Syntax Stories
Epmem for Sentence Processing

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Syntax Stories
Epmem for Sentence Processing

XNL-Soar: Who We Are

- Natural language processing with Soar
- Continuation of NL-Soar (CMU)
- Directed by Deryle Lonsdale (1998-present)

Publications & Milestones

- Semantic meaning (2013)
- -ing Ambiguity Resolution (2013)
- Parsing Japanese (2012)
- PP-Attachment Ambiguity (2012)
- Update C to Java (2010)
- Wordnet Lexicon (2000)

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Ambiguity in Language

- Many types of language ambiguity:
  - Syntactic: “I saw an elephant in my pajamas.”
  - Lexical: “The irons were on the dog by the fire.”

Mostly Unproblematic for Humans

The building blocks are red.

The building blocks the sun.

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Garden Path Sentences

- The natural parse is not the grammatical one
- If humans recover, it is through careful reanalysis
- XNL-Soar successfully fails at the Garden Path Moment
  - How should it recover?

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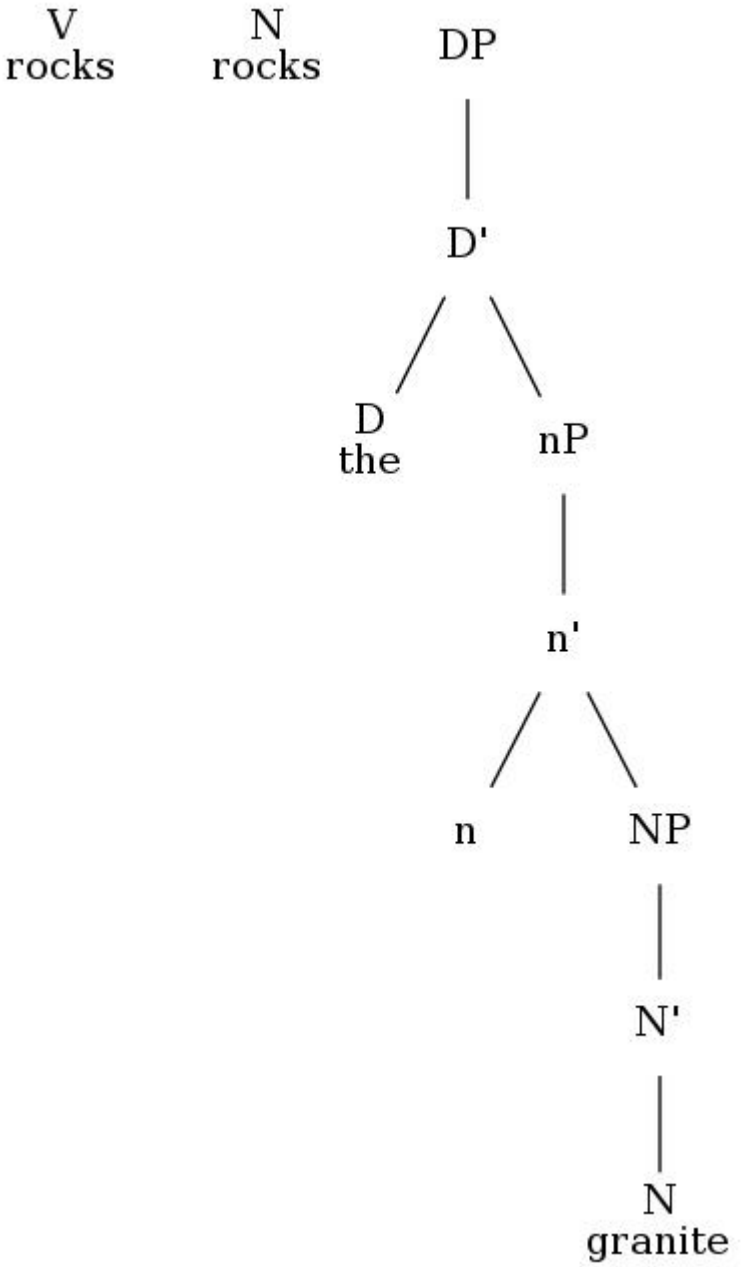
Our System in Action: Sentence 1
Lexical Garden Path

