directs its main attention to the process of sign generation—it does not study the ready-made code of a text, but rather focuses on the process of its generation.

This second aspect of the term text has long been completely neglected. Since the late 1970s, however, the notion of text has been reconsidered and modified within formerly code-oriented semiotics. This reorientation can be clearly seen in the semiotic writings of Yuri M. Lotman, for example, a major theoretician of text and culture in contemporary semiotics.

According to Lotman (1983), the humanities in general, and semiotics in particular, have been characterized by two major tendencies since the 1920s: first, by the conviction that "science considers only repeating phenomena and invariant models thereof" (p. 24), and second, by the assumption that "the objective of any communication is the maximally exact transmission of a particular invariant meaning" (p. 24). Along with

these methodological preconditions and based on a Saussurian, code-oriented semiotics went a notion of text, which was, in Bakhtinian terms, characterized by an orientation toward only the first pole of a text. As Lotman (1986) puts it, a text was predominantly regarded as material in which the laws of a particular "language" manifested themselves (p. 104).

A text, then, has been understood as the manifestation of *one* language: It is, in essence, homostructural and homogeneous. Later, following Lotman (1981b), this homostructural notion of text was submitted to an essential transformation: now, a text came to be regarded as a "generator of meaning" (p. 3), which, according to Lotman (1986) turns out to be "principally heterogeneous and heterostructural" and which, consequently, is "a simultaneous manifestation of several languages" (p. 106).

For Lotman (1983) natural language is characterized by the above-mentioned "principal semiotic heterogeneity" (p. 26). This definition of heterogeneity is different from what van Lancker (1975, 1987) terms the "heterogeneity of language": She refers to the distinction between automatic (reproduced) and propositional (newly generated) speech. Rather, Lotman (1983) means that "every natural language text is a text in different languages, or, more exactly, is an amalgam of languages with a complex system of relations between them" (p. 26). As soon as one agrees with this premise, one must "part from the assumption that natural language is a homogeneous semiotic system and to acknowledge its inevitable heterogeneity and heterostructurality". In this case, a "text in a modern understanding" therefore ceases to be "a passive carrier of meaning"; instead, it turns out to be "a dynamic, intrinsically contradictory phenomenon" (Lotman, 1986, p. 107).

Keeping in mind the Bakhtinian view of the two textual poles, one would have to acknowledge that not only one, but both poles are semiotic in nature. Consequently, semiotics must deal with both of them: Whereas code-oriented semiotics studies the language behind the text (i.e., its cultural code), process-oriented semiotics studies the text as an utterance (i.e., the process of semiosis).

There remains one major problem, however; if we take for granted that a text may be studied from two different perspectives, it remains nevertheless unresolved what exactly renders the text a text. In other words, the notion of text itself as a precondition and starting point for analysis remains ultimately undetermined. Taking into consideration Bakhtin's (1959–61) definition of text as "any coherent semiotic complex," a definition of "text" emerges in which the only necessary criterion for textuality is the presence of several semiotic elements which are somehow connected to each other. But what exactly constitutes the connectedness of these elements, and how is this connectedness achieved?

As far as verbal texts are concerned, this question has been discussed predominantly by text linguistics and by psycholinguistics (i.e., psychology

of text processing) and neuropsychology. The following section considers the question of "textual coherence" from the points of view of all three fields.

IN SEARCH OF TEXTUAL COHERENCE

TEXT LINGUISTICS

Generally speaking, text linguistics, which emerged in the 1960s and had its heyday in the 1970s, began at an important point: It abandoned the examination of single signs and isolated sentences, and it attempted instead to define the relation(s) between signs or between sentences in a more detailed way.

Text linguistics began with a very Bakhtinian understanding of text, defining it as a "coherent sequence of verbal signs and/or sign complexes [. . .], which is not a priori embedded in another (more comprehensive) verbal entity" (Brinker, 1979, p. 7).

In fact, "coherence" became a key term in various aspects of text linguistics. Studies of *grammatical-lexical* coherence, for example, yielded important results about anaphoric and cataphoric processes, pronominalization, and tense structures; studies of *thematic-semantic* coherence worked to describe coherence in terms of propositional complexes; and from a *pragmatic* perspective, researchers made much progress in explaining coherence in terms of its embeddedness in a communicative situation. Still, despite the important steps taken by text linguistics, central concept of coherence has not yet been satisfactorily defined (cf. Viehweger, 1989, p. 256).

A significant step forward was the fruitful distinction between "coherence" and "cohesion", first proposed by Halliday and Hasan (1976), and which later became generally accepted (cf. van de Velde (1981), de Beaugrande and Dressler (1981)). In this distinction, all those functions of a text which denote relations between elements of the surface structure are embraced under the term cohesion; in contradistinction, the notion of coherence, takes into account that a text does not result in any meaning by and from itself, but only by way of an interaction between the TEXT KNOWLEDGE and the STORED WORLD KNOWLEDGE of language users (de Beaugrande & Dressler, 1981).

