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# Bottom-up versus top-down models

## Bottom-up models

Bottom up models - analyse sentence structure based on information from word classes. Do not take into account contextual factors (e.g. plausibility)

## Top-down models

Top-down models - allow for a role of contextual factors (e.g. plausibility) at an early processing stage

# Evidence for bottom up processing

## The garden path model

Garden path sentences involve **temporary mis-analysis** of the structure of a sentence.

We are relatively slow to recover.

They are easy to generate and near universal.

1. Since Jay always jogs a mile and a half seems very short to him.

*A mile and a half* is misanalysed as the object of *jog*

1. The criminal confessed his sins harmed many people

*His sins* is misanalysed as the object of *confessed*

Garden paths allow us to see the inbuilt biases of the **parser**

(parse = analyse a sentence and tag each word according to its word class)

## Ambiguity

Arises where there are two possible analyses. Can be local (ambiguity resolved before the end of the sentence), or global (ambiguity remains even after we have read/hear entire sentence)

Where is the ambiguity in these sentences?

1. The vampires loaned money at low interest rates were told to record their expenses
2. XXX pleaded guilty to running the brothel at Newcastle Crown Court.
3. The young athlete realised her potential might one day make her a world class athlete
4. A bicycle was reported stolen by an old lady
5. They’re cooking apples.
6. The following are some tips to protect women from the police department

## How do we explain parsing biases?

1. Biases/heuristics reflect a general drive towards **simplicity**. Some have suggested that these reflect the innate behaviour of the parser (Frazier, 1987). However, they could also emerge due to processing constraints.
   1. Assume **local relationships**
   2. A bicycle was reported stolen by an old lady = misanalysis involves linking by-phrase to the local verb (*stolen*)
   3. Vlad figured that Boris wanted to take the pet rat out = particle *out* linked to local verb *take*, and not distant verb *out*.
   4. The horse that chased the boy is big = Here the subject of *is* is non-local (*the horse*). However, language-impaired children are overly dependent on this local bias.
   5. Assume **simple structures** (e.g. few nodes and branches)
   6. Since Jay always jogs a mile and a half seems a very short distance to him = *A mile and a half* is part of a new clause. We resist opening a new clause because it involves a more complex structure
   7. The criminal confessed his sins harmed many people = *His sins* is part of a new clause. Again, we resist opening a new clause because it involves a more complex structure
   8. The man saw the woman with a telescope = we are more likely to see the telescope as the instrument of seeing (“high-attachment”, rather an an object in possession of the woman (“low-attachment”). This instrument reading involves the fewest nodes.
2. Biases reflect **statistical patterns** in the input
   1. Vampires loaned money at low interest rates = structure where *vampires* is object of *loan* is rare in the input. Therefore we are unlikely to initially assign this structure
   2. The daughter of the colonel [who had an accident] was beautiful = Spanish speakers prefer “high-attachment”, where the relative clause (*who had an accident*) modifies the daughter, and not the colonel. English speakers do not have this bias. This is likely to reflect statistica properties of the language

# Evidence for top-down processing

## What factors can be classified as “top down”

When referring to top-down processing we are typically referring to

1. Lexical factors
2. Contextual factors

## Role of lexical content

Words clearly bias structural interpretation:

1. The man hit the woman with the \_\_\_\_\_\_\_
2. The boy tempted the mouse with the \_\_\_\_\_\_\_
3. The protestor splattered the policeman with \_\_\_\_\_\_
4. The boy likes the girl with \_\_\_\_\_\_\_
5. The young athlete **realised/thought** her potential might one day make her a world class athlete

Trueswell et al. (1983) - measured reading via a self-paced reading paradigm. Found that

1. Participants used the verb to predict the structure of the sentence. Where the structure was less predictable, processing slowed down
2. Participants used subordinator *that* to disambiguate structure. This led to shorter reading times.

## Discourse context

Can you understand this sentence?

1. The horse raced past the barn fell.

Now let’s put it in context…

Lord Chumley-Worthington wanted to map out a race course around his estate. He therefore wanted to find out if the ground was more slippery next to the barn or next to the pond. So he instructed his servants to race two horses along these different routes. **The horse raced past the barn fell,** while the horse raced past the pond managed to stay on its feet. He therefore conluded that the ground next to the barn was more slippery.

## Referential processing

According to theories of referential processing, set-restriction is a costly process. We therefore avoid where possible

1. The vampires loaned money at low interest rates were told to record their expenses = correct interpretation involves set restriction (we imagine a large group of vampires, and then restrict this set to those who were loaned money)
2. The man saw the woman with the binoculars = low-attachment (dispreferred) reading involves set-restriction (we imagine a group of women and restrict this set to the woman who had the binoculars)

I’ve grouped this under “top down” theories because it is related to semantic interpretation.

# So which account is correct?

Garden paths are easy to generate under laboratory conditions, suggesting that we rapidly make decisions about sentence structure. However, top down effects have been repeatedly demonstrated. Possible positions

1. Both bottom-up and top-down factors are operative at once.
2. Bottom-up processing slightly precedes top-down processing.

# Sentence processing in clinical populations

There is some evidence that language-impaired children may prioritise top-down factors, e.g. animacy.

1. The rock that the boy dropped was heavy
2. The boy that the rock crushed was blond

Where there is an animate and an inanimate entity, the child assumes that the animate entity acts on the inanimate entity. This will lead to the correct interpretation of (1), but an incorrect interpretation of (2)

MORE ON THIS NEXT WEEK

# Homework

Read the following sentence

“No head injury is too trivial to ignore”

Does it make sense to you? Can you paraphrase is? Is there anythin weird about it?