Modelling Language Comprehension Without Propositions

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Some recent theories of language comprehension (e.g., the Immersed Experiencer Framework, Zwaan, 2004) stress the importance of embodiment to the understanding of language. For instance, reading a description of a situation would result in a mental simulation similar to the result of directly experiencing the situation. According to Barsalou (1999), such a simulation requires mental representations that are not arbitrary and amodal symbols, but 'perceptual symbols', which are analogical and modal. Nevertheless, most current computational models of language comprehension (e.g., Budiu & Anderson, 2004) view comprehension as the construction of an arbitrary, amodal propositional structure.

Unlike such models, the Distributed Situation Space model (DSS; Frank et al., 2003) uses a non-propositional representation of events to simulate how knowledge-based inferences are drawn during story comprehension. In DSS, any situation that can take place in a pre-defined microworld is represented distributively as a vector in a high-dimensional 'situation space'. These vectors, which result from training a Self-Organizing Map (SOM) on a list of co-occurrences of microworld events, encode probabilistic relations among these events.

The DSS model's vector representations are clearly analogical: Similarities among vectors reflect similarities among the represented situations. However, they are amodal since they do not encode perceptual information: Only probabilistic information is present in the training input 'perceived' by the SOM. In theory, however, the vector representations could be based on more realistic, perceptual input (e.g., simple images), resulting in representations that are both analogical and modal.

The DSS model takes as input non-linguistic representations of story situations. Recently, Frank et al. (to appear) have worked towards extending this inference model with a sentence-comprehension model by providing it with linguistic input. They trained a simple recurrent network to transform word sequences (i.e., sentences) into the DSS representations of the described situations. During this training, an intermediate representation arises which is not propositional yet can account for empirical data (Fletcher & Chrysler, 1990) that is widely accepted as evidence for the cognitive reality of propositional representations of text. In this way, the model shows how sentence comprehension is possible without explicit extraction of propositional structures, and how a non-propositional, distributed representation can have proposition-like properties.

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