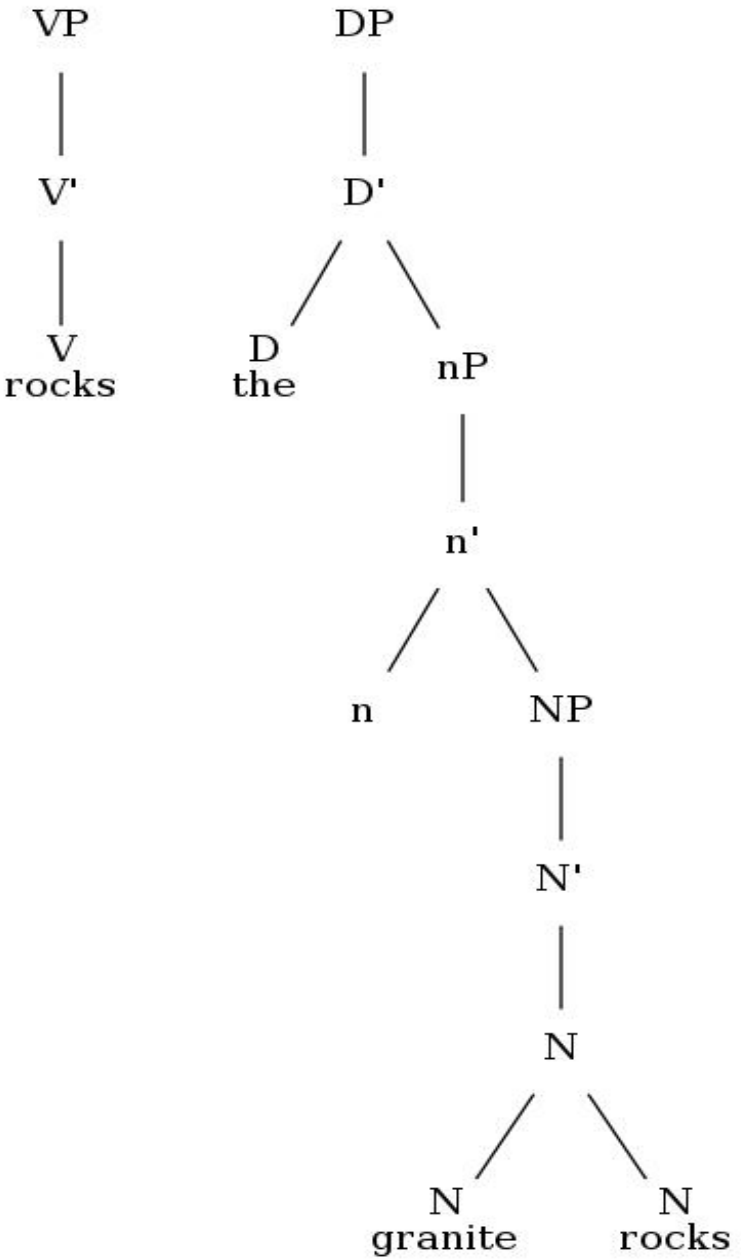
“The granite rocks by the seashore with the waves.”

Sentence 1 Garden Path Trigger

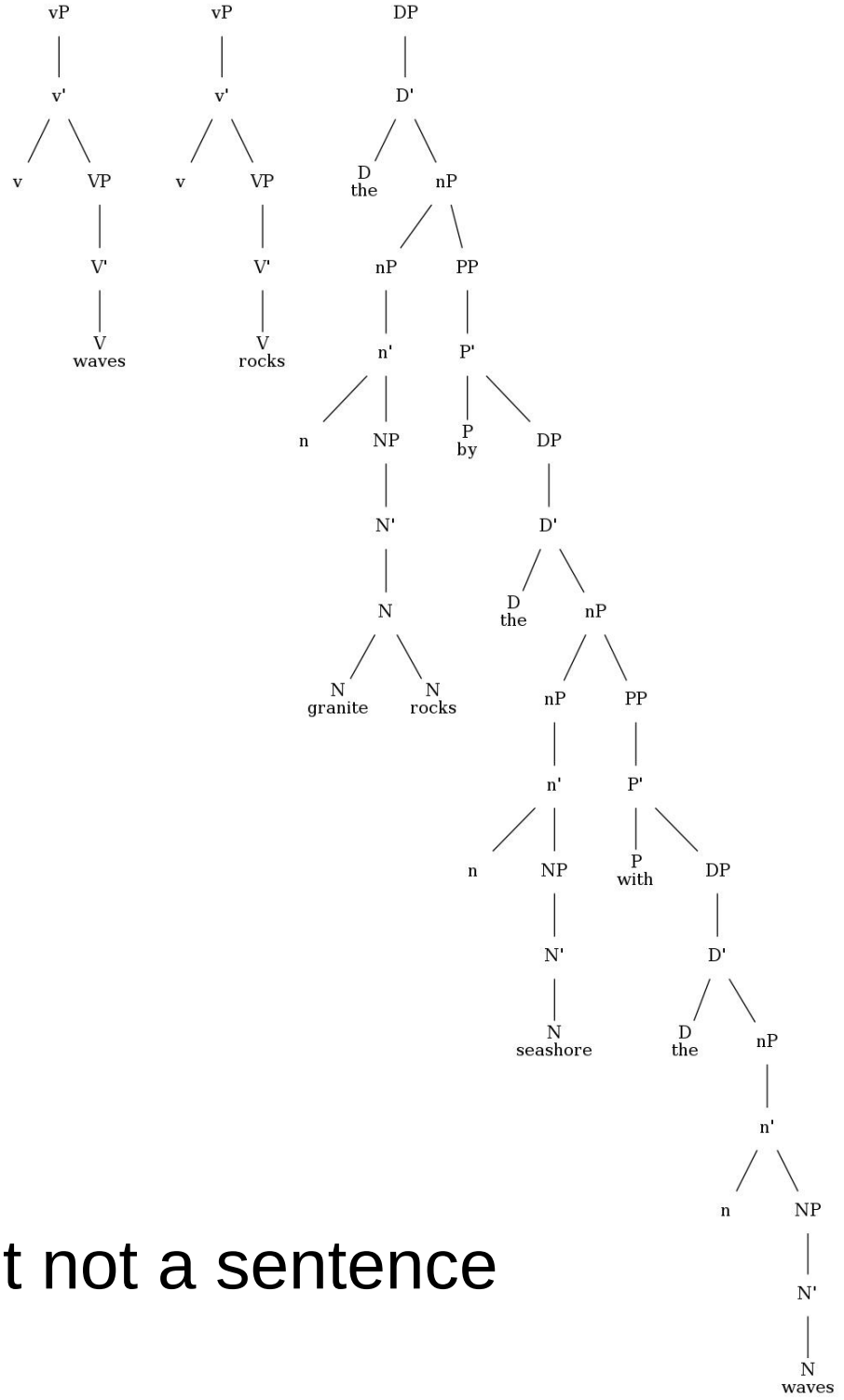
How to interpret “rocks”?



