

The Construction of Mental Representations During Reading

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Toward a Theory of Documents Representation

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In this chapter, we add some considerations to existing theories of text, moving beyond the notions of text base and situation model to outline a theory of documents. The essential idea of this theory—actually a framework for a theory—is that the intelligent use of texts entails mental representations of specific texts, situations described in texts, and relations among texts. Our aim is to explain some of the ways this claim is correct and to show some of the features required of a richer model of text representation. As part of this effort, we first critically examine the important distinction between situations and texts.

TEXT AND SITUATION MODELS

A distinction between the semantic content of texts and the situations they describe is at once obvious and difficult. van Dijk and Kintsch (1983) observed the need for theories of text understanding to honor this distinction, and, at least in principle, they do. The distinction is not without difficulty, however. The problem with the text-situation distinction is not that it is not a valid distinction, but that it is difficult to test. The reason has to do with propositional representations. van Dijk and Kintsch, following Anderson (1983), supposed that situations can be represented as propositions, just as text meanings are. Situations can also be represented as linear or spatial arrays, depending on the text and the reader's task, al-

lowing some possibility of separation. However, for many texts and for many mundane tasks, such separation is very difficult. For example, when the reader's task is only vaguely specified as a request to read for "comprehension," it is not clear what kinds of representation will result. In such cases, both texts and situations may be represented as propositions and to that extent are indistinguishable. Attempts to demonstrate clear separation come from tasks that encourage subjects to construct nonpropositional representations. For example, Perrig and Kintsch (1985) presented subjects with texts written to provide spatial relation in either route or survey form. They were able to show a divergence between a text-based process of recall and a situation-based process of inference-based understanding. A related approach has been to demonstrate spatial analog processes in texts, assuming that such processes have operated on nonpropositional spatial representations (Glenberg, Meyer, & Lindem, 1987; Haenggi, Kintsch, & Gernsbacher, 1995; Morrow, Greenspan, & Bower, 1987). In short, the main approach has been to show that readers can construct spatial and nonpropositional representations that are not based on the explicit content of the text. Such demonstrations, however, do not address directly the existence of multiple representations of situations versus texts *qua* texts. They merely show that the information readers represent includes information of various kinds, and that some of this information is derivative of the text rather than explicitly in it.

Some of this problem of text versus situation disappears if one abandons the text base, assuming no level of shallow semantic representation (Johnson-Laird, 1983). This possibility, which represents text at a syntactic level and restricts semantic representations to situations, has some advantage: It allows a single level of shallow representation, a syntactic-semantic surface form to be used to construct a richer, inference-rich model of relationships. The advantage of the two-level proposal is that the distinction between surface forms and meaning is more readily established than that between two types of meaning, which is what the more standard approach to text requires. Thus, if the main goal were to be able to discriminate semantic-syntactic representations from situation representations, a model that includes just these two levels would help. Comprehension could be described as the transformation of syntactic strings (sentences) having only limited semantic interpretations (e.g., thematic role interpretations) into meaning-rich situation models.

However, text research has been reluctant to move to this two-level representation system: For one thing, the level of propositional representation has proved very successful in its empirical consequences. Measures of reading time, text recall and summarization, and text comprehensibility are all predicted by quantitative assessment of text propositions (Kintsch, 1974; Kintsch & van Dijk, 1978). The relative success of such

predictions compared with alternatives that include a syntactic and nonpropositional semantic level has not been a target of research. Thus, the propositional text base has proved its practical theoretical value more clearly than its representational assumptions. The propositional text base also allows a natural way to describe a relatively superficial level of comprehension, one that may have more lexical-conceptual meaning than is commonly represented in syntax.

We have discussed this issue here because it is important for theories of text representation, and ours is a representational model. We have, on balance, concluded that a propositional level is a practical starting point for the kind of model we propose. The problem we address requires generally richer text representations rather than more impoverished ones. The assumption that one of these representations includes a level of "bare-bones" text meaning without form is consistent with this assumption, and it seems prudent to include it. Our goal requires that we be able to attribute text meaning to multiple texts, and a propositional level serves that purpose. More generally, we assume there must be multiple levels of intermediate analysis of texts during comprehension. These include a level of form representation that provides syntactically parsed inputs for whatever atomic meaning processes assemble the basic meaning representations of a text. This syntactic level is essential, although it is typically ignored in accounts of text processing, except as a means to signal meaning importance (Kintsch, 1992; see Perfetti & Britt, 1995). We ignore it, too, but only because we focus on a level of representation that is well beyond both the syntactic and the propositional. The motivated learner who reads texts, as opposed to one text, acquires rich representations of texts and situations from the atomic and intermediate representations, whatever their form.

If we are correct about the value of rich multitext models, some of the difficulty in seeing situation models through texts disappears. It is difficult to separate the semantic representation of a single text from that of the situation it describes. The distinction between the two, however, becomes more visible with multiple texts. This is especially the case when two or more texts deal with what is ostensibly the same "situation." We return to this point later.

Text and Texts

The world of multiple texts differs from the world of the single text in an even more obvious way. Reading multiple texts produces representations that include connections between the texts. These connections can be of many different kinds. In many cases, the connections are only implicit and may be unrecognized by the reader. In a fairly common case, one text has information that builds on information learned through previous texts,

essentially "updating" a situation model (Larsen, 1983; van Dijk, 1988; van Oostendorp, 1996a, 1996b). A good deal of successful learning from text has exactly this property.

A different case arises from texts that explicitly contradict each other, forcing the reader to recognize the connections between the texts. For example, Perfetti, Marron, and Foltz (1996) presented an example of an oppositional connection based on an actual syndicated newspaper column about Holocaust deniers and a published reply. In effect, the column and the reply constitute a set of opposing arguments. In such a case, the connection between the texts is explicit and unidirectional. The second text replies to the first text by referring to it directly, and then setting down an immediate opposition to it. But the connections between two oppositional texts are also implicit and bidirectional, because they also have links to a situation model. Thus, the first text can be said to oppose the second text despite being written prior to it. It directs the reader to build a situation model that contradicts the situation model made by the second text. In short, explicit connections between texts arise through citation; implicit connections can arise through the situation(s) connected to each text.

