CONCEPTUAL COHERENCE IN TEXT AND DISCOURSE

Arthur C. Graesser
Departments of Psychology and Mathematical Sciences
Memphis State University
Memphis, TN 38152

Description of Symposium

The participants in this symposium present computational and psychological models of coherence in text and discourse. The emphasis is on conceptual coherence rather than syntactic or linguistic coherence. That is, the primary goal is to explain how the text (written or oral), the semantic representation, and world knowledge together determine how idea units are connected coherently. Syntax and other surface linguistic features undoubtedly play a role in a complete theory of coherence; however, their role is not the primary focus of this symposium.

The participants in this symposium span diverse fields in cognitive science: Cognitive psychology, artificial intelligence, computational linguistics, discourse processing, and educational psychology. However, all of the models adopt a computational approach to investigating coherence. That is, each model has particular assumptions about knowledge representation, the formal composition of idea units, symbolic procedures that operate on idea units, and the management of working memory. The models address the process of constructing coherent meaning structures during comprehension in addition to addressing the representation of the meaning structures.

There are several foundations for establishing conceptual coherence when text or discourse is comprehended. First, the textbase becomes more coherent to the extent that explicit propositions can be connected by anaphoric references and bridging inferences (Clark & Haviland, 1977; Halliday & Hasan, 1976; Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). Second, a set of text propositions are conceptually related by virtue of higher order packages of generic world knowledge, such as scripts and frames (Bower, Black, & Turner, 1979; Minsky, 1975; Graesser & Clark, 1985; Schank & Abelson, 1977). Third, coherence may be imposed by virtue of abstract rhetorical configurations (Meyer, 1985), such as problem+solution, claim+evidence, assumptions+conclusion, compare+contrast, setting+plot, question+answer, and so on. Fourth, there is a pragmatic level that considers the common ground and goals of the speech participants. All of these foundations are discussed in this symposium.

Symposium participants

Arthur Graesser, symposium chair, Introduction
Richard Alterman, The conceptual coherence of events
Kathleen Dahlgren, Bases of Coherence
Bruce Britton, Kintsch's computational model of coherence processing: Diagnosing inferences in naturally-occurring text, and repairing text accordingly to increase learning
Paul van den Broek, Establishing coherence during reading: A process model of inference generation
Charles Fletcher, A model of narrative comprehension and recall
Roger Kreuz and Richard Roberts, The elements of conversational coherence
Tom Trabasso and Nancy Stein, discussants

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Reasoning about a Semantic Memory Encoding of the Connectivity of Events[1]

Richard Alterman
Computer Science Department
Brandeis University

In artificial intelligence, human understanding of text is modeled by programs which construct representations. A critical question concerns determining the form of the representation (hence the form of the understanding). The notion of coherence emphasizes the connectivity of items in the understanding/representation. Coherence representations either tie together the words of the text, the discourse units of the text, or the concepts the text invokes. The coherence viewpoint is exemplified by the works of Halliday & Hasan (1976) on cohesion, Lockman & Klappholz (1980) on contextual reference resolution, Hobbs (1979) on rhetorical coherence, and the semantic network-derived text representation techniques of Norvig (1989), Kintsch (1988), and Charniak (1986, 1983).

In the theory of *event concept coherence* (ECC: Alterman, 1985;1982), a sequence of events is represented by a copy of a portion of the web of concepts that holds the events together in semantic memory. The basic idea is that semantic memory provides a vocabulary for encoding the events to be understood: the 'language' of the representation is provided by an underlying semantic network. The work on event concept coherence is most directly influenced by early work in semantic networks and spreading activation (Quillian, 1968; Collins & Loftus, 1973), the incorporation of case frames (Fillmore, 1968) into the semantic network framework by Simmons (1973), and the work of Schank (1982) on dynamic memory. I will refer to the ouput derived from a ECC analysis as an event connectivity graph.