Garden Path Trigger + 1 Step



Garden Path Moment



Parse Failure: All the words, but not a sentence

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Garden Path Moment

- Original Story: XNL-Soar terminates at this failed parse
- Recovery Strategy:

  1) Recognize we've encountered a Garden Path

  2) Query epmem for the garden path trigger

  3) “Wipe Out”

  4) “Transplant”

  5) Disprefer garden path choice

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Wipeout Operator

```
sp {apply*wipeout
   :o-support
   (state <s> ^{<> strategies <> operator <> epmem <> io <> language <>
superstate <> type <> arsets <memory>} <memval>
   ^operator <op> ^epmem <epmem> ^arsets <ars>)
   (<op> ^name wipeout)
   (<epmem> ^wiped-out-sem2 yes)
   (<s> -^wiped-out yes)
-->
   (<s> ^<memory> <memval> -)
   (<epmem> ^wiped-out yes +)
     (<s> ^wiped-out yes +)
}
```

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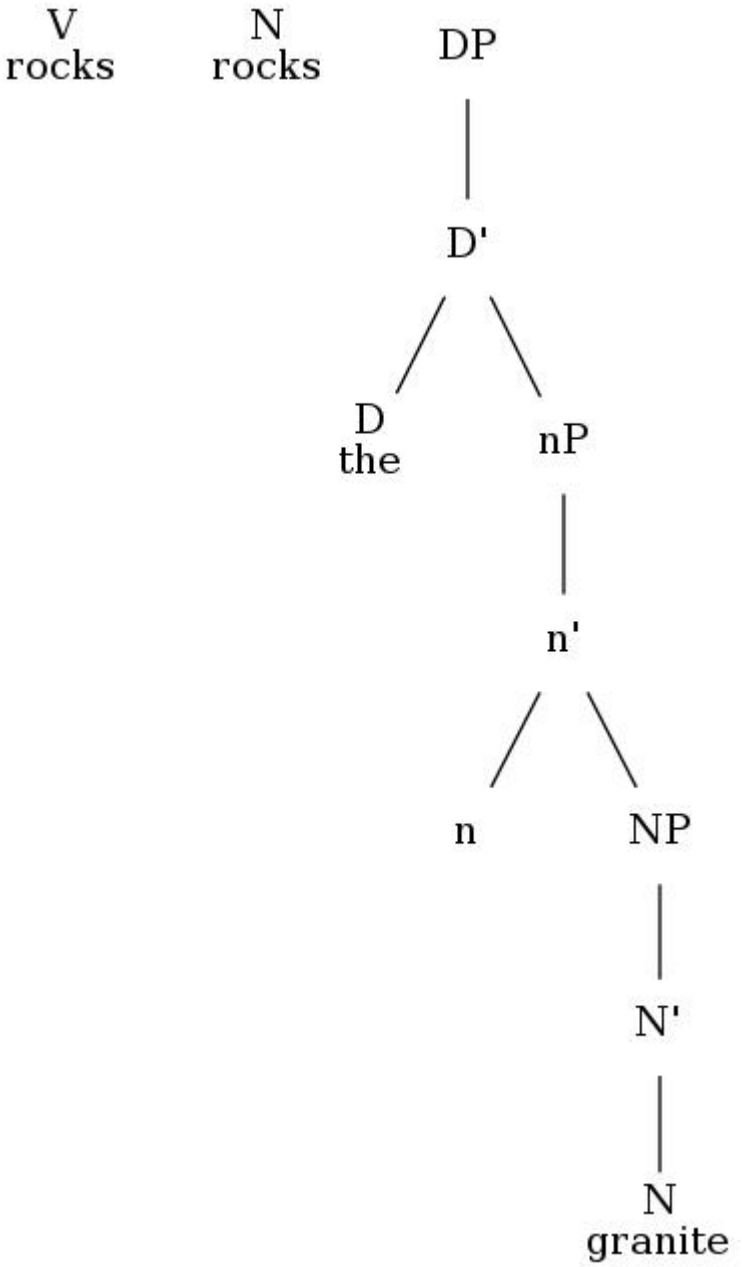
Transplant Operator

```
sp {apply*transplant*hop
   (state <s> ^operator.name transplant ^epmem.result.retrieved <res>)
   (<res> ^hop <val>)
-->
   (<s> ^hop <val> +)
}


sp {apply*transplant*lastacc
   (state <s> ^hop.type clausal ^operator.name transplant
^epmem.result.retrieved <res>)
   (<res> ^lastacc <val>)
-->
   (<s> ^lastacc <val> +)
}
```

