PSYC 3640 Psychological Studies of Language

When Words Combine: Sentence Processing

October 9, 2007

Today’s Outline

- Research Report
- Term Test: Definitions and Short answers
- Bonus abstract
- Review of Lecture 4
- Chapters 7 & 8 in Altmann’s book

Research Report

- Summary of one empirical article
- Use questions as guidelines
- 2-3 pages, doubled-spaced

Term Test

- 20%
  → Don’t worry too much!!!
- Focus on concepts and understanding
- 6 Definitions: 1 or 2 sentences. Examples may help too.
- 5 Short answers: Explanation or integration of concepts
**Bonus Abstract**

- Bonus 3%
- Let me know in advance what you want to write in research paper
- Help to put together the last lecture
- Allow me to polish your ideas

→ win-win situation!

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**Review of Lecture 4**

- Mental lexicon is organized by semantic relations, with sounds as “search indices”.
- The major research methods for studying mental lexicon is semantic priming.
- It is more plausible to conclude that lexical entries form a network. These entries are first activated, then accessed.
- Sounds are led to lexical entries, the right item is chosen based on contextual information.
- Verbs and nouns are not stored separately in the mental lexicon.

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**Language as geometry**

- phoneme → syllaible → word → sentence
- sound → meaning → grammar
- dot/point → line → plane → solid

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**Time flies like an arrow**
Time flies like an arrow

What makes this phrase so complicated?

- Multiple meanings associated with the same word
- Combinations of these different meanings lead to a large number of possibilities
- Other factors: order of the words, verb tense, article, knowledge and interpretation

Grammar

Grammar as a set of conventions

- English: subject-verb-object
- Cross-linguistic differences in SVO
  - Japanese & Turkish: subject-object-verb
  - Classical Hebrew & Welsh: verb-subject-object
- English: adjective-object
- 512 \( \rightarrow \) 500 +12, but not 200 + 51
- Pattern:
  - preposition-prepositional phrase
  - Verbs-object

Roles of Words

Politicians think that the public don’t know. The public know that the politicians don’t think.

- Same ingredients, different recipes
- Each word has its function (role) in a sentence.

The girl thinks the language is beautiful.

Grammar: where to find the items in a sentence to fill all the roles.
Case-Marking

- Mark the role of the noun following an article (like the) by inflecting the article to different forms.
- With case-marking, word order becomes less important.

\[ \text{den Brief gab der Junge dem Lehrer} \]
\[ \text{The letter gave the boy the teacher} \]

\[ \text{dem Lehrer gab der Junge den Brief} \]
\[ \text{der Junge gab dem Lehrer den Brief} \]

Problems with Ambiguity

- Garden-path sentences (probability of a person judging as grammatically correct = .67)
- Alternative ways to mix the ingredients
- Receivers need to figure out the senders’ intended meaning
- One source of ambiguity is the multiple roles/meanings of a single word
- Another source is the multiple grammatical interpretations available.
- Do we activate all the possible interpretations when ambiguity arises?

Can’t get enough ambiguity in the media

1) Include Your Children When Baking Cookies
2) Police Begin Campaign to Run Down Jaywalkers
3) Safety Experts Say School Bus Passengers Should Be Belted
4) Iraqi Head Seeks Arms
5) Teacher Strikes Idle Kids
6) Enraged Cow Injures Farmer With Axe
7) Plane Too Close to Ground, Crash Probe Told
8) Miners Refuse to Work After Death
9) Juvenile Court to Try Shooting Defendant
10) Two Sisters Reunited After 18 Years in Checkout Counter
11) Killer Sentenced to Die for Second Time in 10 Years
12) If Strike Isn’t Settled Quickly, It May Last a While
13) Couple Slain; Police Suspect Homicide
14) Red Tape Holds Up New Bridges
15) Typhoon Rips Through Cemetery, Hundreds Dead
16) Astronaut Takes Blame for Gas in Spacecraft
17) Ban On Soliciting Dead in Trotwood
18) Local High School Dropouts Cut in Half
19) New Vaccine May Contain Rabies
20) Hospitals are Sued by 7 Foot Doctors

Making Sense…

If someone read this sentence thought it was ungrammatical because it missed an ‘and’ between ‘sentence’ and ‘thought’ they would be wrong.

The same person might tell the writer that he or she could not understand to get help.

I was lent a book that I shall avidly read yesterday.
Staub & Clifton (2006)

S-coordination

Either Linda bought the red car or her ______ husband leased the green one.
Linda bought the red car or her husband leased the green one.

NP-coordination

The team took either the train or the subway to get to the game.
The team took the train or the subway to get to the game.

Solutions?

- To maintain cognitive efficiency, simpler interpretation is preferred.
- The more frequently used convention, the most likely it is correct.
  $\rightarrow$ Most frequently used $\neq$ simplest
- Similarity: ambiguities resolution does not involve meaning of words
- Difference: involvement of experience

Context… yet again!

