Advanced issues in cognitive science and linguistics
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Part 2: Two components of the Parallel Architecture:
Conceptual Semantics and Simpler Syntax

The sort of semantic problem I work on (from "Parts and Boundaries")

What's an *end*? Ropes have ends, some tables have ends, talks have an end, years have an end. What is the metaphysics, such that such disparate entities can have ends?

Answer:
1. Basic case is end of a line: boundary of a 1-dimensional object.
2. Various other entities can be schematized as 1-dimensional, extended in space (a line) or in time (events and time periods)
3. A 2- or 3-dimensional object can be conceptualized as a linear axis elaborated by a cross-section. E.g. an H-beam is an H-shaped cross-section extended along a 1-d axis; a tube is an annulus extended along a 1-d axis. Rectangular and oval tables can be conceptualized this way; square and circular tables cannot.

4. The end of a 2- or 3-d object = boundary of its linear axis elaborated by its cross-section. E.g. the end of an H-beam is an H-shaped part of its surface.
5. If you cut off the end of a rope, you cannot just cut off its geometric boundary. You must cut off the boundary plus some pragmatically appropriate small amount ε of its length.
   So the end of the rope = (boundary+ε) elaborated by cross-section, i.e. a 3-d piece of the rope.
6. Imperfective paradox: *He's now ending his speech*. If the end is marked by a point in time, how can the progressive aspect be used, as though a process is going on that takes up an interval of time?
   Answer: The end of a speech = (boundary+ε), i.e. an interval of time. *He's now ending his speech* refers to a process going on in this interval. Analysis shows the virtue of considering spatial and temporal cases in parallel. (Not metaphor)
7. Further abstract extension of the meaning: end = goal = intended endpoint of action

Issues for a theory of meaning couched in terms of reference to the "real world", independent of speakers:
• What does spatial extent have to do with temporal extent?
• How can 3-d objects be treated as 1-d, and how do you tell which ones are *really* 1-d and which ones are not? (e.g. tables)
What is the status of these axes and cross-sections? What is this ε of indefinite extent? What is the truth about how long it can be?

All of this makes sense if we're thinking of the meaning of *end* in terms of our conceptualization of the world. *We* abstract dimensionality and axes from spatial objects, events, and times. *We* make pragmatically appropriate extensions ε of a boundary along a linear axis.

How do we build a theory of meaning around this sort of result?

Conceptual Semantics: Theory of what humans can think about such that they can talk about it: entities in the world *as humans understand it*: This includes all the entities mentioned in Part 1 that can be referred to by deixis, including:
- Physical objects and their parts, plus abstractions such as spatial axes and ends
- Events and times (What happened, and when?), plus
- Abstractions: Ph.D. degrees, marriages
- Theoretical, fictional, and legendary entities: phlogiston, XYZ, quarks, Sherlock Holmes, Achilles, Moses, the devil, beauty, virtue, truth (which is just another word, a predicate over sentences)

Conceptual Semantics is a branch of cognitive science! What is the structure of our knowledge of the world? Connecting semantics with the rest of the mind
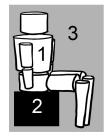
Many aspects of human conceptualization of the world are independent of language, e.g. naive physics. This independence offers potential for explaining linguistic semantics: there is an innate basis of concepts that play a role in learning word meanings. Acquisition evidence often suggests that children need to have concept before they can (properly) acquire words for it.

Other primates share much of our conceptualization of physical world. Evolutionary underpinning of the semantic system of language: our distant ancestors had structured thoughts before they could talk. Part of the semantic system of language is built upon pre-existing primate cognition, especially spatial and social cognition.

Fundamental claim: the mind utilizes multiple sources of combinatoriality (= recursion). Syntactic combinatoriality is just one case. Combinatoriality of nonlinguistic concepts is another. In fact, language is combinatorial specifically so it can express combinatorial concepts.

Contrasts with mainstream generative grammar, where recursive properties of "conceptual-intentional interface" arise through derivation from syntax. Apparent claim: babies and apes cannot think combinatorially. Much evidence suggests this is *very wrong*.