We have also explored this issue through research on document sets about historical controversies (Britt, Rouet, Georgi, & Perfetti, 1994; Rouet, Britt, Mason, & Perfetti, 1996). This research demonstrated that an adequate representation of multiple, contradictory conclusions based on documents must incorporate information about the document itself, for example, the document type (primary source vs. second-hand account), author's identity and/or role in the events, date of publication, and so forth. In an essay-writing task, this information is used to connect a piece of information to its source (e.g., "according to author X . . .") and to state the rhetorical relationships among texts (e.g., "based on Y, author X claims that . . .", "Document X contradicts document Y . . ."). These observations led us to hypothesize the existence of a potentially rich documents representation, which integrates partial, conflicting situation models built from multiple texts. Although the texts describe overlapping events, a single updated situation model would not be sufficient because the texts are describing contradictory models of the situation.

THE DOCUMENTS MODEL

The general Documents Model has two components or submodels: The Intertext Model represents the relationships among documents and among a document and elements of the situation; the Situations Model represents situations very broadly construed—both real situations and hypothetical

ones; and, importantly, multiple interrelated situations. When the Situations Model and the Intertext Model are interconnected, then we have a full Documents Model.

Illustration of the Intertext Model

We illustrate a small piece of the intertext portion of a Documents Model by reference to a piece of cognitive psychology literature. The document space, shown as Fig. 4.1, arises from an interview by one of us (CP) with a document author (who is also one of the authors of this chapter). The author was asked to recall her dissertation, published in 1994, and to answer a few questions about it: "What was the main claim of the published paper? Name the most important papers on this problem at the time. What were their claims?" Other questions might be asked, with the general purpose of getting information that locates named documents in a document space, from which we derive a specific Documents Model. Of course, this is a retrospective procedure and is offered here only to illustrate a general approach to Intertext Models.

To paraphrase what the model represents, the 1994 paper by Britt (Britt, 1994) reported research on a topic treated in other documents (the influence of discourse context on syntactic attachment decisions), thus organizing a document space. There are many more texts in the discourse space than the five represented in Fig. 4.1, but this subset represents a set of connections that are psychologically salient to experts in this field. These documents are connected through a set of document predicates that specify

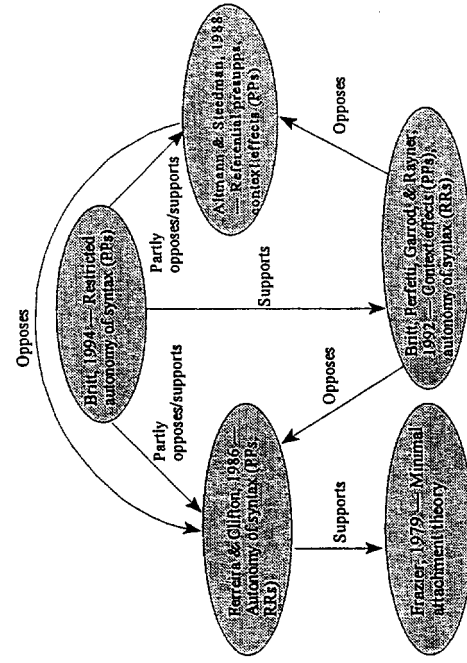


FIG. 4.1. An Intertext Model of five parsing texts.

the functional relations (as opposed to merely temporal or formal relations) among the documents. Thus, a relationship of opposition exists between two of the documents. Altmann and Steedman (1988) argued that because syntactic structures pick out discourse referents, the use of certain structures presupposed referential situations. Discourse contexts, thus, could be arranged to bias parsing decisions. This argument opposes the claim that parsing attachments are initially controlled only by syntactic principles, as represented by minimal attachment theory (Frazier, 1979) and supported by experiments by Ferreira and Clifton (1986), which were criticized by Altmann and Steedman through a widening circle of evidence and argument.

In illustrating the Intertext Model with this particular document set, we do not suggest that it is only in scholarship that Intertext Models are built. They merely provide especially clear examples of such models. Such models will be part of any content domain and may include all kinds of documents.

The Intertext Model

Document Nodes. The Intertext Model includes a node for each document and labeled links between documents and the situations they describe. Figure 4.2a illustrates a template for a Document Node in the Intertext Model. Every node has available variables or slots for Source, Rhetorical Goals, and Content, each of which can be further subdivided. The value for a given slot may or may not be indicated. Whether a slot is filled in will be partially determined by several factors including: the task, discriminability among sources, immediate cognitive demands and time constraints, knowledge of the particular situation, and knowledge of sourcing in general. For example, a novice history student lacking knowledge of the particular

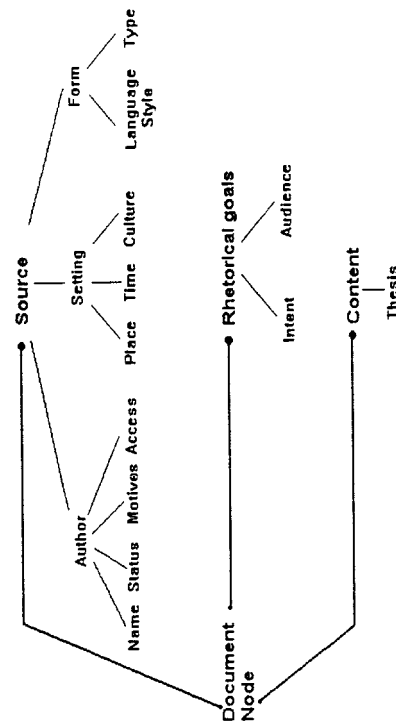


FIG. 4.2a. Template of a Document Node for an Intertext Model.

historical controversy and being only vaguely aware of how to source and why, may only represent the most salient information (i.e., the author's name). However, as shown in Fig. 4.2a, the source variables include a wider range of source information that indicates author identification, setting identification, and document form. Author identification variables identify the author, his or her characteristics, and motives. This includes a slot for the author's name, status or credentials (e.g., President, scholar), motivations in conveying the content (e.g., fame, fortune, posterity), and access to information recorded (e.g., witness, participant, student of). Source information can often be identified through the setting or context, especially information concerning historical setting (i.e., place in which document is created, date and historic period, and cultural context). Finally, document form variables can indicate information pertaining to source identification including the language style (e.g., legal, diplomatic, conversational) and the document type (e.g., treaty, letter, textbook). Of course, there could be additional features that provide important elaboration—distinguishing characteristics of a source that would aid in answering questions about the veracity and significance of a document—but the selected characteristics provide a framework for the type of source information that could be identified and later used in evaluation of the content of the document. Each Document Node may also include information about the document's rhetorical goals. Often the rhetorical goals are not explicitly stated and must be inferred by the reader based on prior knowledge. Rhetorical goals important for evaluating the source of information include the intents of the author (e.g., to inform, persuade, record, illustrate) and the intended or inferred audience for the document (i.e., friend, government agency, newspaper readers). Wineburg (1994) referred to these goals as a document's subtext.