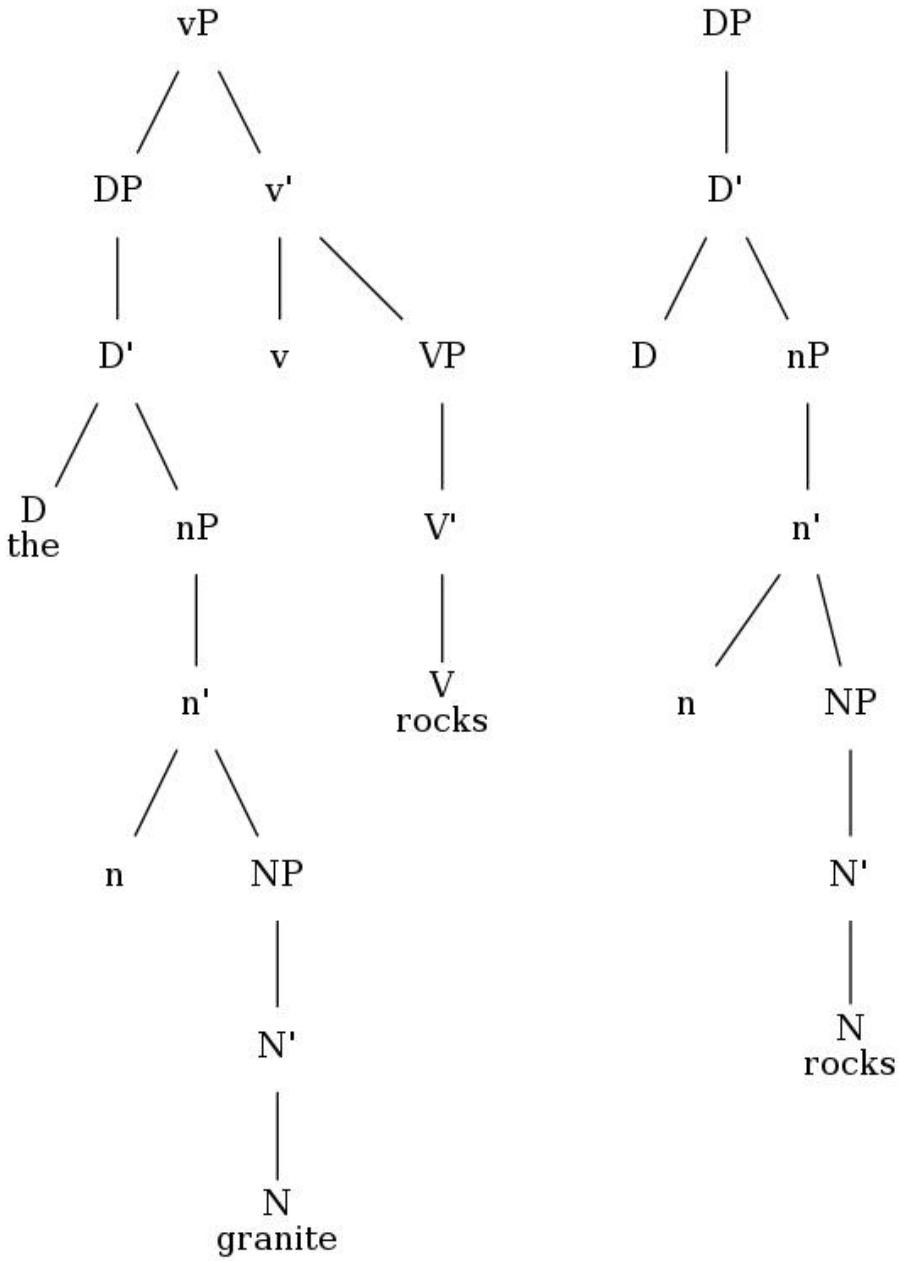
Sentence 1 Garden Path Trigger

How to interpret “rocks”?