In distinguishing between cohesion and coherence, text linguists succeeded in shifting their theoretical focus away from a merely text-oriented perspective. They recognized that the coherence of a text is not a by-product of the text alone, and that "sufficient cohesion is only a small and unsatisfactory part of discourse reception as a whole" (van de Velde, 1984, p. 10). Instead, they emphasized the important role of the text recipient's activity in the processing of text. This partial change of perspective is quite adequately expressed by Charolles (1983), who writes:

No text is inherently coherent or incoherent. In the end, it all depends on the receiver, and on his ability to interpret the indications present in the discourse so that, finally, he manages to understand it in a way which seems coherent to him—in a way which corresponds with his idea of what it is that makes a series of actions into an integrated whole. (p. 91)

This kind of approach offers various possibilities to relate the notion of textual coherence to psychological concepts of information processing. Taking into account Hoermann's (1976) concept of "sense constancy," for example, de Beaugrande and Dressler (1981) postulate "sense continuity" as "the basis of coherence" (p. 88). In doing this, they stressed that understanding a text is not a simple process of receiving information; rather, it is an active process in which information is selected, eliminated, elaborated and, in part, newly generated on the basis of incoming information and in interaction with prior knowledge, so that the result is a text that is meaningful for the interpreter in question.

Thus, within text linguistics the opinion has gained ground that text construction (from the point of view of both reception and production) is not possible without inferences. Planalp (1986), for example, speaks of the "importance of world knowledge for making inferences and deriving gists" (p. 112), emphasizing that the content of inferences depends on world knowledge; in a similar way, van de Velde (1989) states: "man does not organize the world of verbal texts without inferencing" (p. 559). But still, what constitutes this world knowledge remains undetermined. Planalp (1986), for example, asserts rather fuzzily that "world knowledge . . . entails everything that people know" (p. 113). Viehweger's (1989) definition seems at first glance more elaborate. According to him, the kind of world knowledge necessary for making inferences while processing texts can be understood as a "systematic knowledge of states-of-affairs of natural and social environment and of their interrelations, of contexts and their properties . . . , of the action processes underlying certain events, etc., which people have acquired and instrumentalize in certain techniques and strategies of problem solving," and as "the entirety of the knowledge and experience gained by society which is more or less systematically acquired by an individual," or, finally, as "so-called common knowledge as well as the results of scientific insights much deeper in dimension" (p. 259).

Although these definitions of world knowledge are far from concrete, text linguists seem to agree the importance of inferencing in text construction, as well as on the important role world knowledge plays in the inferencing process. It remains unclear exactly how inferences interact with world knowledge, on the one hand, and, on another, exactly how world knowledge itself is organized. We can draw one uncontested conclusion from the above-mentioned research, however: Given the important role world knowledge plays in the generation of texts, the

study of textual coherence must not confine itself to the study of linguistic means of coherence, alone: it must take into account extralinguistic and extratextual factors if it is to progress. Consequently, Petöfi (1989), for example, argues in favor of a broader, semiotic approach to texts, noting that "a semiotic analysis of texts . . . requires a close cooperation between different disciplines" (p. 508). Petöfi therefore confirms van de Velde's (1981) earlier view that the study of coherence is an interdisciplinary task which considers data from neuroscience and psychology. In fact, an interdisciplinary consideration of psychological and neuropsychological insights might have led to new developments in text linguistics earlier.

PSYCHOLINGUISTICS OF TEXT PROCESSING

An essential starting point in the psychology of text processing is the assumption that textual coherence cannot be described by linguistic means alone and that any process of text construction goes beyond given textual information. Thus, unlike most approaches in text linguistics, the psycholinguistics of text processing began with an empirically oriented notion of text; this approach assumes that an understanding of text will be achieved only when our knowledge of text processing progresses (Rickheit & Strohner, 1985, p. 4).

Generally speaking, theoretical development in the psycholinguistics of text processing began in the early 1970s, when a group of American psychologists directed attention toward the constructive character of text processing. One of the group's starting points was the assumption that a sentence must be viewed as a piece of information used to construct semantic descriptions which can contain more information than the original linguistic input. The following example, which, since its original publication in 1972, has become one of the most quoted examples in studies of text processing, aptly illustrates the assumptions underlying the so-called "constructive theory of text processing":

Example 1

- 1a. Three turtles rested beside a floating log, and a fish swam beneath them.
- 1b. Three turtles rested on a floating log, and a fish swam beneath them.

Linguistically speaking, both sentences display an identical deep structure; they differ only in their usage of two different prepositions (beside vs. on); also, both sentences contain information about a fish swimming under three turtles. However, sentence 1b contains some

potentially different information: In addition to the information that the turtles rested on the log, and that the fish swam beneath them, one would usually conclude that the fish did not only swim beneath the turtles, but beneath the log as well. This information, however, was not explicitly given in the input; instead, "it had to come from one's general cognitive knowledge of the world" (Bransford, Barclay, & Franks, 1972, p. 195).

In an effort to empirically support the claim that the interpretation of sentences 1a and 1b calls on a subject's world knowledge rather than on his or her ability to analyze linguistic units, Bransford et al. presented subjects an additional test sentence, after they heard either sentence 1a or 1b; in this test sentence (see 1c below), only the pronoun at the end of the sentence differed from the information in the initial sentence:

1c. Three turtles rested beside/on a floating log, and a fish swam beneath it.