Finally, each Document Node will include a content variable slot, which is a text abstraction of the main point or thesis of the document. For an argumentative text, this could be a summary of the author's main claim or position advocated. For a treaty, the content slot may include the general purpose of the contract agreed on. Because the content of the node is a matter of the reader's knowledge of the document, the content information will be highly variable and will probably not be filled in until after the entire document has been read.

Notice that one might do away with at least the content node as part of the Intertext Model, and assign all such information to the situation model. In such a case, the content of the document would be the situation it describes. Indeed, in a full Documents Model, one with situations as well as documents, this content information must be represented as part of a situation. However, we have decided in favor of some redundancy. A document summary is a characteristic of the document, even as it is also

a claim about a situation. Thus, we have essentially duplicated the duality assumption that gives both text-based and situation-based representations: In effect, some part of the text-base macrostructure is represented as a document node. The situation it asserts is separately represented. This duality is subtly different from the usual distinction between text and situation and may be free of the problems we noted in our introduction: Our claim is not that there is a privileged level of representation that is exclusively propositional. Rather, the Documents Model assumes that a summary (or some fragment, topic, etc.) is available as part of what a reader can come to know about a text. This knowledge may actually have come through the building of a situation model based on the text.

To further illustrate a Document Node for an Intertext Model, consider Fig. 4.2b. This is a fully elaborated Document Node for a hypothetical source used in our prior research, which we refer to again later in this chapter. This source is Professor Norman's historical essay published in 1988. His main intent is to inform readers and to persuade them with arguments that the United States supported a revolt in Panama. It would be very rare that a student would be able to or willing to fill in each slot of the Document Node.

Intertext Predicates. Intertext predicates represent relations between documents and relations between a document and a situation model event or causal relation. They include a range of relationships that can hold between document pairs. As we have noted, these intertext predicates often pivot on a solidarity dimension. Thus, the illustration in Fig. 4.1 includes both links of agreement and opposition between pairs of articles on the role of context in parsing. At this level, however, such links are quite superficial:

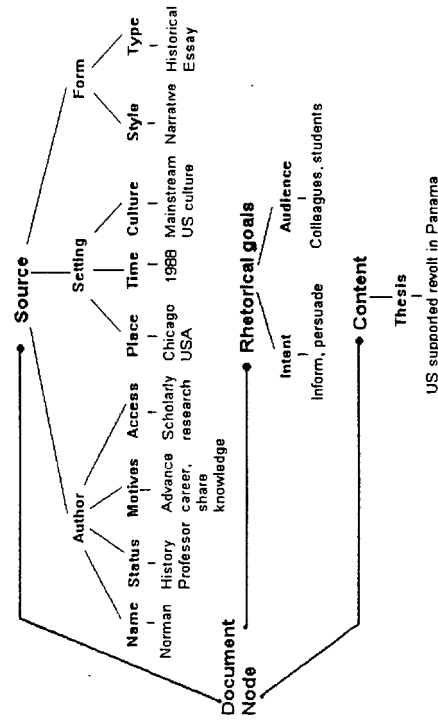


FIG. 4.2b. A Document Node representing Norman's document.

They do not reflect the detailed knowledge an informed reader, especially an expert, can have about the relations between the documents. Thus, an informed reader may represent whether an opposition arises from methodological or interpretational considerations and whether the opposition is more apparent than real, owing to a deeper understanding of the entire document space. However, there is something intuitively right (to us) about this superficial level of representation for many purposes. It appears to capture the level that even an expert might have for many purposes (e.g., summarizing the intertext space) and it may correspond to what survives in memory for the Intertext Model as memory for details fades.

The relations between texts constitute part of a reader's Documents Model, which links texts and situations. The links that label the connections between documents in a particular model can vary widely over many intertext predicates. In many text problems, the predicates are dominated by a solidarity dimension (e.g., *support vs. oppose*, *agrees with vs. disagrees with*, *gives evidence for vs. gives evidence against*, etc.). Such cases are prominent when the documents deal with a controversial issue, such as historical controversy (Rouet et al., 1996), but also in normal scientific discourse. (The practice of scholarly journals to publish comments on articles exemplifies direct and explicit connections of this type.) Other intertext predicates include those that capture incremental relations between texts (*based on*), familial-temporal relations (*predecessor-successor*), intellectual or aesthetic relations (*in the spirit of*), mere referring relations (*cites*), and imprecise relationships (*relevant to*).

These intertext predicates are usually marked explicitly in a text. To the extent they are marked, the reader's Intertext Model mirrors an Intertext Model expressed by a text author. To the extent they are not marked, the reader must infer an Intertext Model based on additional knowledge of the texts. Thus, good scholarly texts are of the first type—authors acknowledge explicitly the connections in the document space. By contrast, for example, an expert reading a student paper expects to find fewer explicit connections, and must build the document space entirely from his or her base of expertise. The nonexpert, of course, may fail to build a good Documents Model because of insufficient knowledge of the document space.

The Situations Model

An Intertext Model, although it can be accessed as a separate component, will ordinarily be connected to situations. The connections then provide a fuller Documents Model, one with texts and situations. In a simple and idealized case, one can think of the reader as learner, using a text to build a mental model of some real or hypothetical world asserted by the text.

With multiple documents, an idealized goal may be to arrive at the most complete and accurate representation of a situation. An alternative practical goal might be to learn which documents support a learner's own beliefs about a situation.

In the case of history texts, a given author may convey a single coherent situation model of a series of events and their causes. However, multiple texts provide multiple situations. A second author may try to convince the reader that certain events had a greater causal impact than those argued by the first author, or that some other perspective on "the situation" should be privileged. In this two-text case, both authors are likely to refer to a core of events and some of their assumptions about causal connections overlap. However, some events and connections may be made by only one of the authors. In order for a reader to be able to represent adequately all the significant events and possible causes that were part of the text content, the reader must be able to access earlier event representations and build on them when reading further elaborations of the events.

Given the potential range of relationships among documents and variability in expertise and motivation of a reader, there is corresponding variability in what the reader comes to understand from a set of texts. To stay with the case of history, a serious learner may not be content to use the documents to build a single unique model of the events. Rather, the learner can come to represent the events and proposed causes in complexes of ambiguous (multiple) situations, along with document support for interpretations of these situations. Alternatively, a reader may strive to integrate information fully from the multiple stories into a single coherent situation model of a single set of events. Still another reader may simply take a given text as the privileged source for a situation model, effectively avoiding the complexity of multiple documents. For the expert, however, the goal is more typically to develop a coherent interpreted situation model based on multiple documents, with a representation of the document sources that support that model.

