## Sentence Processing I

Nick Riches

Newcastle University

March 26, 2019

#### Sentence Processing I

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Bottom-up versus top-down models

Bottom-up mod

bottom up processing

Garden path sentence

The garden path model

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Figure 5: Context influences perception



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Bottom up = analysis based on word classes

(1)The...

(1)

Bottom up = analysis based on word classes

The...woman lost her purse

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Bottom up = analysis based on word classes

(1)The...woman lost her purse

Top down = analysis based on lexical/contextual factors / plausibility

(2)She's just popped out to the...

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Bottom up = analysis based on word classes

(1)The...woman lost her purse

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processing in

Bottom up = analysis based on word classes

(1)The...woman lost her purse

- (2)She's just popped out to the...shops
- (3)The disgruntled accountant decided to hand in his...

processing in

Bottom up = analysis based on word classes

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- (2)She's just popped out to the...shops
- (3)The disgruntled accountant decided to hand in his... notice

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Bottom up = analysis based on word classes

(1)The...woman lost her purse

- (2)She's just popped out to the...shops
- (3)The disgruntled accountant decided to hand in his... notice
- (4) I'm going to give. . .

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Bottom up = analysis based on word classes

(1)The...woman lost her purse

- (2)She's just popped out to the...shops
- (3)The disgruntled accountant decided to hand in his... notice
- (4) I'm going to give...it some thought

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#### The garden path model

We are relatively slow to recover.

Easy to generate and near universal.

**Temporary mis-analysis** of the structure of a sentence.

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### The garden path model

```
(5) [ CLAUSE Since Jay always jogs a mile and a half ]

Od. of 'jogs'
```

(6) [ CLAUSE Since Jay always jogs ] [ CLAUSE a mile and a half seems a long way to him ] S of 'seems'

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(7) The criminal confessed his sins harmed many people

## The garden path model

```
(8) [ CLAUSE The criminal confessed his sins ]

Od. of 'confessed'
```

```
(9) [ The criminal confessed [ CLAUSE his sins harmed many people ] ]
```

#### The garden path model

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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)

# Ambiguity

Arises where there are two possible analyses.

read/hear entire sentence)

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

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Ambiguity	Sentence Processing I
Where is the ambiguity in these sentences? Is it local or global?	Nick Riches  Bottom-up versus top-down models  Bottom-up models
(10) The vampires loaned money at low interest rates were told to record their expenses	Evidence for bottom up processing Garden path sentence The garden path model
(11) XXX pleaded guilty to running the brothel at Newcastle Crown Court.	Ambiguity How do we explain parsing biases?  Evidence for top-down
(12) The young athlete realised her potential might one day make her a world class athlete	processing  What factors can be classified as "top down"  Role of lexical content  Discourse context
(13) A bicycle was reported stolen by an old lady	Referential processing  So which account is correct?
(14) They're cooking apples.	Sentence processing in clinical populations
(15) The following are some tips to protect women from the police department	Homework Bibliograpy 25 / 57

#### **Ambiguity**

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

(17)

XXX pleaded guilty to running the brothel at Newcastle Crown court

# **Ambiguity**

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[ CLAUSE The athlete realised her potential ] (18)

> The athlete realised [ CLAUSE her potential might one day make her a world class athlete ]

A bicycle was reported stolen by an old lady

(20)

(19)

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A drive towards **simplicity**?

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

Processing constraints?

Pottom

Modularity (Jerry Fodor, 1983)

Neural regions dedicated to a particular task The syntactic parser is dedicated to analysing sentences



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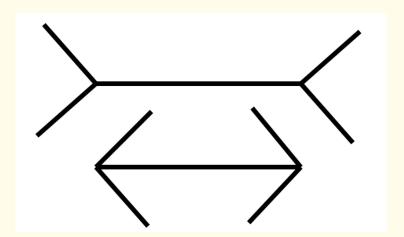
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Behaviour of a module is impervious to external information Is behaviour of parser impervious to top-down information?

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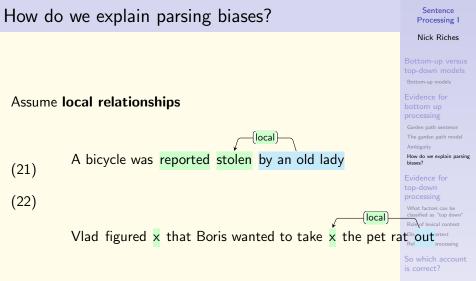
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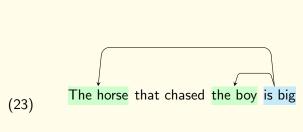
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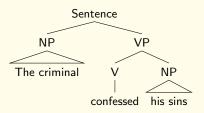
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Assume simple structures (e.g. few nodes and branches)



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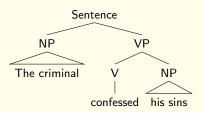
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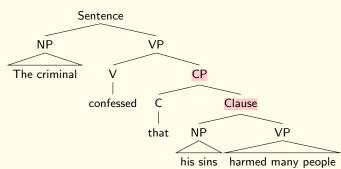
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Assume simple structures (e.g. few nodes and branches)





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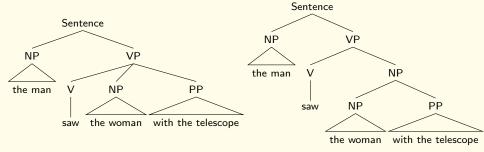
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Alternative: Biases reflect statistical patterns in the input

(24) 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

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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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reading paradigm.

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

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(25) I forgot { Janet's birthday } that it was Janet's birthday }

(26) I hope  $\{I \text{ will remember next time}\}$ 

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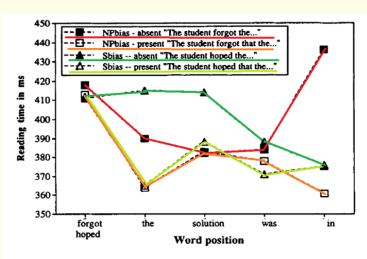


Figure 2. Word-by-word self-paced reading times (in ms). (NP = noun phrase; S = sentence.)

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1. Participants used the verb to predict the structure of the sentence.

2. Participants used subordinator that to disambiguate structure.

## Discourse context

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Can you understand this sentence?

(27)The horse raced past the barn fell How do we explain parsing

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

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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 are operative at once.
- Bottom-up processing slightly precedes top-down processing.

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Culdana 4

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

(28) The rock that the boy dropped was heavy

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## Nick Riches

Bottom-up versus top-down models

Evidence for bottom up processing

Evidence for top-down processing

So which account is correct?

Sentence processing in clinical populations

## Homework

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top-down models

Bottom-up models

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Ambiguity

How do we explain parsing

Evidence for

What factors can be classified as "top down" Role of lexical content Discourse context

Referential processing

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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 is? Is there anythin weird about it?

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