Bransford et al. (1972) concluded that, if subjects had stored only linguistic information, they were likely, after having heard either 1a or 1b, to notice the difference between sentence 1c and sentences 1a and 1b. If, however, subjects constructed a semantic description oriented towards general world knowledge, they were expected to reject 1c as being not identical with 1a, since it was not equivalent with either the original input sentence or with the semantic description to be constructed. Being presented with 1b as initial sentence, however, subjects were highly unlikely to consider 1c as nonequivalent, because they would base their interpretation on the construction of a semantic description. The empirical results confirmed these assumptions; therefore, Bransford et al. (1972) arrived at the overall conclusion that

linguistic inputs merely act as cues which people can use to recreate and modify their previous knowledge of the world. What is comprehended and remembered depends on an individual's general knowledge of his environment. (p. 207)

The general insight gained, then, was that text processing cannot be adequately understood without going "beyond the information given" explicitly in the text. In a sense, the results and theoretical insights achieved by these studies, foreshadowed what would only later, from the early 1980s onward, be discussed in terms of "scenario" or "mental model" (see below). During the 1970s, however, the psychology of text processing was still following an earlier path. In this context, the notion of "inference" assumed central importance, a development much paralleled in text linguistics, as we have seen above.

One of the most general definitions of inference is put forth by Harris (1981); according to him, an inference is "any construction of meaning that a hearer or reader draws from a passage when he or she goes beyond what is explicitly given" (p. 88). As Harris sees it, inferences have two major functions: First, they establish relationships between the propositions in the input as well as between those propositions and already available knowledge; and second, they fill the gaps in the overall structure of the input.

Harris's definition acknowledged that the meaning of a text cannot be described by recourse to text structure (or linguistic input) alone; rather, the meaning results from a combination of the linguistic content of the text *plus* those inferences made by the reader, which make the text comprehensible, and guarantee text coherence.

Thus, inferences were considered to be necessary whenever coherence cannot be obtained otherwise; inferences were understood as additional propositions generated during text processing; they were thought to "bridge" the gaps between explicitly given propositions, that is, to "provide missing links" in the explicitly given text base. Inferences were "regarded as necessary when, and *only* when, they were "interpretation conditions" (Kintsch & van Dijk, 1978, p. 365), that is, when the text lacked information necessary for the recipient to construct a coherent text.

As to the source of inferences, it was referred to as, among other things, "general world knowledge" (Kintsch & van Dijk, 1978, p. 392); Thorndyke's (1976) summary of the role of inferences in text processing conveys the predominant attitude of the time:

A major function of inferences in discourse comprehension is to provide an integrating context for the interpretation of incoming information in order to establish coherence and continuity in the text. A person's ability to extract relevant information and make necessary inferences depends on a wide variety of stored information, including knowledge of the world. (p. 437)

Once again, we encounter the notion that some undefined "world knowledge" is necessary to ensure textual coherence; and as long as it remains unclear how this world knowledge is organized, and how exactly it comes into play in text processing, we cannot adequately understand the important function of inferencing. Abbott, Black, and Smith (1985) recently brought up this issue. They argue:

People use what they know about the real world to understand both actual events and events in stories. That people have such knowledge is hardly controversial. What is debatable is how this knowledge is organized in memory. (p. 179)

Abbott et al. thus confirm an earlier critique of inference research by van Dijk and Kintsch (1983), who found that "our knowledge about inferences in comprehension is as yet quite inadequate" (p. 52). To better understand the role and functioning of inferences, Rickheit, Schnotz, and Strohner (1985) recently raised a number of methodological issues, distinguishing between "on-line" and "off-line" methods in the study of inferences. On-line methods would comprise studies like time measurements, eye movements, thinking aloud during reading, psychophysiological measurements, and so forth. Off-line methods would include free or directed memory tasks, answering questions, and so on. The authors did not consider one additional method, however, namely the analysis of pathological cases, when the ability to make inferences seems to be impaired and can be neuropsychologically interpreted.

It is precisely in this area that a number of studies have been undertaken in the last few years—some of these were cited earlier in the chapter—which have not been adequately examined by text linguistics or by cognitive psychology. It is mainly those studies which attempt to understand text processing with regard to functional brain asymmetry, and which have demonstrated that the right hemisphere seems to play a significant role in this regard.

NEUROPSYCHOLOGY AND TEXT PROCESSING

As far as the problem of inferences is concerned, there are two important studies that directly attempt to relate the problem of inferences to RH capacities. In a study by Brownell et al. (1986), a group of RHD subjects and a control group were sequentially presented with 32 pairs of two sentences (see Example 2, sentences 1 and 2), which the subjects were instructed to understand as "minimal stories." After the subjects read them, these two sentences were removed from view, and two test items (see Example 2, sentences 3 and 4) were presented: One of them included a correct inference (expressing the relationship between sentences 1 and 2), the other one included an incorrect inference, referring to the contents of only sentence 1 or 2. Two additional true/false items (see Example 2, sentences 5 and 6) were constructed for each sentence pair in order to assess subjects' memory for the factual information alone. These additional items referred to only one of the initial sentences, and answering them did not require integration of information across sentences; compare:

Example 2

1. Barbara became too bored to finish the history book.
2. She had already spent five years writing it.

3. Barbara became bored writing a history book.
4. Reading the history book bored Barbara.
5. Barbara grew tired of watching movies.
6. She had been writing it for five years.