To represent the complexity that accompanies the use of these richer document sets while allowing for at least the potential of a unitary situational representation, additional information must be added to a causal-temporal representation of events. This could be in the form of propositions attached to (or marking) relevant nodes or links in the causal-temporal structure. We illustrate the building of a simple Documents Model with two fictitious passages derived from the materials used in the Rouet et al. (1996) study.

Table 4.1a provides a brief account of the 1903 revolt in Panama from a single author. From this passage, a reader may build a representation of the situation analogous to the causal-temporal network shown in Fig. 4.3. Causal-temporal networks of this kind have been shown to represent ac-

4. THEORY OF DOCUMENTS REPRESENTATION

TABLE 4.1a

Norman's Text Describing U.S. Acquisition of a Canal in Panama

The U.S. wanted to build a canal to make travel between the east and west coasts safer and faster. A congressional committee recommended the territory of Panama as a site. To obtain permission, they began negotiations with Colombia, the owner of the province of Panama. The negotiations led to a treaty that was ratified by the U.S. Congress but was rejected by the Colombian Congress. A Panamanian revolutionary who had come to Washington to ask for assistance met with the U.S. President and Secretary of State. The U.S. President did not officially offer support but during the Panamanian revolt, a U.S. military ship was parked in the Panamanian harbor and failed to help the Colombians maintain power. The U.S. presence aided in the success of the revolution. Within three days the U.S. recognized Panama's independence and within 2 months they signed a treaty with the new nation of Panama enabling the U.S. to build and control a canal through Panama.

TABLE 4.1b

James' Text Describing U.S. Acquisition of a Canal in Panama

The U.S. wanted a canal in the Central American region. They created a committee to look for possible locations, and this committee eventually recommended Colombia's province of Panama as the prime location. The negotiations with Colombia led to a treaty that was ratified by the U.S. Senate but was rejected by the Colombian Congress. The rejection of the treaty increased the Panamanian citizens' desire for independence. They worried about losing the financial benefits of the canal. The angry Panamanians planned and carried out a revolution against Colombia. The U.S. happened to have a ship in the area, but the Panamanians took the U.S. presence as a sign of support, and carried out their revolt. It was successful. Several days later, the U.S. and Panama negotiated and signed a treaty permitting the U.S. to build a canal in their territory.

curately what people remember from simple narratives (Trabasso & van den Broek, 1985). Britt et al. (1994) and Perfetti, Britt, and Georgi (1995) discussed the relevance of causal-temporal networks for historical accounts. The causal-temporal network connects the events described in the passage and may be used to answer questions such as "Why was there a revolution in Panama?" or "Did the United States participate in the planning of the revolution?"

The Document Node for this document is represented by the circle labeled "Norman" and could contain information similar to that found in Fig. 4.2b. The document-to-situation links (i.e., a link from the event to the Document Node for that document) of the Intertext Model are represented by the dark dotted lines. Note that not every event is marked or linked to the source. Preliminarily, we suggest that the first event and several controversial events critical to the author's interpretation are marked. This would vary depending on the reader's prior knowledge and the task demands. These Intertext Model links can then be used to answer questions such as "Who argued that the United States intervened based on the 1846 treaty?" or "What

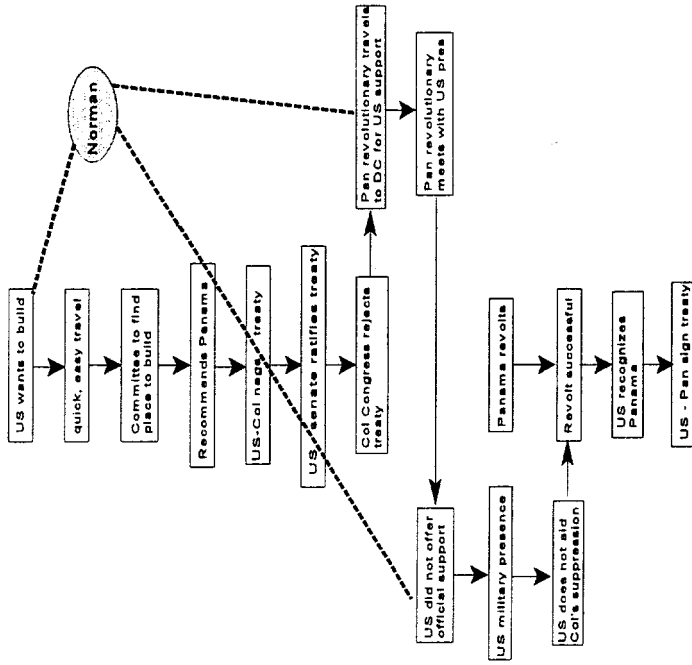


FIG. 4.3. Representation of situation (boxes and solid arrows) and intertext links (dotted lines) to a Document Node (shaded oval) representing Norman's account. See Fig. 4.2b for a fully elaborated form of Norman's Document Node (shaded oval).

evidence did Norman cite to demonstrate U.S. involvement in the revolution?" Whether readers represent an intertext node and links after reading Norman's passage depends on many factors, including context and reader expertise in the discipline of history. We return to these factors later.

The need for a Documents Model appears more clearly if one now considers the passage presented in Table 4.1b, which presents a similar account of the Panama events, except for the sentences in boldface suggesting that the Panamanians, not the United States, were responsible for the revolution. If James' text were presented in isolation, the passage could result in a simple causal-temporal network similar to the one shown in Fig. 4.4. However, when asked to read both Norman's and James' accounts, the reader must resolve the contradiction about the role of the United States in the revolt. The simplest way would be to build a separate causal-temporal network for James' passage, as one would do on the assumption of one-to-one mapping of texts and situations. This would result in two separate causal-temporal networks (see Figs. 4.3 & 4.4).

