Levels of Description in Linguistics

Ling499a, Spring 2009

Slide-copying acknowledgment:
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First of all...

• Linguistics as cognitive science
  – Remember Ling240?

• Marr
Marr

• Mind as information processing system
  – Computational theory of mind (Chomsky; Fodor)

• Vision
Information processing

• Representation
  – Formal system for making explicit certain entities or types of information, together with a specification of how the system does this

• Process
  – Operations over representations (arranging representations in certain ways, combining them to construct more complex ones, etc.)
  – Mappings between one type of representation to another
Examples

- Formal system for making explicit certain entities or types of information, together with a specification of how the system does this:

{0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

Constructing an integer:

Processes: *sum and multiplication*

37 = (3 x 10^1) + (7 x 10^0)

{I, V, X, L, C, D, M}

Constructing an integer:

Processes: *sum, grouping and subtraction*

I
II
III
IV
V
VI
VII
VIII
IX
X

Also base 10

Hard to do anything besides very simple arithmetic

Base 10

easy to discover whether a number is a power of 10
Information processing: levels of analysis

To specify an information processing system:

- Computational theory
- Representation and algorithm
- Implementation

David Marr, *Vision*
Tomaso Poggio
Addition

To specify an information processing system:

- Computational theory
- The theory of arithmetic
- Representation and algorithm
  - Arabic or Roman numerals? Decimal or binary? Add and carry? Group and count?
- Implementation
  - An abacus; pencil, paper and lookup tables; A digital circuit
What about language?
Linguistics

• Theoretical linguistics
  – Syntax, Phonology, Semantics, etc.

• Psycholinguistics?
  – How do we speak, understand and acquire language?

• Neurolinguistics?
  – Brain and language
Language

From Jackendoff (1994)
Linguistic representations

The little star is beside the big star
A quote from Fromkin et al intro-ling textbook:

“Psycholinguistics is the area of linguistics that is concerned with **linguistic performance** – how we use our linguistic competence – in speech (or sign) production and comprehension. The human brain is able not only to **acquire** and store the mental lexicon and grammar, but also to access that linguistic storehouse to **speak and understand language in real time**. (Emphasis added by me)
Using Marr’s levels

**Computational theory**
- What is the problem:
  - Mediation between “sound” and “meaning”
  - Different levels (phonology and syntax)

**Representation and Algorithm**
- How it is done:
  - Processes of online comprehension and production

**Implementation**
- What it is done *with*:
  - Brain

- [Theoretical Linguistics](#)
- [Psycholinguistics](#)
- [Neurolinguistics](#)
Competence vs. Performance

• ...is this what Chomsky intended?
“It has sometimes been argued that linguistic theory must meet the empirical condition that it account for the ease and rapidity of parsing. But parsing does not, in fact, have these properties. [...] In general, it is not the case that language is readily usable or ‘designed for use.’” (Chomsky & Lasnik, 1993, p. 18)
Chomsky (1965)

- “Linguistic theory is concerned primarily with an ideal speaker-listener [...] who knows its language perfectly, and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention, and interest, and errors (random or characteristic) in applying his knowledge of language in actual performance. [...] We thus make a fundamental distinction between competence (the speaker-hearer’s knowledge of his language) and performance (the actual use of language in concrete situations). Only under the idealization set forth in the preceding paragraph is performance a direct reflection of competence.” (pp. 3-4)

- “When we say that a sentence has a certain derivation with respect to a particular generative grammar, we say nothing about how the speaker or hearer might proceed, in some practical or efficient way, to construct such a derivation. These questions belong to the theory of language use - the theory of performance.” (p. 9)
Standard View

\[
\begin{array}{c}
324 \\
697+ \\
\
\end{array}
\]

\[
217 \times 32 = ?
\]
Standard View

specialized algorithm

\[
\begin{array}{c}
324 \\
697+ \\
? \\
\end{array}
\]

specialized algorithm

\[
217 \times 32 = ?
\]

arithmetic
Standard View

specialized algorithm

\[
\begin{array}{c}
324 \\
697+ \\
? \\
\end{array}
\]

specialized algorithm

\[
217 \times 32 = ?
\]

arithmetic

something deeper
Standard View

specialized algorithm

speaking

grammatical knowledge, competence

recursive characterization of well-formed expressions

specialized algorithm

understanding

language
Standard View

language

specialized algorithm

speaking

grammatical knowledge, competence

recursive characterization of well-formed expressions

understanding

precise but ill-adapted to real-time operation
Standard View

specialized algorithm

speaking

grammatical knowledge, competence

recursive characterization of well-formed expressions

well-adapted to real-time operation but maybe inaccurate

understanding

language
One unified system

Representation and algorithm

What are the 'routines' for understanding/producing language?

How are they related to the well-formedness conditions/derivations specified by the computational theory?

Implementation

Or not ...

Performance (use)

Computational theory
Representation and algorithm
Implementation

Competence (grammaticality)

Computational theory
Representation and algorithm
Implementation
Next week

• Syntax of wh-movement (read Haegeman chapter, which is to be uploaded later today)
• Lab 1 will be assigned on Tuesday!
• Presentation assignment (the 1st round)