It turned out that the RHD patients, in fact, performed worse than the controls, and they had significantly more difficulties with inferencing than with comprehension and retention of factual information. This result is particularly interesting because another study from the same year by McDonald and Wales (1986), devoted to the same problem, arrived at contradictory results. In this study, too, a group of RHD subjects and a control group were presented with a set of initial sentences (see Example 3, sentences 1–3); after a brief interval, four test items were given: both a true and a false premise (i.e., a sentence heard before; see 4 and 6 below), and a true and a false inference (i.e., a sentence that was not heard before, but which had to be inferred from the information given; see 5 and 7 below); compare:

Example 3

- | | |
|---------------------------------|-------------------|
| 1. The bird is in the cage. | (Premise 1) |
| 2. The cage is under the table. | (Premise 2) |
| 3. The bird is yellow. | (Filler item) |
| 4. The cage is under the table. | (True premise) |
| 5. The bird is under the table. | (True inference) |
| 6. The cage is on the table. | (False premise) |
| 7. The bird is on the table. | (False inference) |

Subsequent to the presentation of sentences 1–3, and after a short interval, subjects were presented sentences 4–7 and asked to answer "yes" and "no" as to whether they heard it before.

As a result, McDonald and Wales (1986) arrived at the conclusion that their results "did not support the hypothesis that right hemisphere brain damage disturbs the ability to make inferences" (p. 78). One additional result was obtained in this study, however: It turned out that the RHD patients were as 'competent as normal controls at recognizing *true* statements (both premises and inferences), whereas they were significantly poorer than controls at correctly identifying a *false* statement as *not* heard before. Bearing this seemingly curious result in mind, it seems worthwhile taking a second glance at the previous study by Brownell et al. (1986). In fact, a similar tendency was observed in Brownell et al.'s study: It turned out that the RHD group's deficit in inferencing was due to "difficulties in dealing with *incorrect inferences* rather than with correct inferences.

This important issue is brought up by Joannette and Goulet (1987) in their attempt to explain the seemingly divergent results of the studies reported. They additionally direct attention to an important point with regard to the Brownell et al.'s study: In it, some of the initially presented items require an inference per se, as in the following sentences:

Example 4

1. Sally brought a pen and paper with her to meet the famous movie star.
2. The article would include comments on nuclear power by well-known people.

As Joannette and Goulet (1987) correctly point out, in Example 4, the first premise in itself induces an inference: reading only sentence 1, it would seem almost plausible to infer that Sally wanted to have an autograph. The second premise, sentence 2, however, draws the reader back from this inference; instead, she or he is re-oriented toward the fact that Sally is writing an article for which she needs to interview the star.

In other words: The overall task, in this case, not only requires inferencing between sentences 1 and 2; it additionally might require the subject to reject an initial inference, that is, to re-structure its entire content on the basis of a previously made inference.

A similar interpretation might hold true, then, for the McDonald and Wales (1986) study, which also implies that inferencing per se is not impaired. Difficulties arise only when the new information does not coincide with prior information, or when it is necessary to modify a previously constructed interpretation due to an incongruous new piece of information.

Given the overall difficulties RHD subjects experience in processing coherent texts, on the one hand, and taking into account that it might not be inferencing per se which is affected in these patients, on the other hand, one question quite naturally arises, namely: What kind of text theory might then be able to explain this group's problems in constructing coherent texts, and which kind of theory might then, consequently, explain the phenomenon of coherence in general?

MODELS OF TEXT(S) AND WORLD(S)

TEXTS AS MODELS

It seems obvious that an additive-linear model of text processing will not be able to fully solve the question of coherence. In fact, two basic

approaches to text processing, which have been termed "elementaristic-additive" on the one hand, and "holistic," on the other hand, were distinguished in the 1980s (Schnotz 1985, 1987a, 1987b, 1988). Within each of these two approaches, the inferencing function works differently.

In the elementaristic-additive approach, the content of a text is described as a set of discrete semantic units or elements (as, e.g., propositions of a text, or, on a different level, episodes of a story grammar). Comprehension is consequently perceived as an addition of these elements; inferences—which quite logically are reduced to a minimum necessary for text comprehension—are seen to have the function of bridging coherence gaps within the text, and they are seen to be strongly dependent on the coherence of the text itself: inferencing is strongly text-dependent.

In contradistinction to this view, holistic approaches to text processing assume that from the beginning, a holistic mental structure, or mental model, is constructed. This mental model is a dynamic representation, which is incrementally constructed (Oakhill, Garnham, & Vonk, 1989) and which, as information grows, is specified, evaluated, and, if necessary, revised on the basis of the text. According to this view, inferences are not considered to be entirely text-dependent; in fact, they do not predominantly serve the coherence structure of the text as such, but instead are generated to satisfy the requirements of the mental model being constructed. Inferences thus do not serve to fill coherence gaps in a text, but are used as a means of generating, enriching and elaborating a mental model.