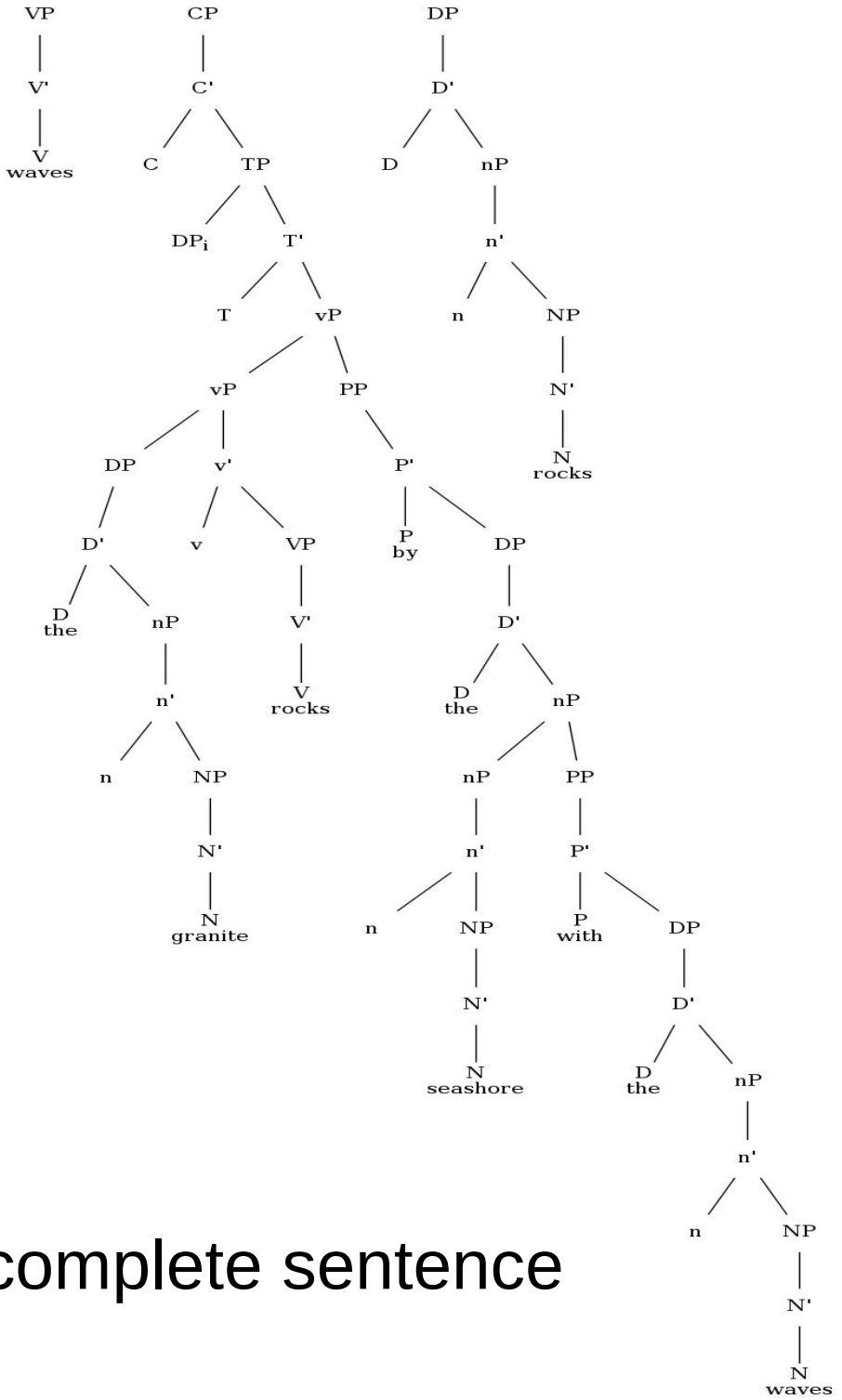


Sentence 1 Recovery

Don't choose the noun



Sentence 1
Garden Path Resolution



Parse Success: All the words, complete sentence

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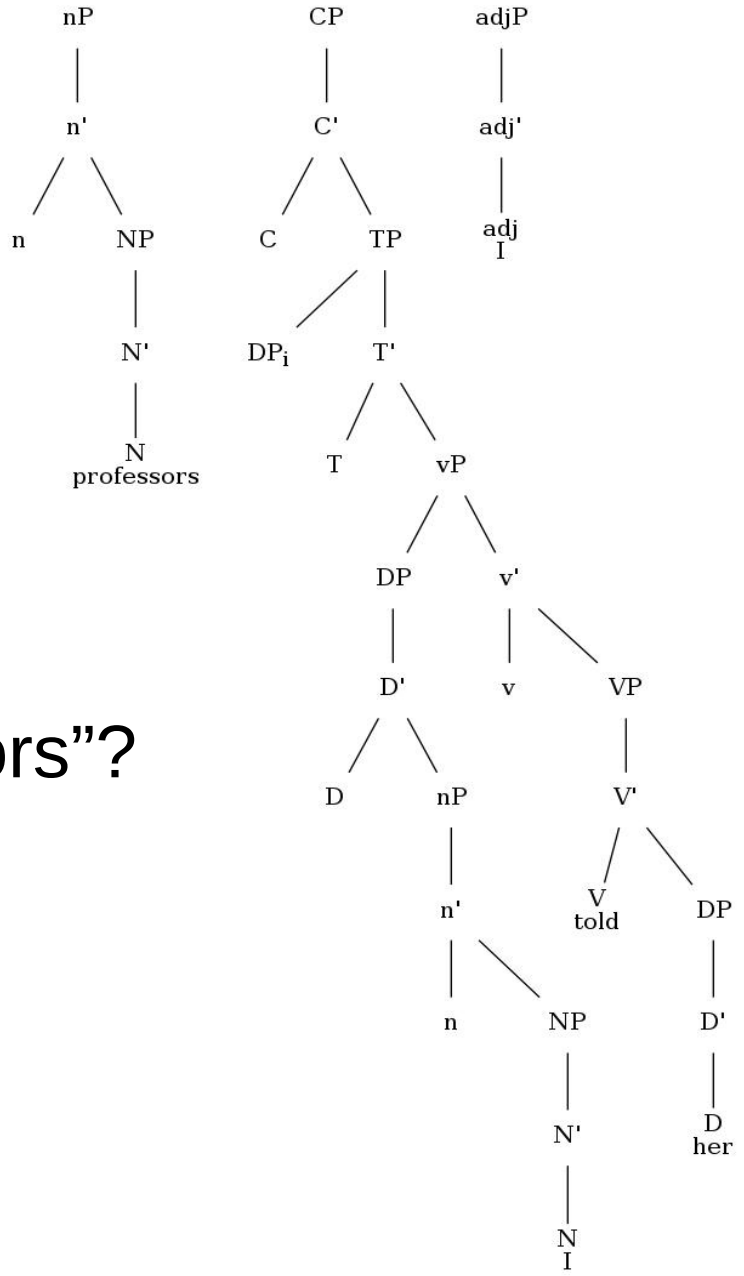
Our System in Action: Sentence 2
Syntactic Garden Path

“I told her professors underestimate me.”

