

Sentence Processing I

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Newcastle University

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Sentence
Processing I

Nick Riches

Bottom-up versus
top-down models

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Ambiguity

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Figure 5: Context influences perception



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(5) Since Jay always jogs a mile and a half seems a short way to him

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(5) Since Jay always jogs a mile and a half seems a short way to him

(6) [**CLAUSE** Since Jay always jogs a mile and a half]

Od. of 'jogs'

The garden path model

(5) Since Jay always jogs a mile and a half seems a short way to him

(6) [**CLAUSE** Since Jay always jogs a mile and a half]

Od. of 'jogs'

(7) [Since Jay always jogs] [**CLAUSE** a mile and a half seems a short way to him]

S of 'seems'

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Temporary mis-analysis of the structure of a sentence.

We are relatively slow to recover.

Easy to generate and near universal.

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(8) The criminal confessed his sins harmed many people

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(9) [**CLAUSE** The criminal confessed **his sins**]

Od. of 'confessed'

(10) [The criminal confessed [**CLAUSE** **his sins** harmed many people]]

S of 'harmed'

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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)

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Garden paths arise due to **syntactic ambiguity**

Can be **local** (ambiguity resolved before the end of the sentence), or **global** (ambiguity remains even after we have read/hear entire sentence)

EXERCISE

Where is the ambiguity in these sentences? Is it local or global?

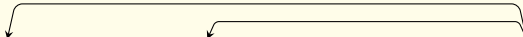
- (11) The vampires loaned money at low interest rates were told to record their expenses
- (12) XXX pleaded guilty to running the brothel at Newcastle Crown Court.
- (13) The young athlete realised her potential might one day make her a world class athlete
- (14) A bicycle was reported stolen by an old lady
- (15) They're cooking apples.
- (16) The following are some tips to protect women from the police department

EXERCISE

(17) The vampires (that were) loaned money at low interest rates were told to record their expenses

(18)

XXX pleaded guilty to running the brothel at Newcastle Crown court



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(19) [**CLAUSE** The athlete realised her potential]

(20) The athlete realised [**CLAUSE** her potential might
one day make her a world class athlete]

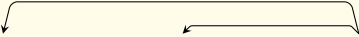
(21) A bicycle was **reported** **stolen** **by an old lady**



EXERCISE

(22) They're cooking apples: is cooking a verb or an adjective?

(23) The following are some **tips** to protect **women** from the police department

A horizontal line with a bracket at the right end connects the word 'tips' to the word 'women'. Two arrows point downwards from the line to each word, indicating a relationship or comparison between them.

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A drive towards **simplicity**?

Innate behaviour of the parser? (Frazier & Fodor, 1978,
'The Sausage Machine')

Processing constraints?

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Modularity (Jerry Fodor, 1983)

Neural regions dedicated to a particular task

The syntactic parser is dedicated to analysing sentences



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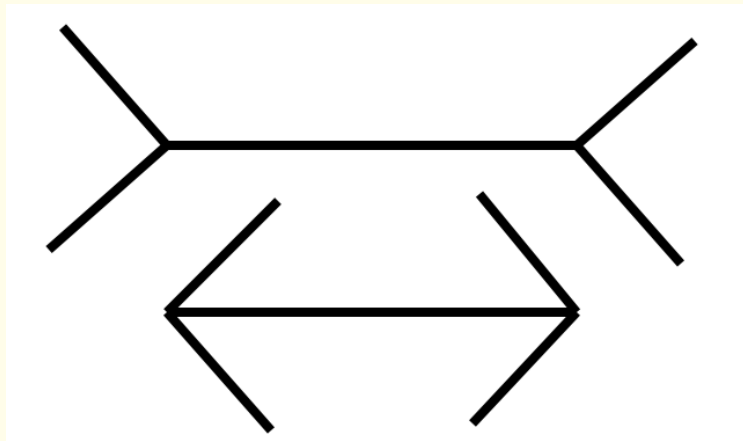
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Behaviour of a module is impervious to external information

Is behaviour of parser impervious to top-down information?

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Assume **local relationships**

(24) A bicycle was reported stolen by an old lady

The diagram for sentence (24) shows the words 'reported' and 'stolen' highlighted in green. A bracket labeled 'local' is positioned above these two words, with arrows pointing down to each, indicating a local relationship between them.

(25) Vlad figured x that Boris wanted to take x the pet rat out

The diagram for sentence (25) shows the words 'take' and 'out' highlighted in green. A bracket labeled 'local' is positioned above these two words, with arrows pointing down to each, indicating a local relationship between them.

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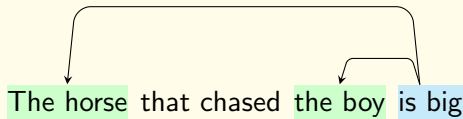
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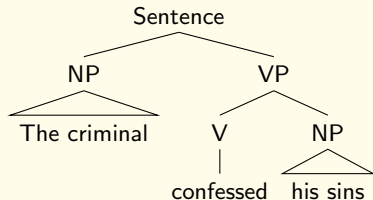
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(26)



How do we explain parsing biases?