The following example, given by Collins, Brown, and Larkin (1980) lent credence to the "holistic" line of research; it nicely demonstrates the strong argument in favor of the mental model theory.

Example 5

He plunked down \$5 at the window. She tried to give him \$2.50, but he refused to take it. So when they got inside, she bought him a large bag of popcorn. (p. 387)

Without any problem, this text should be analyzable into a propositional structure; according to an additive-elementaristic approach, no inference would be necessary for text understanding, since each proposition of the text can be related to at least one other proposition. Although the processing of this text should provide no problems, most readers face serious difficulties in actually understanding this text: More often than not, readers initially imagine a scene in front of a movie or a theater, and they assume that "she" is a woman in a ticket office, a betting window, or something similar; being astonished that "he" refuses to take the \$2.50 (which is the supposed change), and being surprised that "they" went in ("he" and the woman behind the window?) they re-interpret the whole scene and arrive at a different situation.

As Example 5 shows, text processing indeed seems to involve the immediate construction of an initial holistic model which depends on the available information, and which is then progressively refined. It supports the claim that there is a distinction between "elementaristic-additive" and "holistic" text processing.

To a great extent, this distinction is based on Johnson-Laird's and Garnham's research on "mental models" (especially Garnham 1981, 1982, 1983, 1987; Johnson-Laird 1980, 1981, 1983). One of the basic assumptions of this line of research is, "that there are two kinds of representation for discourse, a superficial propositional format close to linguistic form, and a mental model that is close to the structure of events or states of affairs that are described in the discourse" (Johnson-Laird, 1983, p. 377). The logic of this approach is convincing: According to Johnson-Laird (1980), a propositional representation is a description which is neither true nor false without respect to the world (p. 98). Because our apprehension of the world is not direct (we possess only an internal representation of it), a propositional representation is only true or false with respect to a model of the world. And from the further assumptions that "all knowledge of the world depends upon our ability to construct models of it" (Johnson-Laird 1983, p. 402), and that the perception of the world is model-based, it follows that discourse about the world must be model-based, too (Johnson-Laird, 1983). Propositional and model-like representations, thus, are heterogeneous in nature (Johnson-Laird 1983):

Unlike a propositional representation, a mental model does not have an arbitrary chosen syntactic structure, but one that plays a direct representational role since it is analogous to the structure of the corresponding state of affairs in the world—as we perceive or conceive it.

Two points need to be emphasized here: First, the analogical character of mental models, and second, their status in relation to truth conditions. The first point refers back to the point of the heterogeneity of semiotic processes in general, and of text processing in particular. It turns out that the structure of a mental model, as opposed to a propositional description, is not arbitrary, but instead "represents information analogically" (Johnson-Laird, 1980, p. 108), that is, it is "structurally similar to parts of real or imaginary worlds that are described in the texts from which they derive" (Garnham, 1981, p. 564).

This leads to the second important point, the status of the mental model in relation to truth value. According to the proponents of the mental model concept, a mental model need not be veridical in nature—the processes by which fictitious discourse is produced or understood are not strikingly different from those by which true assertions are produced (Johnson-Laird, 1981, p. 361). A mental model thus is a representation of that part of the

real or an imaginary world which is relevant to the interpretation of a text or discourse "(Garnham, 19, p. 2). What is crucial, then, is that "there should be something in a mental model to which the expression refers" (Johnson-Laird, 1981, p. 361). Thus, a necessary condition for the coherence of discourse is that its constituent sentences should have a common set of referents (Ehrlich & Johnson-Laird, 1982, p. 297).

It is important to note that the mental model approach is quite different from what logicians such as Hintikka, Kripke, and others, would do within the framework of possible world semantics, where the real world is only one member of the set of all possible worlds (cf. Johnson-Laird, 1983, p. 172). For Johnson-Laird (1983), an assertion is true if it corresponds to reality (p. 438); that is, it can be judged to be true (or false) by evaluating it in relation to a model of the world or by establishing that it follows necessarily from other assertions known to be true. Within the mental model approach, the actual world thus is not interpreted as one possible world among others, but as the mental model of the world the individual has internalized in the course of his or her life.¹ In this respect, it seems most reasonable to side with Johnson-Laird's (1981) distinction between a mental representation of discourse, i.e., a "discourse model" as some kind of "intermediary model" between propositional language, on the one hand, and a model that is a complete representation of the world (i.e., a "world model"), on the other hand. This distinction allows for a clearer definition as to the truth value of a given text (Johnson-Laird, 1981):

A text represented in a discourse model is true provided there is a proper embedding of the discourse model in the real world model, i.e. a mapping of the individuals and events in the discourse model onto the individuals and events in the real world model in a way that preserves the same properties and relations. (p. 370)

As Johnson-Laird (1981) correctly points out, there remains one pervasive problem: the ontological status of the real world model into which discourse models are embeddable. It seems most practical, in this regard, to agree with him that our knowledge of reality is nothing more than another mental model. Ultimately, there seems to be no way to determine the truth value of a given text; a text and a corresponding discourse model constructed on its basis can only be related to what we know, or seem to know, about the real world. Johnson-Laird (1981), therefore, is quite right to maintain, that "there is much work to be done to account for the organization and mobilization of knowledge that underlies the plausibility of discourse" (p. 368).