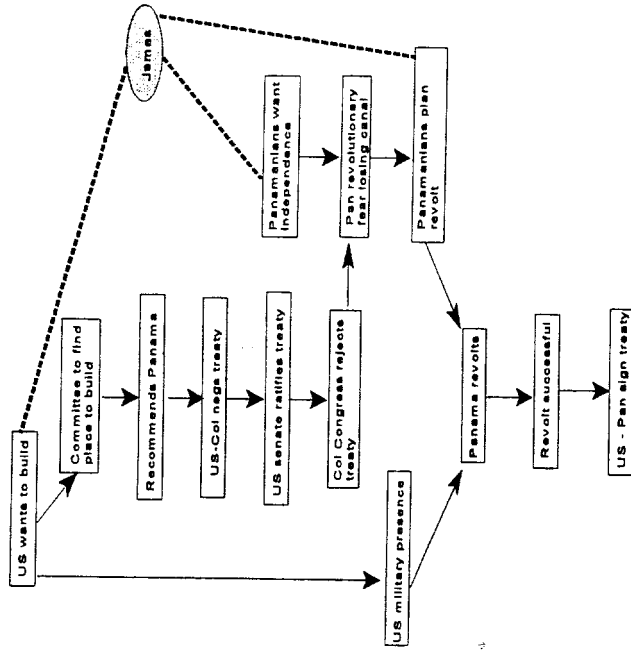


FIG. 4.4. Representation of situation (boxes and solid arrows) and intertext links (dotted lines) to a Document Node (shaded oval) representing James' account.

Integrated Documents Model

Under certain circumstances, the reader may try to integrate the information in the two texts, including the discrepant information. In this case, the first sentence of the passage may lead to a search through memory for possible relevant knowledge, activating a representation of the Norman document (see Fig. 4.3; Mannes, 1994; Mannes & Hoyes, 1996). This representation can then be used as a model of the situation on which to scaffold new information, guided by evaluating critical events and causes to traditions. This may be done by connecting critical events and causes to the appropriate Intertext Document Node (e.g., Norman or James). Figure 4.5 illustrates a possible Documents Model for the integrated situation model described by the two texts. There are several important things to note in this figure. First, the situational model events (i.e., boxes) and the links (i.e., arrows) vary in their strength. Those mentioned by both authors are strengthened and therefore represented by darker elements. Second, the two authors are indicated by the shaded circles. Each of these Docu-

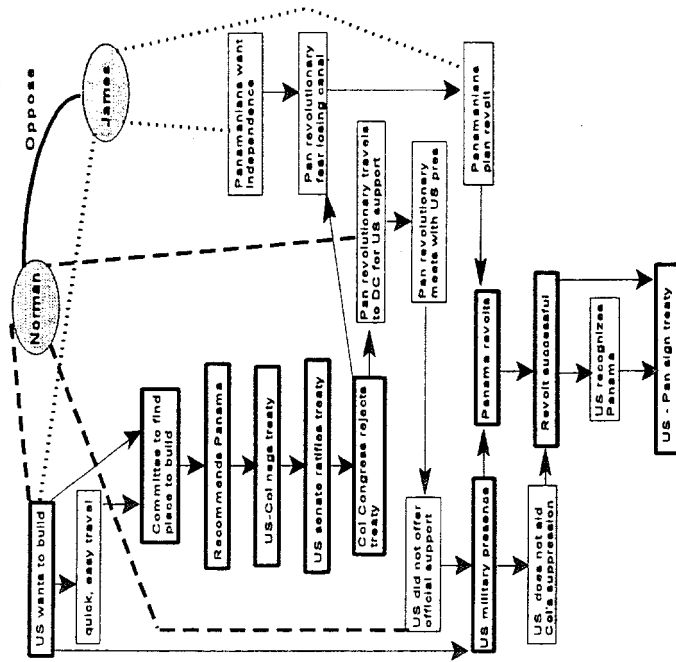


FIG. 4.5. Representation of a model of the combined situation (boxes and solid arrows) and intertext links (dotted lines) to Norman's and James' Document Node (shaded ovals). Strength of the nodes and links are represented by the darkness of the boxes and arrows.

ment Nodes would have some of their respective Source, Rhetorical goals, or Content slots filled in. Third, the darker dotted lines signify Norman's document-to-situation links and the lighter dotted lines signify James' document-to-situation links. Finally, there is a single link between the two documents shown by the dark solid line and labeled "Oppose" because the two authors argue opposing theses.

Given this type of Documents Model representation, the reader may use these Intertext links to signal the origin of information to the reader. For instance, if the reader is asked to account for the Panama revolt, he or she may use phrases such as "according to Norman," or "based on James' essay" to mark the connection between some events and a particular source. The reader may use similar connectors to state the connection between the claim made in a particular document and supporting evidence for this claim (e.g., "Based on the 1846 treaty, James argues that the United States had a right to block the railroad"). Finally, the reader can use other rhetorical predicates to mark the intertext connections (e.g., "Norman disagrees with James as regards the role of the United States"). The infor-

mation present in the intertext document node (see Figs. 4.2a and 4.2b) is critical to make this kind of connection.

Assuming the reader builds a Documents Model along the lines just sketched, an interesting question is what he or she comes to believe about the situation. In our example, we account only for the Documents Model, including the links between documents (depicted by a solid line in Fig. 4.5) and between situations and documents (depicted by dotted lines in Fig. 4.5). This is ample for a learner to answer a range of questions about the events in the text and positions of authors regarding these events and their interpretation. It is also useful to capture what the learner will be able to access to write countless variations of essays of the form, "What was the cause of the Panamanian revolution?" It does not represent a "true" situation, nor a "believed" situation, which, of course, for the believer are the same thing. An expert who has studied a complete set of documents may come to have (an always tentative) best-guess true-situation model. And nonexperts, of course, can readily come to have (believed) "true" models without substantial document support, although this is less likely with the Panama story than with other stories more emotionally important to the individual. In short, we emphasize that a Documents Model is a model of the document and situation space. It can be accommodated to build individual belief models, but that is not part of what we want to demonstrate at this point.

EMPIRICAL CONDITIONS ON BUILDING DOCUMENTS MODELS

So far, we have focused on an abstract theoretical framework. We turn now to the question of what influences the construction of integrated document models. In general terms, what are the contextual and learner factors that make a difference?

An important general question concerns the extent to which a reader's situation model, as constructed on an initial reading, is affected by subsequent readings. There has been evidence pointing to the possibility that once formed, a reader's understanding of a situation is resistant to being overturned by contradictory information, at least under some circumstances. Readers continue to make inferences based on information read earlier, even when later information has discredited this information (Johnson & Seifert, 1994; however, van Oostendorp, 1996b, reached a different conclusion about this "continued influence effect"). More generally, the question is the conditions under which readers "update" a situation model based on subsequent information. van Oostendorp (1996a) reported that subjects who read newspaper articles on the U.N. action in

Somalia had difficulty updating information; when given a second article that included new information, they were not very accurate in judging the accuracy of information based on the new information, especially when the information was highly relevant. It is not clear how to interpret this result, partly because the level of performance that would have occurred in the absence of a first text is unknown. However, it is interesting that subjects who had developed accurate situation models based on the first article were more likely to update this model accurately with information from the second article. This suggests that whatever difficulty there might be in integrating information over multiple texts, the formation and updating of a single coherent situation model can occur with skill, or other variables affecting text comprehension. We also suspect that learners are more likely to build relationships among situations when the texts themselves are separately represented, such that an actual Documents Model is formed.