The elephant that a giraffe bumped against lay down and went to sleep

The elephant that bumped against a giraffe lay down and went to sleep

Crain & Hamburger

- Function of relative clause: help the receiver to figure out which is the subject in the sentence
- Children can figure out (or even produce!) the correct description when there is more than 1 elephants.
  $\rightarrow$ Context lends a hand!
- Sentence comprehension in adults should be studied in context.
Eye-movement Experiments

- Finding out where the eyes fixate or return to ambiguity in the sentence

*Sam told the writer that he couldn’t understand to get some help from a decent editor*

*Sam asked the writer that he couldn’t understand to get some help from a decent editor*

When encounter ambiguity…

- Fit with context
- Frequency of occurrence of the different structures associated with the ambiguous word

OR

- Frequency of occurrence of different meanings associated with the ambiguous word
- Problem: meaning of a word → grammatical structures, how to separate the two arguments?

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Prosody

A linguistics professor was lecturing to his class one day. "In English," he said, "A double negative forms a positive. In some languages, though, such as Russian, a double negative is still a negative. However, there is no language wherein a double positive can form a negative."

A voice from the back of the room piped up, "Yeah, right."

Prosody in Spoken language

- You’re wrong – Sam didn’t buy Mary a PIZZA
- You’re wrong – Sam didn’t buy MARY a pizza
- You’re wrong – Sam didn’t BUY Mary a pizza
- You’re wrong – Sam DIDN’T buy Mary a pizza
- You’re wrong – SAM didn’t buy Mary a pizza

→ Empathic stress adds more possibilities in some cases, but helps to disambiguate in others.
Summary of Chapter 7

- Sentence processing requires understanding of grammar (= morphology + syntax)
- The role(s) that each word plays in a sentence is the core mystery of language comprehension.
- Ambiguity in sentence processing arises even when there is unambiguous meaning of a word.
- Resolving ambiguity: context, frequency of occurrence of structures and meaning, prosody (but it depends)
- Mental representations of meaning rely on a set of convention for understanding the interplay between words in a sentence.

Sentence Processing

- Meaning = morphology
- How the meaning is put together = Syntax
  - Grammar
  - ‘that’: pointing words
  - Relative clause
  - Part of a message

Pronoun

- Replaces a noun or another pronoun
- He, she, it, him, her... etc.
- Reflexive pronoun: himself, herself, myself... etc.
- I am not myself...

The president discusses his resignation with him.

Who did what to whom?

- Who, what, whom
- Start a question
- Relative clause
- Identifying a gap in a question helps to assign a role to the ‘who’, ‘what’ and ‘whom’.

Which woman did Bertie present a wedding ring to ___ before falling over?

- Do we understand language this way?
Research Methods

• Self-paced word presentation
• EEG

Ambiguity in sentences

• Michael Tanenhaus
  *Which woman did Bertie present a wedding ring to__?*
  *Which horse did Bertie present a wedding ring to__?*
  • What can’t we wait until the gap?

Case-marking revisited

• Der junge – junge as subject
• Den junge – junge as object
• No word is role-less. But why are we so impatient?

Ungrammatical Sentences

*The marriage that she thought __ was long overdue took place last week*

*The marriage that she thought Bertie’s offer of__ was long overdue took place last week.*
Tolerable grammar, why?

- Rigid obedience to what the conventions of language imply
- Ignorance of these conventions → second guess the correct assignment of roles

→ We do not simply ignore the conventions. Instead, we use the actual location of gaps to confirm or disconfirm the original role assignment.

Grammar Constraints

- Gap in a sentence should receive a role from the verb.
  What did she think Bertie’s offer of __ was long overdue?
  The marriage that she thought Bertie’s offer of __ was long overdue took place last week.
  Which verb?

Is that all?

- Cross-language difference
- Case-marked vs. non-case-marked languages
- Whether the verb appears early or late in a sentence
- Size of mental lexicon
- Where does grammar, at least in English, come from? Associative learning? Innateness?
- Aging? General cognition?

Summary of Chapter 8

- Humans are impatient!
- In sentence processing, we cannot wait until the ‘gap’ to eliminate all the possibilities.
- Ambiguity arises when participants in a sentence are left roleless.
- Grammatical constraints limit our understanding of a sentence → block our minds
- After all, why is meaning so important? What is it anyway?
Waters & Caplan (2005)

- Examined the age-related changes in working memory capacity, processing speed and language comprehension.
- Young and older native English speakers
- All participants are healthy and neurologically normal
- Administered a battery of tasks: WM capacity (span tasks), processing speed and sentence comprehension/processing

Results of Sentence Processing

Results on Sentence Comprehension

Conclusion

- WM capacity: O < Y
- Listening time: O > Y
- Age difference not affected by complexity
- Syntactic processing not affected by age
- Rather, it's the thematic roles assigned to verbs that is affected (evidence: CO vs. CS)
- Discourse-level thematic roles of verbs?
- Age doesn’t affect the on-line construction of syntactic form and meaning, but related to processes after meaning has been extracted.