¹ In this context, we will not further dwell on how this "world model" is different from what has been termed a world model in cultural semiotics (cf. Grzybek, 1993c).

At this point, we confront the extremely important notion of "plausibility" which will lead us a step further in understanding the observed impairment of RHD patients in processing coherent discourse. There are good reasons to assume that the mental model theory in general, and the related concept of plausibility, in particular, can explain these patients' difficulties in arriving at a coherent text.

The question at stake may be phrased as follows: If mental models are constructed on the basis of incoming information, on the one hand, and by reference to a general model of the world, on the other hand, how then, exactly, does this general world knowledge come into play? What causes the reader of Example 5, for example, to assume—at least initially—that the text seems to be about a man at the ticketoffice of a movie theater, for example, and to suspect that he is dealing with the cashier?

In his presentation of findings on mental model research, Schnotz (1988) brings up an important issue, assuming that it is real-world knowledge that causes the reader to construct "some kind of a *prototypical* situation which might represent something like the "best fit" guess to construct an initial model:

When mental models are constructed on the basis of cognitive schemata, and of the assumptions about the section of reality contained in them, one should expect, that these models correspond to some kind of prototype of the situation in question, or, that they represent the most probable state of affairs. However, there are neither any theoretical nor empirical analyses as to this topic thus far. (p. 326)

What comes into play, then, is an experience-driven decision about probability, an issue that has been discussed under the term of "plausibility" in mental model research. As Johnson-Laird (1981, 1983) argues in favor of a clear-cut distinction between "coherence" and "plausibility," asserting that "coherence must be distinguished from *plausibility*, since a discourse may be perfectly coherent yet recount a bizarre sequence of events" (1983, p. 370), Garnham (1983), too, in a general critique of story grammar approaches, maintains that two principal factors influence text processing: referential continuity and plausibility. In a more general discussion of this topic, Black, Freeman, and Johnson-Laird (1986) argue in favor of a mutual interdependence between referential coherence (as a property of discourse, based on "bridging" inferences) and overall plausibility (Black et al. 1986), understood as some kind of "statistical approximation" based on knowledge (p. 52f.). It seems most likely, then, that a clarification of the concept of plausibility implies a specification of what has been generally termed "world knowledge."

Interestingly enough, the notion of "plausibility" has been explored in neuropsychology as well—quite independently from mental model

theory—in in effort to explain RHD patients' difficulties in text processing. Wapner et al. (1981) invoke the notion of a "plausibility metric" (p. 30), for example, as one way of conceptualizing these patients' difficulties in processing coherent discourse. According to these authors, normal individuals can assess, with reference to a given element, whether that element is appropriate to a given context. It is the ability to assess plausibility which seems to be vitiated in many right-hemisphere damaged patients (cf. Gardner et al., 1983, p. 186); similarly, Foldi et al. (1983) found that "these patients experienced difficulty in judging the plausibility of individual events within the context of the narrative" (p. 80). More recently, Joannette, Goulet, and Hannequin (1990) confirmed this interpretation; in their opinion, RHD subjects "seem to have problems with evaluating the plausibility of an event within a given context ('plausibility metrics')" (p. 166).

At first glance there seems to be a parallel between developments in mental model theory and neuropsychology, as to the function of plausibility in text processing. One major problem arises with this reading of the notion of "plausibility," however: If plausibility is defined as a factor which is relevant only "within a given context," then it must "be understood as a kind of **intrinsic plausibility**, valid only within the limits of a particular text. Yet, this definition does not explain, for example, why a reader typically assumes that "she" in Example 5 is the cashier; both variants—that "she" is the cashier or an accompanying friend—are equally "plausible", though not with regard to the initial model, but "in retrospect. Both interpretations are not equally **probable**, however; that is, they do not display the same degree of **extrinsic plausibility**, or probability, based on general world knowledge.² Therefore, Joannette et al.'s (1990) definition of "plausibility" seems to be far more exact, referring to "the pragmatic probability of occurrence of an event given the general knowledge of the world as the specific knowledge shared by two or more individuals" (p. 176). As the authors correctly point out with regard to Example 4, it is important to determine whether incorrect inferences were accepted by the RHD subjects in Brownell et al.'s (1986) study in accordance with their degree of plausibility.

²This juxtaposition of "context-oriented" (intrinsic) and "world-knowledge-oriented" (extrinsic) plausibility, or probability, depends somewhat on the reading of the term context, as it is used in psychology and neuropsychology. More often than not, this term—like the term pragmatics, too—is not sharply defined, and because it is used differently from its stricter semiotic readings paves the way for misunderstandings (cf., e.g., Joannette et al., 1990, p. 160ff.). In a semiotic view, "context" may either refer to the linguistic context of a given text, or to the situational circumstances in which the text is uttered—but "context" would not be used to denominate internalized knowledge. The same holds true for the notion of pragmatics, which, in semiotics, is used to refer to external conditions of sign usage only (the relation between sign and sign user, in Morris' 1938 concept). To prevent misunderstandings, it would be reasonable to use these terms in a more sharply defined manner in psychology and neuropsychology as well.