The Role of Learners' Tasks and Goals

The learner's goals, and the task context in which they are realized, are important in influencing the construction and use of a Documents Model. The goal or purpose of reading multiple documents normally includes more than just learning the propositional content of the documents. Indeed, as we emphasized, the goal of a learner goes beyond both text models and situation models. Readers generally want to use document information in order to perform a specific task (e.g., solve a problem or answer a question). In some situations, including school learning, these tasks are defined through explicit assignments, study directions, or queries. We expect these tasks to matter for multiple-document learning, just as they do for single-text learning, where several kinds of research supports the assumption that the task has a strong influence on how readers read, evaluate, memorize, and use information from multiple sources.

The first type of evidence comes from research on the comprehension of single texts. Based on the van Dijk and Kintsch (1983) model of text comprehension, several studies have shown that the nature of the reading task (e.g., learning vs. memorizing information) can promote the building of either a literal or elaborative memory trace (Mannes, 1988; Schmalhofer & Glavanov, 1986). In addition, a number of studies showed that specific study directions can influence the selection and hierarchization of text information in memory (Baillet & Keenan, 1986; Pichert & Anderson, 1977). Thus, the relation between the text content and the reader's cognitive representation may change as a function of task requirements.

For multiple documents, however, the problem is more complex for two reasons. First, the multiple-documents case brings an increase in text

diversity and task complexity. Second, the issue of information selection and ordering must be considered both at the within-document and between-document levels. Several studies have found an influence of the task faced by readers on their understanding of document information. For example, Wiley and Voss (in press) asked college students to study a text presented in one condition as a single text and in another condition as multiple texts. After studying, readers were asked to write either a narrative or an argumentative account of the situation described in the text(s). Wiley and Voss reported that the combination of multiple sources and the argumentative writing task resulted in more causal, connective, and transitive information in the written account. They concluded that constructive understanding of a historical situation can be promoted through argument-centered writing tasks. In terms of a Documents Model, this effect can be said to reflect the learner's distribution of attention between the two major components of the document space, the Intertext Model and the situations model. The multiple document space allows an Intertext Model to be constructed; and the argumentative task encourages the development of an integrated Documents Model—one in which the intertext components and the situations are interconnected, at least during the writing task. By contrast, narrative writing appears to encourage the construction of a single situation model.

A second kind of task effect comes from a study by Rouet and Britt (1996), who found evidence that study directions can affect the accuracy of readers' memory for information sources. Their study investigated the effects of situation versus argument-centered instructions on 17-year old French students' memory for information sources. The participants read four documents about revolts in post-World War I Europe. Students who were instructed to compare Soviet and Western interpretations (i.e., argument centered) tended to remember primary sources better, whereas students instructed to learn what happened (i.e., situation centered) remembered secondary sources better. This distinction between primary and secondary sources is interesting from the perspective of the Documents Model. Secondary sources are narrative accounts that draw on primary sources, which themselves are of various types. (Some can be narrative, but many are not.) Thus, when the task is to learn what happened, the student may attend more to texts that provide an account of the situation (i.e., a narrative). When the task is to compare interpretations, the student may attend more to texts that provide the source of interpretative differences. This suggests the construction of the intertext portion of the Documents Model.

Task effects may also be involved in producing superficial discrepancies in the research on multiple document understanding. Wineburg (1991) compared history graduates' and high-school students' understanding of

a set of documents about the Battle of Lexington, one of the first military events of the American war for independence. The results showed that, contrary to the novices, history experts use elaborate reasoning heuristics while reading, and hierarchize information as a function of source parameters. However, Rouet et al. (1996) found that college students with little experience in history were able to understand and use primary documents when reasoning about an unfamiliar controversy. One difference between these two studies was in the study directions given to participants. Wineburg (1991) instructed the students to read in order to find out what happened in Lexington on that day, with no explicit mention that information may be inconsistent or conflicting across sources. Rouet et al., in contrast, instructed their subjects to read in order to form an informed opinion about a controversial topic. More explicit directions may have directed students' attention toward information sources (as opposed to content) and toward the interpretations presented in the documents (as opposed to factual information).

In general, task effects reflect the interaction between a learner's goals and the document space in the construction of a Documents Model. Tasks that encourage attention to documents, as opposed to situations, should lead to the construction of an Intertext Model, and thus a functioning Documents Model. Such tasks might include instructions to compare documents, to cite arguments of a specific text author, to describe the types of documents read, and so on. By contrast, tasks that direct attention to producing simple causal event sequences may encourage the development of a situation model, but not necessarily an Intertext Model. Such tasks may include summarization, recall, and certain kinds of question answering. These may indirectly lead to a relatively impoverished Documents Model, one that contains mainly or only situations. The distinction between the two classes of tasks is roughly between questions about "what was said by whom?" versus "what happened?"

As a practical matter, it is possible that the situation models come rather easily, even when there is some emphasis on documents. Because situation models have the advantage of resting on familiar, highly used cognitive structures that center on narrative and causal-temporal event chains, they may need less specific instructions. Intertext representations may be less likely to be formed without specific guidance, but, in the course of constructing document representations, situation models may come as natural bonuses. If so, tasks that focus on situations lead to poor document representation, whereas tasks that focus on documents will not have a corresponding negative effect on students' understanding of situations.

Other contextual variables, such as the amount of time devoted to studying, the document presentation format (e.g., printed text vs. computer-based hypertext), availability of expanded source information, and

other between-document organizers may also play a critical role on the organization of multiple documents in memory. However, there is so far too little empirical evidence to support a discussion of these aspects of context on the construction of integrated Documents Models.

The Role of Reader Expertise

Studies of single-text processing have either assumed or demonstrated that domain knowledge allows domain experts to build up richer text representations (e.g., Dee Lucas & Larkin, 1988; Spilich, Vesonder, Chiesi, & Voss, 1979). However, when looking at multiple texts it is obvious that domain knowledge is only one among several sources of knowledge involved in the comprehension process. Other sources include knowledge about texts as sources of information, and knowledge about how to use texts for a specific purpose or problem (see, e.g., Dillon, 1991). Rather than examine all possibilities for different kinds of knowledge, we exemplify this class of knowledge influences by referring to the reader's initial discipline knowledge. By discipline knowledge, we refer to an undifferentiated knowledge that includes specific domain knowledge and trained experiences with the texts in that domain.