Recent Chomsky: "Narrow syntax" is "close to Language of Thought"; word order, phonology, and morphology are "externalization." His Language of Thought = PA's conceptual structure. His Externalization = what everyone else calls "language." Differences in opinion about biological timescale.

How do we talk about what we see? Spatial structure and conceptual structure

Argument from John Macnamara: There must be a pathway for visual information to be "translated" into linguistic form. In PA framework: An interface between visual representations and conceptual structure.

Hypothesis: The relevant level of representation is quasi-geometric or topological "Spatial Structure." First approximation: highest level of the visual system: "visual understanding," following Marr

- Objects represented in terms of detailed shape, but perspective-independent (object constancy). Motions and forces (naïve physics)?
- Objects may be represented schematically (e.g. sitting in terms of schematic figure)
- Not exclusively visual: shape and configuration from touch and body sense (sitting again)

Therefore: Spatial Structure is a central level of cognition, coding the physical world in relatively modality-independent fashion.

Conceptual Structure: algebraic structure built up from discrete features and functions
    (*Semantics and Cognition*, *Semantic Structures*)
Cannot encode details of shape (e.g. long neck of geese); but does encode distinctions not available in geometric/topological format of Spatial Structure, not directly derivable from perception:

- Type-token distinction, distinguishing categories from individuals
- Taxonomic relations: 'X is an instance/subtype of Y'
- Temporal relations: 'X is past/future'
- Causal relations: 'X causes Y', 'X enables Y', 'X impedes Y'
- Modal notions: 'X is hypothetical/nonspecific/potential/fictional'
- Social notions: 'X is dominant to Y', 'X is kin to Y', 'X is member of group Z', 'X owns Y', 'X is obligated to perform act Y'
- Theory of mind notions: 'X believes/imagines/intends Y'

Further properties of word meanings

Defined in terms of relative proximity to a standard: *red* vs. *orange*; *bald*
Preference rule conditions (Wittgenstein, gestalt psychologists): *game*, *climb*
   Both of these are found in perception as well – even in phonetic perception (VOT, aspiration)
Potential complexity: *X buy Y from Z* is not just 'Z give Y to X and X give money to Z':
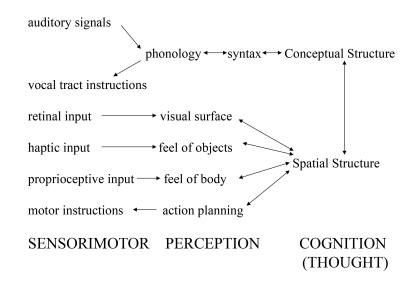   The two actions are linked as a joint action undertaken by agreement between X and Z;
   joint action = complex network of rights and obligations;
   change of ownership depends on what owning is: complex of rights.

Dot objects (Pustejovsky): Entities involving two domains at once in preference rule relation:
   book = physical object • information
   read = scan with eyes • take in information
   point (in a game) = physical action • contribution to score
   person = body • soul/spirit

None of this shows in syntax!

Overall architecture of the mind

auditory signals

phonology ←→ syntax ←→ Conceptual Structure

vocal tract instructions

retinal input ——→ visual surface

haptic input ——→ feel of objects

proprioceptive input ——→ feel of body   Spatial Structure

motor instructions ←—— action planning

SENSORIMOTOR   PERCEPTION   COGNITION
                                  (THOUGHT)

The lexicon: What do you store?

"Knowledge of language," understood psycholinguistically = What's stored, such that you can build an unlimited number of utterances online. (More concrete than Chomsky!)

A word = piece of semantics, piece of phonology, some syntactic features, linked together. For words that denote things with a physical structure (e.g. *cat*), possibly also a piece of Spatial Structure. A word is part of the interfaces – no separate "lexical interface".