RH information processing might, then, be strongly based in general world knowledge and be characterized by a probability-orientation with respect to it. Evidence supporting this view has emerged from studies on the processing of syllogisms after unilateral electroconvulsive shock therapy (Černigovskaja & Deglin 1986; Černigovskaja, in press; Deglin, in press). One experiment attempted to study subjects' reasoning under the conditions of a relatively autonomously working single hemisphere; to this end, subjects were presented a set of syllogisms. Usually, the task of solving a syllogism presupposes that "one remains within the framework of the given task, and relates particular elements of the task to other elements of it, instead of turning to the reality the task is about" (Tulviste, 1988, p. 247). This "theoretical" strategy allows a subject to solve the task "independent of his/her knowledge about reality, and independent of the fact if s/he believes in the premises and conclusions" (p. 244).

To test if the two cerebral hemispheres differed in strategy, some of the syllogisms employed by Černigovskaja and Deglin (1986) were related to the subjects' personal experience (therefore they were expected to know the answers a priori; compare Example 6 below), and some of them were solvable only by way of logical conclusions based on the given premises (compare Example 7):

Example 6

1. Fish can be found in all rivers where fishermen throw out nets.
2. Nets are thrown out into the river Neva.
3. Are there fish in the river Neva or not?

Example 7

1. All states have flags.
2. Zambia is a state.
3. Does Zambia have a flag or doesn't it?

In their analyses of the results, the authors did not direct as much attention toward the correctness of the answers given as to the type of reasoning the patients used to justify their answers. Still, under the control conditions, subjects gave mainly correct answers; these were predominantly of a formal-theoretical motivation. After RH treatment, this tendency to give rather "theoretical" reasons even increased. As opposed to this, after LH treatment (i.e., with predominant RH functioning), the number of "empirical" answers increased significantly (e.g., "Formerly, there were many fish in the river Neva, but now that they have poisoned the river, the fish have disappeared"); when patients did not know the answer, they no longer tried to arrive at the solution by relating the premises to each other, but instead tried to explain or define as much as they could about the realia of the syllogism in question

(e.g., "Does a state such as Zambia exist, after all? Where is it? Who lives there?"; or "What Nonsense! Such a state does not exist!").

Evidently two different strategies are employed by the two hemispheres in solving the syllogisms: a theoretical-formal strategy, characteristic of the LH, which relies on logical reasoning, and an empirical strategy, which is based on the individual's personal experience and his or her world knowledge, characteristic of the RH. This finding seems to be in line with the RH's assumed involvement in general world knowledge, as discussed above. But wasn't it the (LH) theoretical-formal approach which seemed to be dominant in these tasks? To demonstrate that this is not actually the case, Černigovskaja and Deglin (1986) constructed a second series of syllogisms involving false premises, such as the following:

Example 8

1. Apes can jump through trees.
2. Porcupines are apes.
3. Can porcupines jump through trees or not?

In this case, after LH treatment, patients emphatically refused to be told lies, identifying the false premise by pointing out that porcupines are not apes (e.g., "A porcupine? It can jump through trees? It's not an ape. It has spines, like a hedgehog. No, this is not true."). On the other hand, after RH treatment, patients did not arrive at correct solutions, not relating the contents of the syllogism to their general world knowledge, but remaining within the syllogism's framework (e.g., "A porcupine jumps through the trees, if it is an ape If the porcupine is an ape, then it jumps through trees. This is what is written here.").

Irrespective of the conclusion's obvious absurdity, the LH seems to be inclined to intrinsic, intensional logic and semantics, whereas the RH processes information with reference to a previously internalized model of the world. In contradistinction to the LH, for which there seem to exist only "possible worlds" which represent intrinsically plausible models, the RH is oriented toward experience: It generates extrinsically plausible models, which are, in this sense "probable worlds."³

This conclusion converges with observations about RHD patients' inability to discern the world of fiction from real world events; Wapner et al. (1981), for example, found that their patients constantly violated the boundary of the stories and "seemed uncertain about the difference

³The neuropsychological results obtained in this study might explain what has been termed "belief bias effects" in syllogistic reasoning (cf. Oakhill, Garnham, & Johnson-Laird, 1990).

between what could happen and what actually did happen" (p. 24); moreover, these patients seemed "unable to honor the world of the fictive, the imaginary . . ." (p. 30).

To summarize, these insights about the reported RH functions relate not only to what generally has been termed "world knowledge." They also provide a concrete definition of Hoermann's concept of "sense constancy," and thus a theoretical and empirical framework for the phenomenon of text coherence. Now, is there a way to further specify the character of this undefined "world knowledge"?

MODELING WORLD KNOWLEDGE

Attempts to model human world knowledge emerged in the domain of artificial intelligence in the mid-1970s and, subsequently, in the realm of psychology. Such attempts have spawned terms like frame, schema, or script. Schank and Abelson (1977), for example, speak of a "world knowledge store" (p. 9), and of "implicit real-world knowledge" (p. 24). Based on these concepts, Roman, Brownell, Potter, Seibold, and Gardner (1987) attempted to test the hypothesis that the observed RH deficit in processing coherent texts is related to or dependent on a reduced access to scripts; this hypothesis seemed reasonable, since other studies with LHD (aphasic) patients showed that this group's otherwise well-structured speech production may be guided by the activation of such scripts (Ulatowska, Freedman-Stern, Weiss Doyel, & Macaluso-Haynes, 1983). However, the study by Roman et al. (1987) demonstrated a "general preservation in script knowledge in RHD patients" (p. 167); their results, then, argued against a loss of script knowledge as such in RHD patients (cf. Joannette & Goulet, 1990).