We suggest that readers' ability to build comprehensive Documents Models varies as a function of the reader's initial discipline knowledge. Given a set of documents and a problem, some readers will tend to build a simple narrative model, with few connections to information sources, whereas others will construct a model in which the story(ies) will be embedded in the Intertext Model.

We consider the two short essays presented in the Appendix to illustrate this suggestion. These essays were collected as part of previous studies (Rouet et al., 1996; Rouet, Favart, Britt, & Perfetti, in press). The two essays were written by students with different backgrounds but under similar study conditions. The students were asked to read a set of documents about the 1903 United States military intervention in Panama, with the purpose of answering a controversial question (i.e., to what extent was the United States intervention justified?). Then the students were asked to write their opinion about the controversy.

Essay 1 was written by a first-year college student from an American university. It contains a selection of facts ordered so as to make a coherent story. The gist of the story contained in the student essay is as follows: A revolution was about to break out in Panama, American lives were threatened, which resulted in a limited intervention on the part of the U.S. military. The intervention was successful even though the Marines were outnumbered, probably because some Colombian leaders were corrupt. There is no explicit reference to documents, nor any mention of the

controversy. In terms of the Documents Model framework, there is no explicit connection between the situation model and the Intertext Model. In fact, there is no evidence that the student has acquired an Intertext Model. Rather, it seems that a subset of consistent information was selected from a subset of sources, and a story reconstructed from this selection of information. Such an essay may indicate the student's efforts to reduce a complex, inconsistent situations model into a single, simplified situation model.

Essay 2 was written by a graduate history student from a French university. The essay introduces the structure of the Documents Model immediately (i.e., two opposed interpretations triggered by the same set of events and supported by various kinds of evidence). No attempt is made to provide a single, coherent story. Instead, there are many references to the documents and a clear effort to present the contribution of each document. In terms of the Documents Model, the student is describing both the Intertext Model and the critical connections between the Intertext Model and the Situations Model.

It is important to note that the problem statement, the document set, and the study conditions were similar for the two students. Of course, many individual factors can explain the differences in the essays—cultural or ideological background, amount of academic training, expertise in the discipline of history. Our purpose here is not to discuss the relative importance of these factors. We suggest only that studying multiple documents can lead a reader to various types of representations, which vary in the extent to which connections between content and sources of information are established. Experts are more likely to develop a detailed situation model from a text in their area of expertise (Kintsch, Welsch, Schmalhofer, & Zimny, 1990). Additionally, Rouet et al. (in press) suggest that experts are more likely to develop a connection between situations and text sources, at least during comprehension. Discipline expertise does not lead to the construction of simple narrative situational models, but to a more interconnected Documents Model.

We emphasize, however, the likelihood that differences between experts and nonexperts can be affected by the task. The task used by Rouet et al. (1996) encouraged attention to documents. As we suggested in the previous section, such a task should promote the construction of an Intertext Model, compared with tasks that require the student to "tell what happened." With such instructions, differences between experts and nonexperts might be even larger. Experts may typically choose to build an Intertext Model in their area of expertise, even when not encouraged to do so. Indeed, they may prefer to do so even in areas outside their immediate expertise as was suggested by Rouet et al. (in press; see also Perfetti et al., 1995).

SUMMARY AND CONCLUSIONS

Most text-comprehension theories assume the existence of two basic levels of representation: a textbase and a situation model. It has been previously argued that the building of a situation model is critical for tasks that involve text learning or text-based problem solving (e.g., Kintsch, 1986; Schmalhofer & Glavanov, 1986). In this chapter, we described a theoretical framework that accounts for tasks that involve reading multiple texts. We argued that in such cases, an additional level of representation may be needed. This additional level, the Documents Model, includes a mental representation of each text, each situation described in a text, relations among texts, and also relations between texts and situations.

The Documents Model includes two major components, the Intertext Model and the Situations Model. The Intertext Model represents all relevant information attached to a text (i.e., information about source, content, and rhetorical goals) and the relationships among texts (i.e., references embedded in text and solidarity relationships—confirms, opposes). The Situations Model represents the situations, facts, and events described in the texts. Some parts of a Situations Model can be connected to the Intertext Model, for instance, when several texts provide conflicting accounts or interpretations of the same events. When this is done, there is a rich Documents Model, one that represents not only a single situation, but a range of possible situations tied to the documents. Whether such a model is actually constructed by a learner is influenced by a number of factors, including the learner's goals and the demands of the task, as well as expertise, discipline training, dispositions toward learning, and other factors that can influence the extent to which an individual will be motivated to make connections between texts and situations.

APPENDIX

Two opinion essays based on a unique document set.

CONTROVERSY: To what extent was the November 1903 U.S. military intervention in Panama justified?

Essay 1 (U.S. First-Year Student)

United States military intervention was minimal. Only 42 marines were on the USS Nashville. They only came onto Panama when American lives were threatened. The revolution was bound to happen. Colonel Shaler

was the one that [sic] shut down the railroad to the Colombian troops. I think he would have done this even if Colonel Hubbard didn't request/demand the action. The Panamanians wanted to revolt. The United States had forty-two marines in the harbor, while the Colombians had four hundred troops at their disposal. I think the Colombians [sic] leaders were corrupt and there was some type of payoff/scandal involved that we will never know about. So, I believe the limited intervention was justified.

Essay 2 (French History Graduate Student)¹

The U.S. intervention in Panama gave birth to two radically opposed theses: One defending the intervention, the other one not supporting it. The opposition between the two viewpoints is evidenced from the time of the U.S. landing (Carmack/Roosevelt) but it continues till the present times since two historians deliver different interpretations of the events.

However the arguments proposed in each thesis do not "weight" the same. The U.S. President as well as historian Wilson seem to consider [past events] as a unique criterion. It is the past (the numerous interventions in Panama, the relations with Colombia) that justifies the [1903] intervention. This argument, which poorly explains the sudden necessity of [another] intervention, is buried into a discourse that uses tricks to convince the reader or hearer that their point of view is correct. Whereas the thesis that does not defend the U.S. intervention is supported by arguments selected in the very text that rules the relations between Colombia and the U.S.: the 1846 Treaty. It is on the basis of a text of international law that they argue; and they consider that there was a violation of the Treaty.

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REFERENCES

- Altmann, G., & Steedman, M. (1988). Ambiguity, parsing strategies, and computational models. *Language and Cognitive Processes*, 3, 73-97.
Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

¹This is translated from the French.