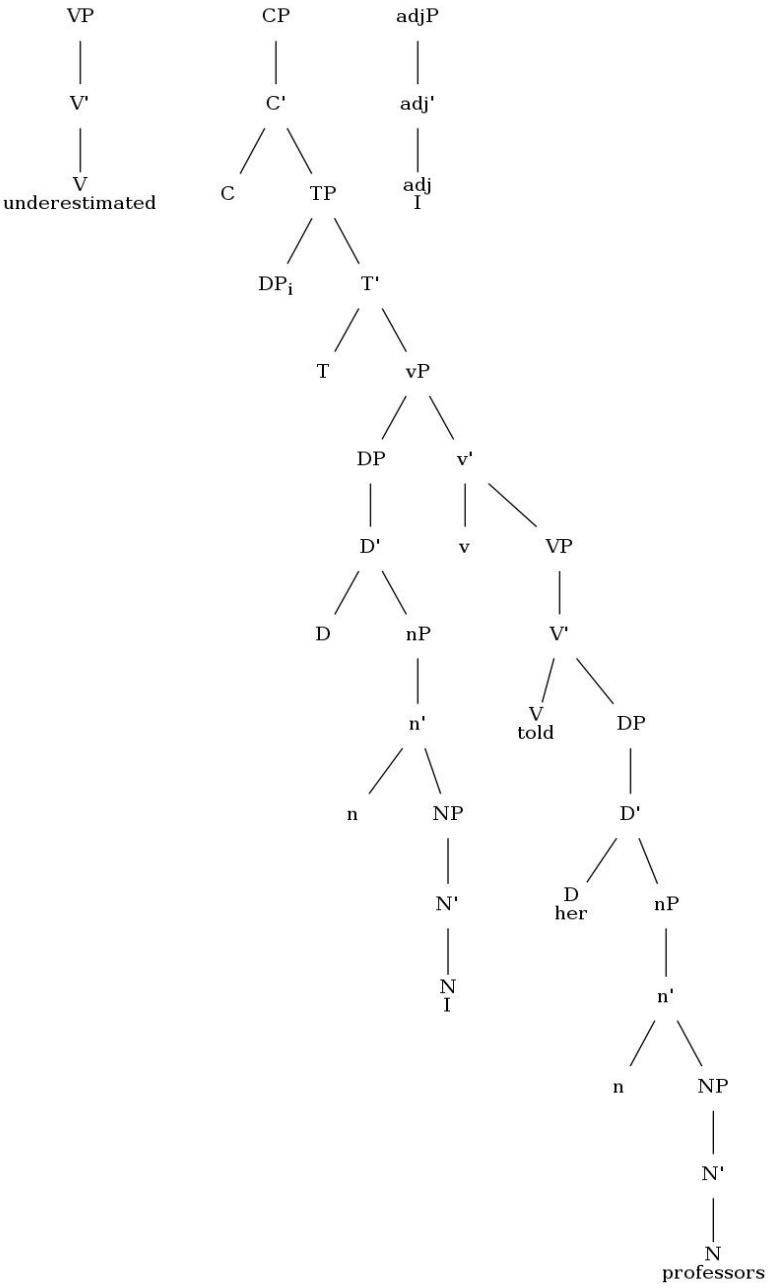
Sentence 2 Garden Path Trigger



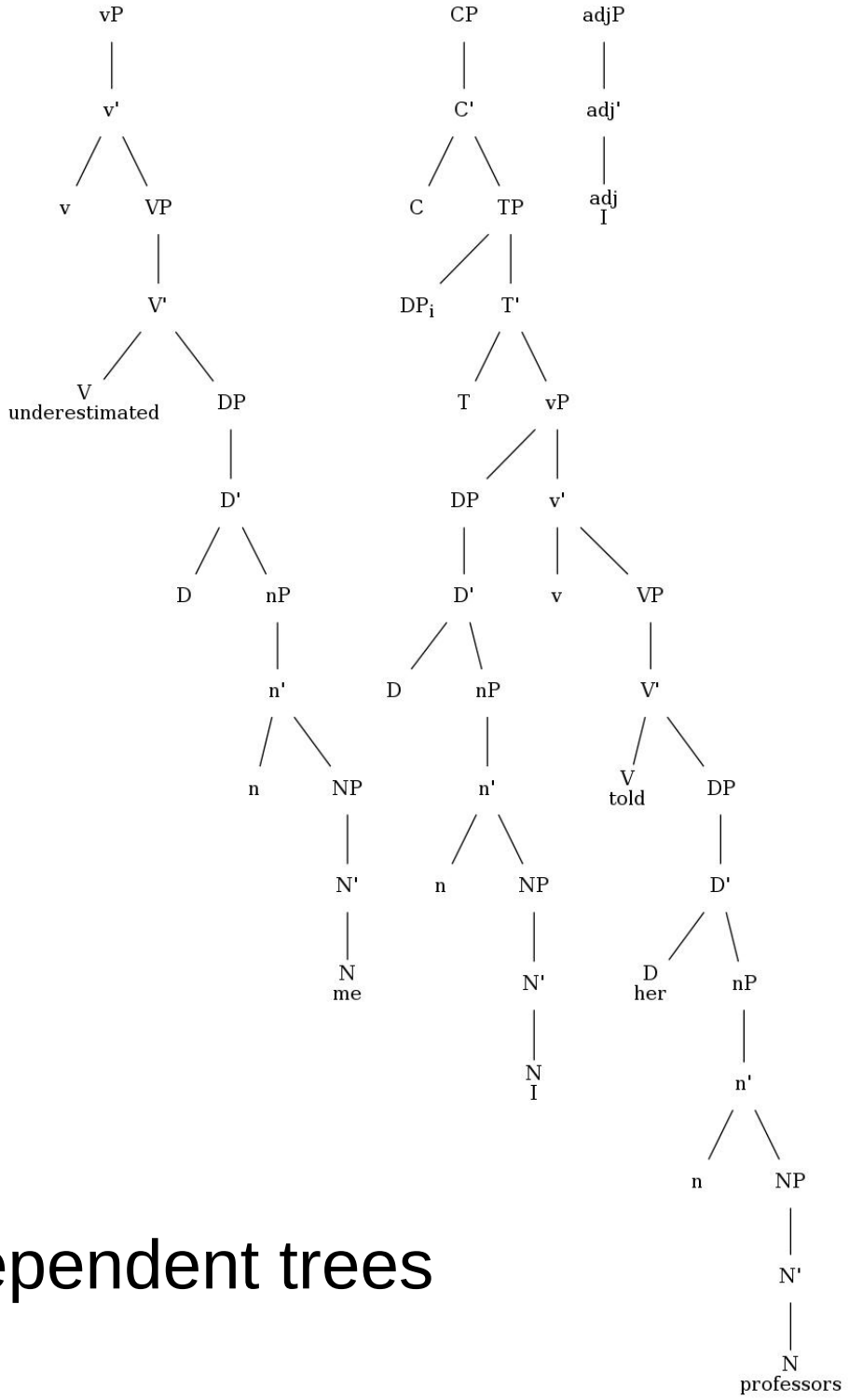
How shall we attach “professors”?