A logical conclusion resolving these seemingly contradictory results would be that scripts are not the only possible way of organizing or representing world knowledge. In other words: If access to world knowledge is impaired in RHD patients, but script knowledge is not affected, then there must exist a different way of mentally organizing world knowledge—one which does not involve scripts! When we compare the script- or frame-oriented organizational approach to the mental model approach delineated above, it becomes clear that attempts to define world knowledge in terms of scripts or frames do not take into account the important analogical components of world knowledge. A mental model, on the other hand, is used to construct a world model, which in turn plays a crucial role in the construction of a so-called discourse model. Studies measuring only subjects' script constructing abilities consequently ignore the important role of analogical components in both world and discourse models.

From a semiotic point of view, it seems reasonable to understand scripts either as the formalization of a symbolically coded world model, or as the symbolic translation (or transcoding) of otherwise analogically or iconically coded world knowledge (cf. Grzybek, 1991b). A comparable interpretation has been achieved by Schnotz (1985, 1988) with respect to mental models. As he correctly emphasizes, a mental model, as opposed to a propositional representation of discourse, does not consist of digital units, but represents discourse in an analogical form. A mental model is thus characterized by a different quality than a propositional description, although a mental model may be, at least in part, *described* in terms of digital units or symbols (such as the phrases of a text or the corresponding propositions)—but a description of a mental model is not, of course, the mental model itself.

Attempts to model world knowledge in terms of scripts or frames, and the empirical studies based on those attempts, have thus relied exclusively on an arbitrary (symbolic) code, dismissing the important function of iconic elements in all semiotic processes. Here, the relevance of a comprehensive semiotic theory which might improve neuropsychological interpretations of text processing becomes obvious. This approach quite logically results in a need for relevant *neurosemiotic* concepts.

CONCLUSION

A comprehensive neurosemiotic theory requires, first, specific hypotheses concerning the processing of both symbolic and iconic components by the two cerebral hemispheres. A good starting point might be the hypothesis put forth by Deglin, Balonov, and Dolinina (1983), who speak of the "iconic world model" (p. 41) the RH contributes to communicative processes. It would be incorrect, of course, to interpret neurosemiotic interpretations as a simple-minded projection of the problem of coherence or "textuality" from the semiotic level onto the neurological level. In further elaborating specific neurosemiotic hypotheses, it is important that the relationship between symbolic and iconic processes is not oversimplified.

Also, it would be banal to say that signs are generated in the brain; and it would be oversimplistic to unproblematically equate symbolic processes with the LH, and iconic processes with the RH. Clearly, however, a more exact neurosemiotic interpretation of what Lotman terms the "heterogeneity" of semiosis is needed.

It goes without saying that the quality of any attempt to relate semiotic concepts to neuropsychological findings depends on the semiotic categories employed. To this purpose, it would be useful to employ not only the commonly known categories of signs, that is,

symbols, icons, and indexes, but to reconsider the original definition of each of these terms, disregarding later modifications which reinterpret them on the basis of specific theoretical assumptions.⁴ One might consider, for example, that Charles S. Peirce's original semiotic theory stresses the fact that the processing of any symbol necessarily involves iconic components; in contradistinction to many more recent "re-interpretations" of his sign typology, which ignore this iconic element, his concept describes a constant overlapping of symbolic and iconic components (cf. Grzybek 1989, 1991a, 1991b, 1993a).

Given Peirce's more comprehensive semiotic theory, which foresees Lotman's concept of heterogeneity from a slightly different perspective, we can anticipate pioneering studies in text processing, which try to establish the actual role of the RH in these processes. The most recent developments in the neuropsychology of text processing already offer closer parallels to the text-theoretical studies of Bakhtin and Lotman. Parallels to Bakhtin (mainly to his references to the "second pole" of a text) are unmistakable: Neuropsychologists such as Deglin et al. (1983) write that the RH "determines the orientation of speech toward extralinguistic reality and to individual, irreproducible personal experience" (p. 38). Further convergencies with Lotman's views on the principal heterogeneity of semiotic processes also emerge—the more so because Lotman himself, in his ruminations on text theory, mentions the concept of functional brain asymmetry (1977, 1981a, 1983).

A consideration of the asymmetrical functions of the left and right hemispheres is clearly germane to developments in both (textual) semiotics and in the cognitive sciences in general. We have yet to find out precisely how the heterogeneity of semiosis is engendered by the two hemispheres, and how heterogeneous semiotic processes are then integrated by the human brain. A thorough semiotic theory can contribute to a more adequate investigation of these and other neuropsychological questions, whereas neuropsychological findings can assist semioticians in evaluating their own theoretical categories.

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⁴The few neuropsychological studies which employ this basic sign typology to semiotically interpret their findings, are mainly based on Roman Jakobson's modifications of it, rather than on Peirce's original definitions.

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