(1) Semantics: CAT_1
     (Morpho)syntax: $\{N, \text{MASC}\}_1$
     Phonology: $/gato/_1$

     (Subscripts denote links between different levels of structure)

Some items that don't have all three components:

(2) hello, yes, ouch, oops, dammit   (semantics and phonology, no syntax)
     It's hot in here, He didn't come, a picture of Bill (syntax and phonology, no semantics)
     hey diddle diddle, eenie-meenie-minie-mo   (only phonology)

Stored items bigger than a word: idioms and other fixed expressions:
(3) kick the bucket (VP), spill the beans (VP), a breath of fresh air (NP), in the know (PP)

Stored items with argument structure:
(4) take NP for granted ('assume NP'), throw NP for a loop ('shock/surprise NP')

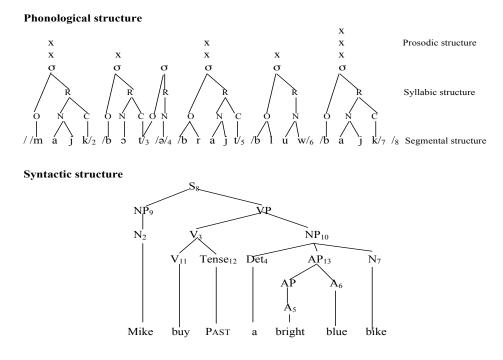Meaningful constructions (cf. Construction Grammar):
(5) [$_{VP}$ V *pro's* way PP], [$_{AP}$ (all) N/V'd out], How about XP?

Phrase structure rules:
(6) [$_{VP}$ V (NP)]   (only syntax)

Conclusion: Rules are part of the lexicon: Stored pieces of linguistic structure. Declarative, not procedural. (More discussion in Part 4.)
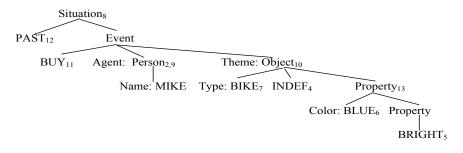
A sample sentence in PA notation

Phonological structure

$$
\begin{array}{l}
\hspace{8.3cm} x \hspace{1cm} \text{Prosodic structure}\\
x \hspace{2.5cm} x \hspace{2.3cm} x \hspace{1cm} x\\
x \hspace{1.3cm} x \hspace{1.2cm} x \hspace{1.3cm} x \hspace{1.2cm} x
\end{array}
$$

σ   σ   σ   σ   σ   σ

R   R   R   R   R   R   Syllabic structure

O N C O N C O N O N C O N O N C

/ /m a j k/$_2$ /b ɔ t/$_3$ /ə/$_4$ /b r a j t/$_5$ /b l u w/$_6$ /b a j k/$_7$ /$_8$ Segmental structure

Syntactic structure

Semantic/conceptual structure

[$_{Situation}$ PAST$_{12}$ [$_{Event}$ BUY$_{11}$ (AGENT: [$_{Person}$ NAME: 'Mike']$_{2,9}$,

       THEME: [$_{Object}$ TYPE: BIKE$_7$; INDEF$_4$; [$_{Property}$ COLOR: BLUE$_6$; [$_{Property}$ BRIGHT$_5$]$_{13}$]$_{10}$)]]$_8$

(or, in tree form:)

The words are distributed across the three structures, linked by the subscripts. Unmarked case: 1-1 correspondence. But mismatches are possible: *bought* in phonology corresponds to V+T in syntax and two functions in semantics; PAST is outermost function in semantics but corresponds to deeply embedded PAST in syntax.

In *spill the beans*, the whole VP is coindexed to semantics but the individual words are not.

What does syntax have to do?

Argument structure:
What semantic arguments have to be expressed? What semantic arguments *can* be expressed?
In what syntactic configuration? (cf. Levin's book on argument structure alternations)

(7)   Bill ate/devoured the cake.
        Bill ate/*devoured.   (*devour* obligatorily expresses Patient)
        Bill swallowed vs. Bill swallowed the cake.   (*swallow* has optional Patient)
(8)   Sue gave/presented/*bought a book to Amy.
        Sue gave/*presented/bought Amy a book.
        Sue *gave/presented/*bought Amy with a book.
(9)   Ezra bought a book (from Levi) (for 10 dollars) (optional expression of arguments)
(10)   Tom believes/thinks that Beth is smart.
        Tom believes/*thinks Beth to be smart.
        Tom believes/*thinks the story.

