Conclusion: what does it all mean?

- Theme: *integrating* time, cognition, language
- traditional approaches to natural language semantics are not concerned with integration:
- truth conditions (Lewis), possible worlds semantics (Montague, Dowty), generalised quantifiers (Barwise/Cooper), temporal operators (Prior) ...
- Questions for this approach:
  - what are the semantic representations?
  - what about language acquisition,
  - -production,
  - -comprehension,
  - -evolution?

Cognitively inspired approaches to semantics aim at such integration:

- Semantic representations are *mental* entities.
- criticism of traditional approaches: dim view of truth conditions, prototypes, multiple representations, role of analogy/metaphor, irrelevance to cognition, ...
- importance of lexical semantics.
- tries to anchor semantics in conceptual structure.
- primitives: EVENT, PATH, STATE, GOAL, CAUSE...
- approaches: (in a sense) DRT (Kamp); more characteristic, but nonformal: conceptual semantics (Jackendoff; cf. *Foundations of Language*), cognitive linguistics (Langacker, Croft ...)

- Questions for this approach:
  - primitives defined?
  - semantics just translation into different language ('Markerese')?
  - what is a linguistic theory?
  - why blast logic?

What semantics can learn from psychology

- emphasis on computational models
  - in the case of language, truth values should be (efficiently) computable, in order to explain production, comprehension
  - ordinary model theoretic semantics does not give this
- semantic representation (networks) and distinction between sense and reference

Case study: time in language

- time as represented in language is *not* physical time
- although treated as such in standard model theoretic semantics
- cognitive (conscious) representation of time characterized by
  - 'time from space (probably)'
  - 'time from planning'

Intermezzo: time from space 1 (Guyau 1890)

- sense of time arose when man first became conscious of his reactions toward pleasure and pain
- of the sequence of muscular (propioceptic) sensations associated with these reactions.
- reaching movement is associated with the transition from pain to pleasure: 'voilà la germe de l'idée de l'avenir'.
- 'En somme, la succession est un abstrait de l'effort moteur exercé dans l'espace; effort qui, devenu conscient, est l'intention'.
- 'Un être qui ne désirerait rien, qui n'aspirerait à rien, verrait se fermer devant lui le temps . . . L'avenir n'est pas ce qui vient vers nous, mais ce vers quoi nous allons'.

Intermezzo: time from space 2

- from 'go to' (spatial) to 'be going to' (temporal, marks future)
- 'The temporal meaning that comes to dominate the meaning of [be going to] is already present as an inference from the spatial meaning. When one moves along a path to a goal in space, one also moves in time. The major change that takes place is loss of spatial meaning. Here ... the function of expressing intention comes into play. When a speaker announces that s/he is going somewhere to do something, s/he is also announcing the intention to do that thing. Thus intention is part of the meaning from the beginning, and the only generalization necessary is the generalization to contexts in which an intention is expressed, but the subject is not moving spatially to fulfill that intention'. (Bybee, Perkins and Pagliuca 1994)
- aside: not a simple metaphor, but rather 'bleaching' of spatial component

A corollary for language:

- 'The semantics of tense and aspect is profoundly shaped by concerns with goals, actions and consequences ... temporality in the narrow sense of the term is merely one facet of this system among many'. (Mark Steedman, chapter *Temporality*, in Handbook of Logic and Language)
- in standard model theoretic semantics, 'goals, actions and consequences' are not represented
- Steedman attempts a form of dynamic logic (and notices its limitations)
- but event calculus is much more expressive framework

Meaning as represented in the event calculus

- every VP comes with (default) *Aktionsart* $(\bullet, \bullet, \bullet, \bullet)$
- which determines lexical part of scenario (= part characterized by quantifcation over time)
- *goal* can be event e, fluent f or both
- occurring in statements

$$\ldots \rightarrow \mathit{Happens}(e, t)$$

and

$$\mathit{Initiates}(e, f, t)$$

- goal and its realization are therefore separated; this solves imperfective paradox
- scenario mentions *actions/activities* which help in achieving the goal
- *plan* can be derived which works in minimal model
- EC is rooted in spatial reasoning

Computability of meaning

- *sense* of a VP is lexical part of scenario corresponding to that VP
- can be turned into *algorithm* which takes as input episodic (tense) information and outputs minimal model and denotation of VP in that model
- well-defined because minimal model is *unique* model of completion
- denotation is transient, unlike sense
- associated algorithm is logic programming
- which has good psychological credentials:
- compare Anderson's model of memory ACT-R, which is about reducing goals to subgoals

What kind of computation can the mind (apparently) do well?

- spreading activation
- pattern matching
- retrieval from LTM for temporary storage in WM
- transfer from WM to LTM

How to compute meaning with these ingredients

- logic programming proceeds backwards, reducing goal to subgoal
- can be viewed as combination of pattern matching and transfer between LTM and WM
- logic programming needs negation-as-failure
- which is a consequence of spreading activation

What have we learned about

- what are the semantic representations?
  - sets of production rules
- language acquisition?
  - concept of planning determines tense/aspect system; deviant planning may thus lead to deviant language production/comprehension
- -production?
  - we know more about way semantic knowledge is stored and computed with
- -comprehension?
  - comprehension appears to be construction of model; see below
- -evolution?
  - this approach gives some support to the view that motor skills (including planning) have been important in language evolution (Corballis 1991)

Language comprehension

- Bransford, Barclay and Franks (1972) provide evidence that recalled sentences are inferences from explicitly presented material–this can easily be explained if people construct a model of discourse, and 'read off' what is true there.
- 'Three turtles rested on a floating log and a fish swam beneath them'
- subjects later confused this with
- 'Three turtles rested on a floating log and a fish swam beneath *it*'.

- Recall of a piece of discourse is facilitated if the discourse determines a *unique* model. Compare
- The spoon is to the left of the knife.
  The plate is to the right of the knife.
  The fork is in front of the spoon.
  The cup is in front of the knife.
- The spoon is to the left of the knife.
  The plate is to the right of the spoon.
  The fork is in front of the spoon.
  The cup is in front of the knife.

Stenning 1978; Mani and Johnson-Laird 1982:

1. verbal recall of indeterminate description better than that for determinate description,
2. 'gist' of determinate description can be recalled much more accurately than for indeterminate description.
3. suggests that computing the 'gist' is computing the unique model