Assume **simple structures** (e.g. few nodes and branches)



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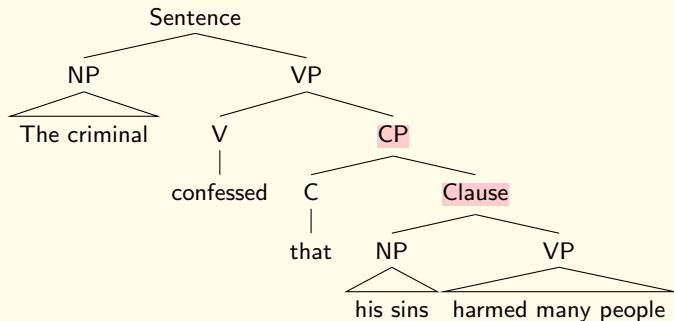
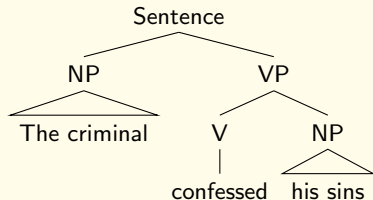
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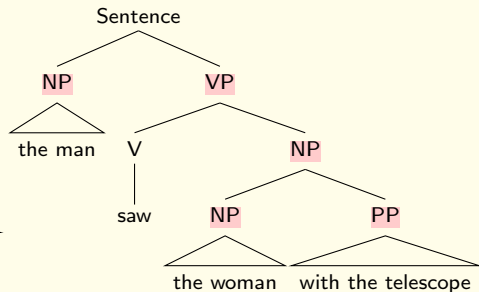
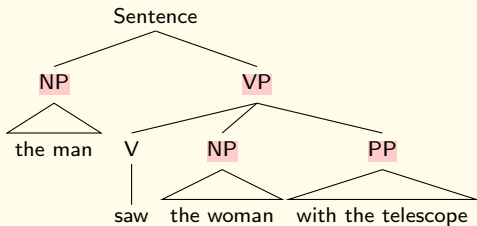
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Alternative: Biases reflect **statistical patterns** in the input

(27) Vampires (who were) loaned money at low interest rates. . .

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

1. Lexical factors
2. Contextual factors

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

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

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- (28) The student forgot $\left\{ \begin{array}{c} \textit{the solution} \\ \textit{the solution was in the book} \end{array} \right\}$
- (29) I hope $\{ \textit{I will remember next time} \}$

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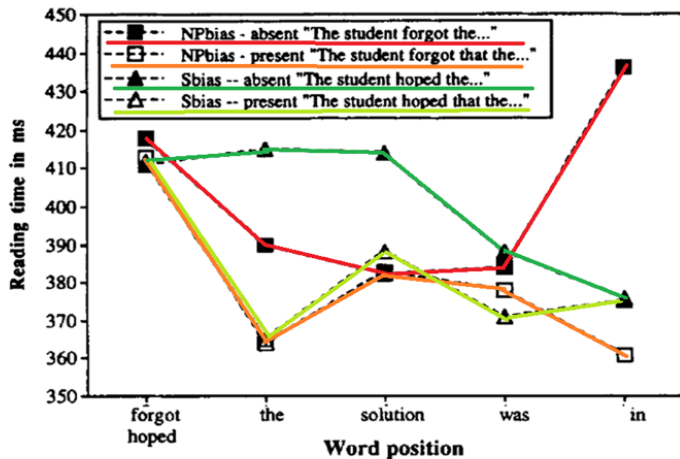


Figure 2. Word-by-word self-paced reading times (in ms). (NP = noun phrase; S = sentence.)

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1. Participants used the verb to predict the structure of the sentence.
2. Participants used subordinator *that* to disambiguate structure.

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Can you understand this sentence?

(30) The horse raced past the barn fell

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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 concluded that the ground next to the barn was more slippery.

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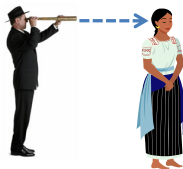
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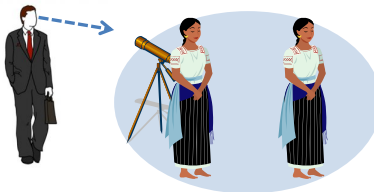
Referential processing

According to theories of referential processing, set-restriction is a costly process.

1. The vampires loaned money at low interest rates were told to record their expenses
2. The man saw the woman with the binoculars



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Garden paths are easy to generate under laboratory conditions

However, top down effects have been repeatedly demonstrated.

1. Both bottom-up and top-down factors operate almost immediately, and may co-occur.
2. Bottom-up processing slightly precedes top-down processing.

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

(31) The rock that the boy dropped was heavy

(32) The boy that the rock crushed was blond

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Read the following sentence

"No head injury is too trivial to ignore"

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

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