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- Baillet, S. D., & Keenan, J. M. (1986). The role of encoding and retrieval processes in the recall of text. *Discourse Processes*, 9, 247-268.
Britt, M. A. (1994). The interaction of referential uniqueness and argument structure in parsing propositional phrases. *Journal of Memory and Language*, 33, 251-283.
Britt, M. A., Rouet, J.-F., Georgi, M. C., & Perfetti, C. A. (1994). Learning from history texts: From causal analysis to argument models. In G. Leinhardt, I. L. Beck, & C. Stanton (Eds.), *Teaching and learning in history* (pp. 47-84). Hillsdale, NJ: Lawrence Erlbaum Associates.
Campanario, J. M., & van Oostendorp, H. (1996, September). *Updating mental representations when reading scientific text*. Paper presented at the International Seminar on Using Complex Information Systems, Poitiers, France.
Dee Lucas, D., & Larkin, J. H. (1988). Novice rules for assessing importance in scientific texts. *Journal of Memory and Language*, 27, 288-308.
Dillon, A. (1991). Readers' models of text structures: The case of academic articles. *International Journal of Man-Machine Studies*, 35, 913-925.
Ferreira, F., & Clifton, C., Jr. (1986). The independence of syntactic processing. *Journal of Memory and Language*, 25, 348-368.
Frazier, L. (1979). *On comprehending sentences: Syntactic parsing strategies*. Bloomington: Indiana University Linguistics Club.
Glenberg, A. M., Meyer, M., & Lindem, K. (1987). Mental models contribute to foregrounding during text comprehension. *Journal of Memory and Language*, 26, 69-83.
Haenggi, D., Kintsch, W., & Gernsbacher, M. A. (1995). Spatial situation models and text comprehension. *Discourse Processes*, 19, 173-199.
Johnson, H. M., & Seifert, C. M. (1994). Sources of the continued influence effect: When misinformation in memory affects later inferences. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20(6), 1420-1436.
Johnson-Laird, P. N. (1983). *Mental models*. Cambridge, MA: Harvard University Press.
Kintsch, W. (1974). *The representation of meaning in memory*. Hillsdale, NJ: Lawrence Erlbaum Associates.
Kintsch, W. (1986). Learning from text. *Cognition and Instruction*, 3, 87-108.
Kintsch, W. (1992). How readers construct situation models for stories: The role of syntactic cues and causal inferences. In A. F. Healy, S. M. Kosslyn, & R. M. Shiffrin (Eds.), *From learning processes to cognitive processes: Essays in honor of William K. Estes* (Vol. 2, pp. 261-278). Hillsdale, NJ: Lawrence Erlbaum Associates.
Kintsch, W., Welsch, D., Schmalhofer, F., & Zimny, S. (1990). Sentence memory: A theoretical analysis. *Journal of Memory and Language*, 29, 133-159.
Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review*, 85, 363-394.
Larsen, S. F. (1983). Text processing and knowledge updating in memory for radio news. *Discourse Processes*, 6, 21-38.
Mannes, S. (1988). A theoretical interpretation of learning vs memorizing texts. *European Journal of Psychology of Education*, 3, 157-162.
Mannes, S. (1994). Strategic processing of text. *Journal of Educational Psychology*, 86, 377-388.
Mannes, S., & Hoyer, S. M. (1996). Reinstating knowledge during reading: A strategic process. *Discourse Processes*, 21, 105-130.
Morrow, D. G., Greenspan, S. L., & Bower, G. H. (1987). Accessibility and situation models in narrative comprehension. *Journal of Memory and Language*, 16, 165-187.
Perfetti, C. A., & Britt, M. A. (1995). Where do propositions come from? In C. A. Weaver III, S. Mannes, & C. R. Fletcher (Eds.), *Discourse comprehension: Essays in honor of Walter Kintsch* (pp. 11-34). Mahwah, NJ: Lawrence Erlbaum Associates.
Perfetti, C. A., Britt, M. A., & Georgi, M. C. (1995). *Text-based learning and reasoning: Studies in history*. Mahwah, NJ: Lawrence Erlbaum Associates.

- Perfetti, C. A., Marron, M. A., & Foltz, P. W. (1996). Sources of comprehension failure: Theoretical perspectives and case studies. In C. Cornoldi & J. Oakhill (Eds.), *Reading comprehension difficulties: Processes and intervention* (pp. 137-165). Mahwah, NJ: Lawrence Erlbaum Associates.
- Perrig, W., & Kintsch, W. (1985). Propositional and situational representations of text. *Journal of Memory and Language*, 24, 503-518.
- Pichert, D. E., & Anderson, R. C. (1977). Taking different perspectives on a story. *Journal of Educational Psychology*, 69, 309-315.
- Rouet, J.-F., & Britt, M. A. (1996, July). *Remembering information from multiple documents: Effects of task demands and source information*. Paper presented at the meeting of the Society for Text and Discourse, San Diego, CA.
- Rouet, J.-F., Britt, M. A., Mason, R. A., & Perfetti, C. A. (1996). Using multiple sources of evidence to reason about history. *Journal of Educational Psychology*, 88, 478-493.
- Rouet, J.-F., Favari, M., Britt, M. A., & Perfetti, C. A. (in press). Studying and using multiple documents in history: Effects of discipline expertise. *Cognition and Instruction*.
- Schmalhofer, F., & Glavanov, D. (1986). Three components of understanding a programmer's manual: Verbatim, propositional and situational representations. *Journal of Memory and Language*, 25, 279-294.
- Spillich, G. H., Vesonder, G. T., Chiesi, H. L., & Voss, J. F. (1979). Text processing of domain-related information for individuals with high and low domain knowledge. *Journal of Verbal Learning and Verbal Behavior*, 18, 275-290.
- Trabasso, T., & van den Broek, P. (1985). Causal thinking and the representation of narrative events. *Journal of Memory and Language*, 24, 612-630.
- van Dijk, T. A. (1988). *News as discourse*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York: Academic Press.
- van Oostendorp, H. (1996). Updating situation models derived from newspaper articles. *Metapsychologie*, 8, 21-33.
- Wiley, J., & Voss, J. F. (in press). The effects of "playing historian" in history. *Applied Cognitive Psychology*.
- Wineburg, S. S. (1991). Historical problem solving: A study of the cognitive processes used in the evaluation of documentary and pictorial evidence. *Journal of Educational Psychology*, 83, 73-87.
- Wineburg, S. S. (1994). The cognitive representation of historical texts. In G. Leinhardt, I. L. Beck, & C. Stainton (Eds.), *Teaching and learning in history* (pp. 85-135). Hillsdale, NJ: Lawrence Erlbaum Associates.