Garden Path Trigger + 1 Step

“her professors” are who I told

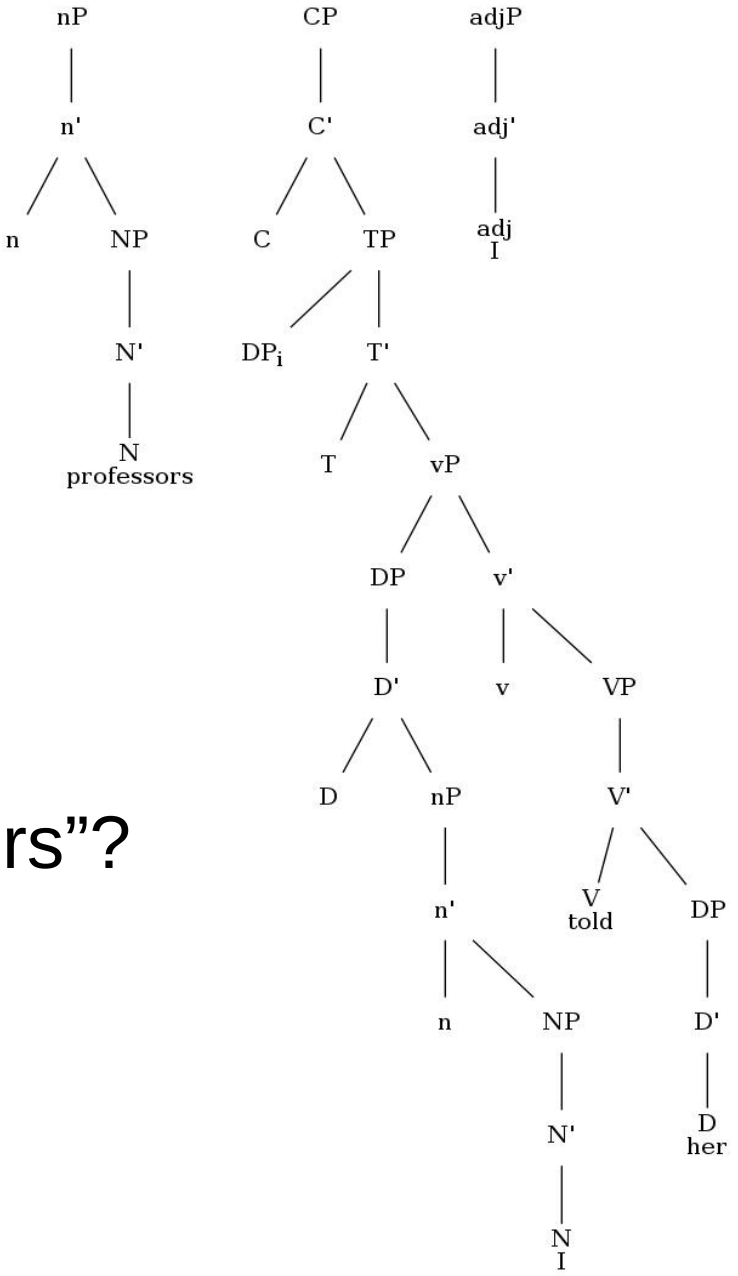


Garden Path Moment



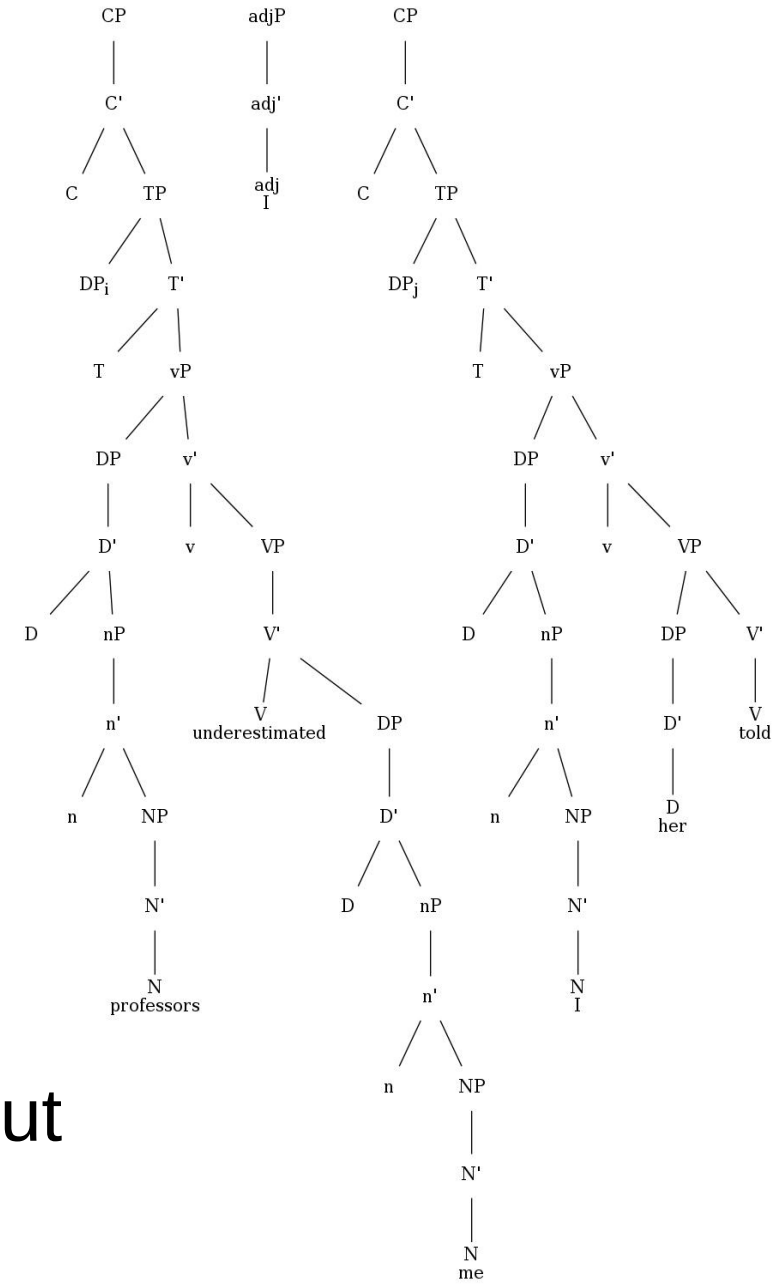
Parse Failure: All words, 2 independent trees