Can subject be omitted ("pro-drop")?
Is VP (if there is VP) head-initial or head-final? What about NP? PP? AP?
Is word order fixed or flexible? Exactly how flexible, in what ways?
Where do function words go?
Is there case-marking, and if so, accusative or ergative? Are there other cases?
Is there case-marking inside of NPs? How does it compare with case-marking in clauses?
Are there genders or other sorts of noun classes?
Is there verb agreement with the subject? With the object? With what features?
Are there other forms of agreement? Determiner, prenominal adjective, predicate adjective?
Are there object clitics? Are they doubled?
How are relative clauses marked? Are there resumptive pronouns?
How do other embedded clauses work? Comparatives?
Are there long-distance dependencies and, if so, how are they constrained?
Are there serial verb constructions? Are there light verb constructions?
 etc. etc.

There is still plenty for syntax to do!

The variety and very detailed specificity of many of these do not lend themselves to a treatment
    in terms of innate parameters. (Parameters are supposed to be the basis for learning syntax. If
    there are a lot of them, and they're very specific, it's much hard to argue that they are innate.
    But if they're not innate, where do they come from?)

A sample: English long-distance dependencies. They all obey (approximately) the same
extraction constraints, but their "signatures" vary widely.

(11) *Direct question: Inversion, wide variety of wh-words, pied piping possible*
        a. Who does Bill claim that Sue likes?
        b. Who (the hell/else) did Tom come to the party with?
        c. With whom did Tom come to the party?

(12) *Tensed indirect question: Like direct question, but no inversion, pied piping dispreferred*
      a. Fred wonders who Bill claimed that Sue likes.
      b. Fred wonders who (the hell/else) Tom came to the party with.
      c.?Fred wonders with whom Tom came to the party.

(13) *Infinitival indirect question: Subject of clause must be absent, pied piping dispreferred*
      a. Fred wonders who to see.
      b.*Fred wonders who to go to the party.
      c.*Fred wonders who (for) Bill to meet.
      d. Fred wonders who (the hell) to talk to.
      e.?Fred wonders to whom to talk. (cf. Fred wonders who he should talk to)

(14) *Tensed relative clause: Choice of wh-word or* that *(or zero, except for subject relatives)*,
        pied piping possible
      a. the woman (who/that) Joe met
      b. the woman (who/that) Bill claimed (that) Sue likes
      c. the woman with whom Tom came to the party
      d. the woman who/that (*the hell) Tom came to the party with
      e.*[NP the woman came to the party] is my friend

(15) *Infinitival relative clause: Relativized subject and fronted NP impossible,*
        P-wh-phrase or for+*subject, but <u>not both</u>*
      a a woman (for Joe) to meet
      b. a woman to talk to
      c. a woman with whom (*for Joe) to talk
      d.*a woman to meet Joe
      e.*a woman who(m) to talk to

(16) *Exclamative:* What *and* how+*adjective are only possible signatures, main clause*
        but no inversion
      a What big teeth you have! How lovely your teeth are!
      b.*Which theories you have been studying!
      c. What sorts of friends Tom is running around with!
      d.?What a book John says Sue has written!
      e.*With what sorts of friends Tom is running around!
      f. *Who Tom has been running around with!

What can parameters for these "signatures" be like? How are parameter settings triggered?

Better: Learn signature from surface structure distribution, specify that it plays the semantic role
    associated with a trace (or gap) somewhere in the structure it c-commands.
As in HPSG, constraints on "extraction" are realized instead as permissible node configurations
    for connecting signature to gap. Alternative: Some of them are semantic, some have to do
    with processing difficulty.

This is why the theory is Simpler Syntax, not Simple Syntax!