The focus of this talk is on the semantics of the ECC-derived representation scheme. I will describe a program called SSS (developed with Larry Bookman) that exploits the event connectivity graph in support of several reasoning tasks: SSS uses the graph to identify the conceptual roots of the narrative. (Roughly the conceptual roots correspond to the basic event notions of the representation/understanding.) An interesting property of the conceptual roots is that they are the minimum set that *covers* the entire interpretation graph. With the addition of the techniques that determine the conceputal roots, SSS is able to succinctly explain the connection between any two concept coherent events in the narrative. Also implemented in SSS is a measure of importance that quantifies the author's conceptual emphasis. Lastly, I will outline the summarization techniques used by SSS to describe the basic event content of the narrative.

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Bases of Coherence

Kathleen Dahlgren
Intelligent Text Processing, Inc.
1310 Montana Avenue, Santa Monica 90403

Different coherence theories related different entities: portions of the text, propositions expressed by the discourse, or nodes in a semantic net of inferences. We will justify the claim that coherence relations related the discourse events, states and other abstract types in a cognitive model of the events introduced into the discourse. Coherence relations form a cohesive event model for the discourse. "Coherent" means that there is some causal or other link between the content of each clause and some other clause or clauses in the discourse.

Choosing events in a model as the relata assumes a perspective on the nature of the relations themselves. If coherence relations are justified on the basis of cognitive strategies for the interpretation of events, then they must relate events or events in a model. We propose a short closed set of coherence relations based upon cognitive strategies which are employed in the interpretation of events as observed, as well as of events as reported in discourse. They are justified by evidence that they are used in interpretation of observed events, psychological evidence that texts are interpreted using them as the basis for integrating a new sentence interpretation with the prior discourse interpretation, morphological forms, and evidence that they are sufficient to determine segment boundaries which constrain anaphor resolution.

Psychological evidence for coherence includes the intuition that (1) is more acceptable as a discourse than (2).

(1) John invested heavily. He made a huge profit.
(2) John invested heavily. He ate pizza.

Psycholinguistic studies justify coherence in several ways. Subjects reliably draw large numbers of inference about texts when questioned after reading. Those events which are causally or superordinately related to others in a text are more quickly interpreted, better recalled, and better recognized than unrelated events. Texts which are organized for ready identification of event hierarchy (topicality) are more quickly read and better understood. Discourse interpretation involves the construction of an event model of the emerging situation.

Linguistic evidence for discourse coherence is provided by our study of anaphor resolution in a 20,000 word corpus. Pronominal anaphors cannot find their antecedents across segment boundaries. The latter are most often signalled by change in coherence relation and change in sentence subject, not by cue phrases. Therefore, constraints on anaphor resolution provide evidence that coherence relations must be assigned during discourse interpretation.

Kintsch's Computational Model of Coherence Processing: Diagnosing Inferences in Naturally-occurring Text, and Repairing Text Accordingly to Increase Learning

Bruce K. Britton

University of Georgia

Kintsch's computational model of coherence processing provides an algorithm for detecting specific locations in text that require bridging inferences to create coherence. Only when propositions representing those inferences are inserted into the text base can Kintsch's program create a coherent representation of the text.

If Kintsch's model is correct for humans, then texts that require many such bridging inferences should not be represented coherently in memory, and so should be difficult to recall. This prediction was confirmed in a study of eight 600-1000 word history textbook passages. Reliable negative correlations (-.70 to -.89) were found between the number of inferences detected by Kintsch's program and the amount of recall.

Kintsch's model also implies that when such inferences are experimentally inserted into a text that requires them (i.e., the text is repaired according to the principles of the Kintsch model) the new text should be represented more coherently in memory, and therefore should be recalled better; also, the reader should have a better situation model of the situation described by the text, and should read at a faster rate because no pauses are necessary to compute inferences.

