Some Parallels between Visual and Linguistic Processing

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The processing of a speech signal may be much more similar to sensory processing, in particular visual processing, than has previously been assumed (Chomsky 1976). In visual perception, certain features are extracted from the retinal (preprocessed) image, and relayed through several centers (Shepherd 1994). Feature extraction utilizes lateral inhibition which serves to enhance the signal-to-noise ratio. Several distinctive pathways for types of information (color perception, motion detection, texture analysis, shape perception) can be anatomically differentiated. 'Relay centers' have an increasing range of input from different centers and turn out features or schemas which are increasingly complex and useful for the organism. They feature interactive sideways and feedback connections (VanEssen & Deyoe 1995).

These concepts may equally be applied to linguistic processing. The processing of a speech signal may be relayed along several distinguishable pathways within a highly interconnected processing scheme.

Parallels in feature extraction, transformation and schema integration can be explored in detail in the area of microfeatures that are extracted from grammatical categories and link to cognitive units. In previous work (Scheler 1995), we have explored a hypothetical pathway for temporal information. The following elements seem to be essential for a biologically realistic model of semantic processing:

- semantic feature extraction as organized using "dimensions" of mutually exclusive features: lateral inhibition creates enhanced recognition

  interactive sideways: by feeding information to other pathways compressed contextual units are created ("wherever useful information arises it is used").

- feature transformation: recognition of affixes, formation of stable grammatical categories, semantic feature recognition, primary schema formation, central schema integration (cf. Fig 1).

  The emergence of a set of cognitive primitives may be seen as an exploration into the cognitive space accessible with language (Scheler & Schumann 1995). They can be interpreted as a set of interrelated primary schemas.

  central schemas as multimodal integration of sensory information may be organized as multiple overlays of the same set of information in various ways ('scripts').

  feedback links as reinforcement connections from logically "higher" levels integrate schema-driven with data-driven analysis. They provide a more flexible scheme than lateral inhibition, allowing for a top-down flow of information. By activation of lower nodes from higher nodes, decisions can be made faster and schema recognition can be stabilized.

Numeric simulations of a qualitative model may add the essential traits to make empirically testable predictions on the time-course, interference effects, and results of semantic processing.

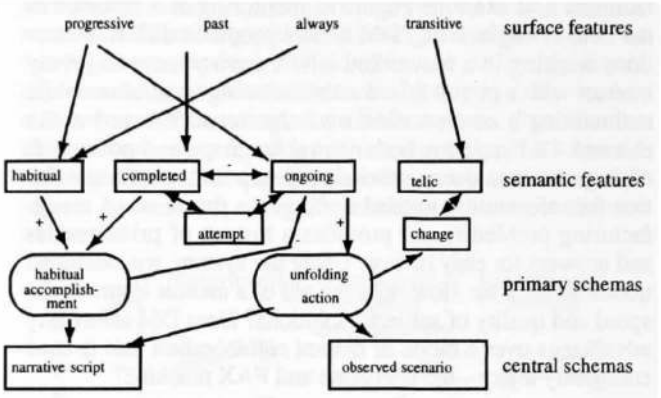

Figure 1: Feedback and Lateral Inhibition in Semantic Analysis of Temporal Meaning. Only a subset of connections and nodes are shown.

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