

below) that people do not decompose words into their semantic primitives during comprehension. Even if they do, a representation of an entire text should focus on the many higher order, complex relations that express the message of the passage, not the lower level complexities. Frederiksen's system seems devised for representing the relations *within* a sentence, not *among* sentences. The network has capacities for connecting propositions referentially and temporally, but apart from these, there is little in his system that seems concerned with the text level as opposed to the sentence level. Textual aspects which he does not represent include the overall organization of the text, of the plot, and inferences and elaborations that connect lines of input.

Kintsch (1974) has also developed a formal representation for texts and has performed numerous experiments to test the validity of this theory. The fundamental unit in his analysis is the proposition. A text is represented as an ordered list of propositions. He avoids network representations such as those described earlier, due to their impracticality for passages of any length or complexity. Networks are messy for single propositions, and they rapidly become unwieldy when expressing multiple propositions. A sentence may consist of one or more simple propositions, each proposition consisting, in turn, of a relation and a set of arguments. The representation has the flavor of predicate calculus. Verbs and adjectives are relations (or attributes), and nouns and other propositions are its arguments. Propositions are connected together by means of a repetition rule, in which one proposition is referred to by a "superordinate" proposition that contains this subordinate as an argument. This forms a hierarchical structure. Propositions are also connected by sharing the same arguments or concepts (e.g., a character in a story can be in multiple propositions). The first proposition that uses the shared argument is considered the superordinate of the proposition that contains the repeated argument. Propositions can also be connected by an ampersand when they share a common argument. For example, Kintsch (1974) represents "John broke his leg yesterday" as: (BREAK, JOHN, LEG) =  $\alpha$ ) & (TIME,  $\alpha$ , YESTERDAY) (p., 63). Kintsch claims his hierarchical organization of text has predictive value for recall.

Kintsch does not include any inferences in his examples of text representations, yet his theory does include rules for generating some inferences. It is not clear from his rules what inferences could or could not be generated, nor which inferences are likely to be stored as part of comprehension.

Kintsch reports numerous experiments in support of his theory (e.g., Kintsch & Keenan, 1973; Kintsch, McKoon, & Keenan, 1974; Kintsch & Monk, 1972). He admits that these experiments support a class of representations, of which his is one; some studies though (e.g., Kintsch, 1974, ch. 7) were designed to distinguish between his propositional representation and other extant proposition representations. A few of his studies will be described below in varying detail.

In order to determine whether subjects draw and store inferences while reading, Kintsch et al. (1974) looked at reading times for paragraphs that either stated or implied facts that followed from the text and looked at time to judge if these facts were true of the text. The "level" of difficulty of the inference was manipulated in one study; the delay from study at which the question was asked was varied in a series of experiments. Table I gives the example used in Kintsch's (1974) book for the different levels of inference. Kintsch et al. (1974) in one condition actually presented the inference as part of the text (explicit condition), in another condition, the statement was not presented but could be readily inferred (implicit condition).

TABLE I

*Level 1*

A strong hand was needed to restrain the dog. The animal's instincts had been aroused by the sight of the fleeing deer. (The dog was an animal.)

*Level 2*

A burning cigarette was carelessly discarded. The fire destroyed many acres of virgin forest. (A discarded cigarette started a fire.)

*Level 3*

Police are hunting a man in hiding. The wife of Bob Birch disclosed illegal business practices in an interview on Saturday. (Bob Birch is the man who is hiding.)

They found no difference in reading times that depended on whether the statement was explicit or implicit, and no systematic effect on reading time due to level of inference. Time to verify a fact did not depend on level of inference either. Subjects were faster to verify statements that were explicit in the text immediately and a half minute later, but the difference in reaction time to verify explicit versus implicit statements was not significant 20 minutes or 48 hours later. They concluded that immediately there is a surface structure advantage for the presented condition, but, over time, this superficial difference in memory representations evaporates, that is, subjects have stored the inference in the implicit condition and the underlying representations in memory are the same. One may question this interpretation, however, since the appropriate statistical test was not conducted.<sup>5</sup>

Kintsch and Monk (1972; Kintsch, 1974, ch. 5) argued that ideas in a text are represented in propositional format, which does not depend on the surface structure complexity of the input. Two versions of a passage were constructed, one simple in structure and one complex, although both were presumed to convey the same ideas. Subjects read one of the two versions. Reading time was of interest as was time to judge that an inference from the story was valid. They found that reading times were longer for complex passages, but that latencies to judge inferences did not vary as a function of complexity. These findings are consistent with their notion that it takes longer to comprehend complex statements and encode them into a propositional format; once stored in their canonical representation, however, the time to make the inference should not reflect surface structure. Kintsch also suggests that recall can be predicted by level in the hierarchy, superordinate propositions being recalled more frequently. Kintsch and Keenan (1973) found this trend. McKoon (1977) found that subjects were faster and more accurate to verify topic information than details and that the discrepancy between topic and details grew with delay.

<sup>5</sup> Although the conclusion offered by Kintsch et al. (1974) may be correct, the statistics performed on the data do not warrant this conclusion. They have merely failed to reject the null hypothesis at the two longest delays. The appropriate test would have been to assume, as the null hypothesis, no difference between explicit and implicit inferences over time (i.e., assume the functions to be parallel across delay). If they had found an interaction between delay and explicit versus implicit, they would have been more justified in their conclusion.