In two experiments with undergraduates and Air Force recruits, the Original Version of a 1000 word naturally occurring Air Force text was repaired according to the principles of the Kintsch program. Then the new version, here called the Principled Revision, was empirically compared with the Original Version. Measures of learning and reading rate showed that recall was doubled for the Principled Revision, the situation model was significantly better for the Principled Revision, and reading rate was significantly faster.

These studies support Kintsch's model and its usefulness for diagnosing processing problems in naturally occurring texts, and repairing them to increase learning.

Establishing Coherence during Reading: A Process Model of Inference Generation

Paul van den Broek
Department of Educational Psychology - University of Minnesota
178 Pillsbury Dr. SE - Minneapolis, MN 55455

In this presentation, I will describe a process model of reading comprehension. According to the model the reader attempts to build a coherent mental representation or situation model of the text by maintaining local coherence. Local coherence is maintained via backward and forward causal inferences. Backward inferences connect each focal event (1) to a preceding event that is still in short-term memory, (2) to earlier events that are reinstated from long-term memory, and/or (3) to events that are added to the situation model via elaborative inferences. In addition, forward inferences may anticipate (1) upcoming events, as well as (2) future relevance of the focal event. The model proposes a set of production rules that direct the generation of these inferences. The production rules are based on two types of constraints. Conceptual constraints determine whether sufficient coherence has been established, or whether additional inferences are required before the focal event is adequately comprehended. Thus, the conceptual constraints provide criteria for coherence that initiate and terminate inferential processes. Procedural constraints reflect the processing resources that are available to the reader. Based on attentional or short-term memory limitations, they determine whether long-term memory for the text or general background knowledge is accessed to generate the required inferences. Together, the conceptual and procedural constraints establish under what circumstances causal inferences are generated, what kinds of inferences are made, and what their content is. Reading time and primed recognition data provide empirical support for several aspects of the model.

A Model of Narrative Comprehension and Recall

Charles R. Fletcher
Department of Psychology
University of Minnesota
75 East River Road
Minneapolis, MN 55455

In this presentation, I will describe a process model of narrative comprehension and recall that borrows heavily from existing models of comprehension, problem solving, and retrieval from long-term memory. The comprehension component of the model adds propositions to its short-term memory one at a time. As each proposition is processed, it becomes associated with itself, the context, and all other propositions in short-term memory. When a sentence boundary is reached, the model focuses its attention on the most important propositions from the last clause with causal antecedents--but no consequences--earlier in the text. The free recall component of the model uses a probabilistic search process to retrieve a causal path that connects the text's opening to its final outcome. This is achieved by using propositions from the most recently recalled clause with antecedents--but no consequences--as retrieval cues. A computer simulation of this model accounts for 35% of the variance in college students' free recall data on four simple narrative texts.

The Elements of Conversational Coherence

Roger J. Kreuz and Richard M. Roberts
Memphis State University

Researchers who study coherence have primarily focused upon text in their efforts to determine how coherence is established and maintained. Coherence processes in conversation are, to a certain degree, dependent upon these same mechanisms. However, conversations differ from texts in important ways, and these discrepancies have important implications for our understanding of conversational coherence. Some of the ways in which texts and conversations differ will be reviewed.

In addition, the concept of conversational coherence itself will be critically examined. A lack of consistency in the literature has made it difficult to operationally define coherence. However, a simple metric for determining the loss of conversational coherence will be advanced and explained.

Two fundamentally different ways of viewing conversation will be presented. One view suggests that conversational coherence is fragile, while the other maintains that coherence is relatively robust. Some evidence exists for both of these extremes, and this discrepancy will be resolved by positing that coherence is best viewed as a relative attribute of conversation, instead of as an absolute attribute.

Previous research on conversational coherence will also be reviewed. In particular, Paul Grice's ideas about a Cooperative Principle and conversational maxims will be characterized as an important but incomplete description of conversational interaction. By appealing to Clark's notion of common ground (in which the degree of experiential overlap is computed by conversational participants), a number of problems concerning conversational coherence be resolved.