

grammar as just one grammar or "schema" among many that people have available for everyday functioning. Rumelhart and Ortony discuss schemata in terms that go beyond story comprehension. They define a schema as an abstract representation of a generalized concept or situation. There are schemata for pattern perception (e.g., a face schema), for motor skills (e.g., a juggling schema), as well as for comprehension (e.g., a "give" schema). These schemata operate at all levels. A higher level schema will call a subschema to analyze part of the passage. A representation involving schemata would merely have pointers to subschemata. For example, the "stroll" schema would merely point to the "walk" schema. This is a departure from Rumelhart's earlier views in which, for example, all verbs were "unpacked" for comprehension (Rumelhart & Levin, 1975).

The schemata for stories are like a grammar in that they allow one to decide what is and what is not a story and what are the constituents of the story. If a story does not fit any of the available schemata, it is not an "acceptable" story. The schema Rumelhart describes is one in which something happens to the protagonist which sets up a goal. The rest of the story is concerned with trying to achieve the goal. A passage is a story fragment when a goal has been set up and the passage does not have a resolution or an outcome.

The idea of using schemata is actually an old one. Rumelhart and Ortony mention that Kant (1787/1963) as well as Bartlett (1932) put forth related views. More recently, Chafe (1976) and Winograd (1977) have also adopted the term in trying to describe the mechanisms involved in prose comprehension. According to these theorists, a schema or prototype gives the basic structure of a class of its instantiations. No instantiation matches the prototype or schema perfectly. Chafe believes that when a person stores information about an event in memory, it is encoded with respect to a prototype of similar events, but that the match is not all or none. He argues that information is stored in a "schematic" rather than a "propositional" form because a person does not report the same experience in the same way on two separate occasions, each report being a variation on the schema. This argument is less than convincing for two reasons. First, it is not clear why a propositional representation is incompatible with novelty in expressing the same event; second, my own impression is that the overlap in the retelling of events, jokes, etc., by a given individual is often more striking than any novelty in exposition (see Dawes [1964, 1966] for experimental support). In fact, such retellings often remind me of a prerecorded message being played again.

Winograd (1977) has also adopted the term schemata but relates it to Minsky's (1975) "frames." The distinction he offers between the two concepts is quite subtle. Frames are definitions; they denote a representation with variables or slots to be filled by a particular instance. Certain slots are optional; that is, they do not have to be given a value for a particular instance. Others are mandatory and assume default values when not specified in the story. Schemata, on the other hand, are more flexible in that they allow for partial fits in expressing ideas.

Like Rumelhart, Winograd believes that schemata represent concepts which vary in their levels of abstraction; one schema can be embedded within another. Both Winograd (1977) and Rumelhart (Note 8) mentioned briefly, when presenting papers at the 1976 Carnegie Symposium, that schemata include procedural information for

recognizing whether something should be classified as an instance of the schema. How this recognition process would work is not yet clear.⁶

While arguing for the virtues of schemata, Winograd (1977) also criticized other approaches, viz., the use of scripts and plans by Schank and Abelson (Note 9), as being far too rigid and not accounting for many problems in comprehension. On the other hand, Schank and Abelson have specified their comprehension procedures to a far greater extent than have those advocating schemata. It is not at all clear how one would write other schemata, even another plot structure, nor how any of its claimed virtues would be implemented. Schank and Abelson have developed more examples of scripts and plans than have Rumelhart, Winograd, or Chafe developed examples of schemata.

Necessary Inferences

The notion that drawing inferences is necessary for comprehending a passage has gained more attention in the last few years (e.g., Paris & Lindauer, in press; Shank & Abelson, Note 9; Charniak, Note 10; Clark, Note 11; Frederiksen, Note 12; Rieger, Note 13; Trabasso & Nicholas, Note 14). Most of these papers demonstrate the importance of world knowledge and the drawing of inferences by presenting example stories and showing what inferences were necessary for comprehension. The papers by Clark, Rieger, and Trabasso and Nicholas actually present classifications of necessary inferences. Clark's work will be discussed in detail because he also presents empirical data to support some of his claims.

Clark (Note 11) and Clark and Haviland (1976) focus their analysis of inferences on those they call "authorized inferences." These inferences are called authorized to indicate that they are intended by the speaker, or "backward inferences" to indicate that they are to connect the current sentence with previous ones. Many of the notions Clark and Haviland discuss are based on Grice's (1975) *Co-operative Principle*. One aspect of this principle concerns finding the intended antecedent that allows comprehension of the current statement. Finding the antecedent sometimes involves "bridging," or the drawing of inferences by the comprehender. Clark (Note 11) describes a number of types of bridging, some of which are described below.

One form of bridging is determining reference. There are many ways in which this can be done. An interesting way is by means of epithet. An example of an epithetic reference is "I met a man yesterday. The bastard wanted to stop all governmental support of education." Epithets are restricted in use; "the bastard" could not be replaced by "the doctor." Another type of bridging involves inferring information about something previously mentioned. This also may resolve reference. If one reads "I walked into the room. The ceiling was very high," it is easily inferred that "ceiling" refers to the ceiling of the room since it is a necessary part of the room. However, if one reads, "I walked into the room. The chandeliers sparkled brightly," the idea that the room has chandeliers has been induced; this time the bridge has conveyed new information. Chandeliers are not a standard attribute in a "room frame."

⁶ Bobrow and Winograd (1977) have developed a language called KRL (Knowledge Representation Language) that is supposed to recognize instances of a schema. The details of how this is accomplished have not been given, nor are the limitations of the program known.