Sentence 2 Garden Path Trigger



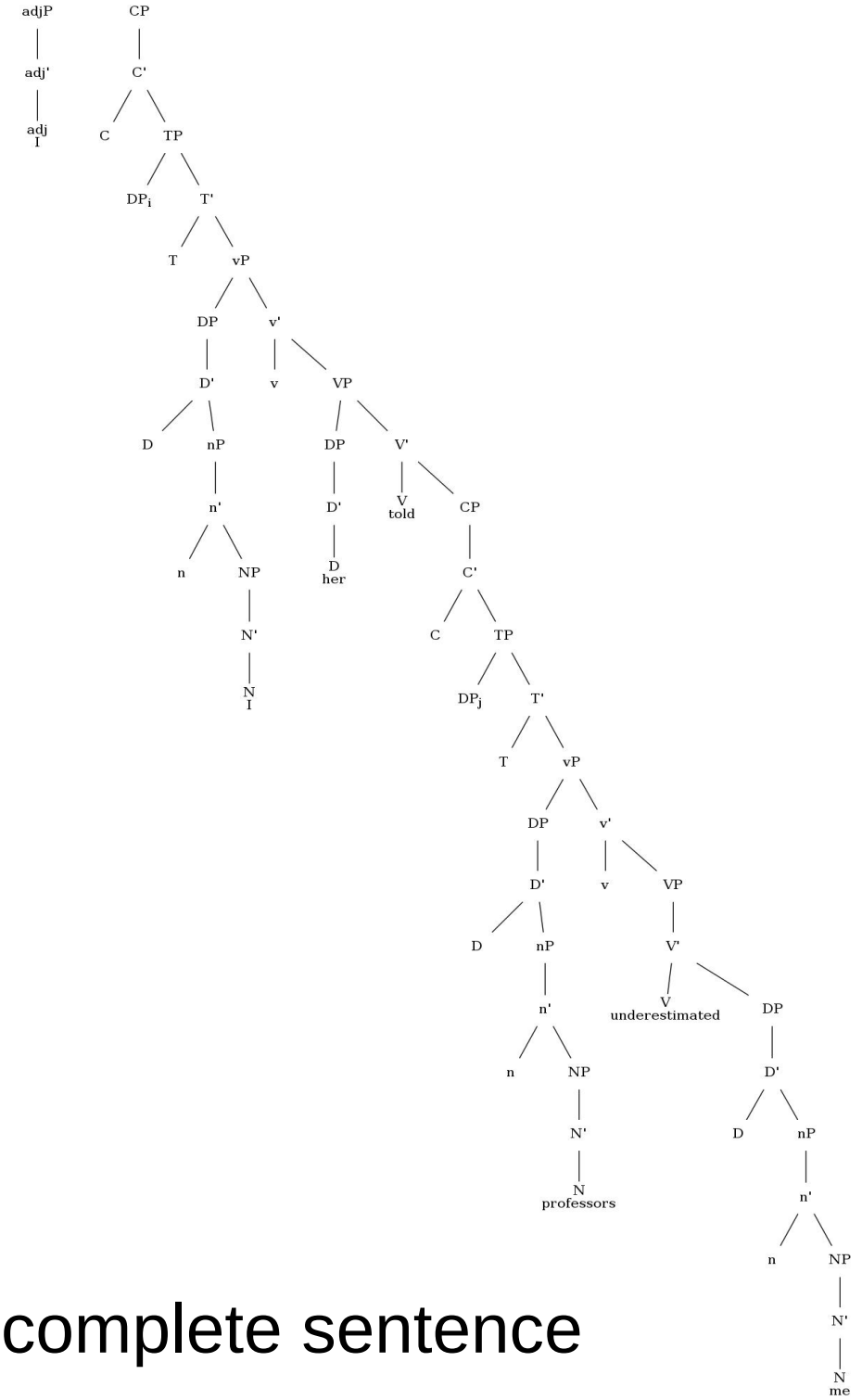
How shall we attach “professors”?

Sentence 2 Garden Path Recovery



“professors” are what were told about

Sentence 2
Garden Path Resolution



Parse Success: All the words, complete sentence

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Gold Nuggets

- Use of epmem for recovering from garden paths
- Off-the-shelf implementation of episodic memory
- Two very different types of garden paths
- Using an updated system & syntax that potentially offers different judgments on garden paths than Lewis' original work

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Coal Lumps

- This is a proof of concept; generalization is needed
- XNL-Soar is linguistically & Soar-ly complex
- “Wipeout” is delicate and should be refined
- 25 more garden path structures to go (Lewis '93)

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Future Work

- “Retrieval” loop for epmem result filtering
- “Attempt” loop for multiple recoveries
- Implementation of all garden paths
- Generalization of garden path types
- Epmem for general parsing/ambiguity recovery