COSC421: Neural Models of Language

Lecture 11: A sensorimotor interpretation of clause syntax

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Recap

Our example sentence: **The man grabbed a cup**.

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What I want to argue in today's lecture:

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- In Minimalism, the **LF** of the above sentence has a certain form. (Lectures 8–9)

What I want to argue in today's lecture:

- The LF of the above sentence can be interpreted as a description of the process of replaying the working memory sequence.

Replay of the WM sequence: timecourse of signals

Sustained signals	Transient signals		
	Context signals	Action signals	Reafferent signals
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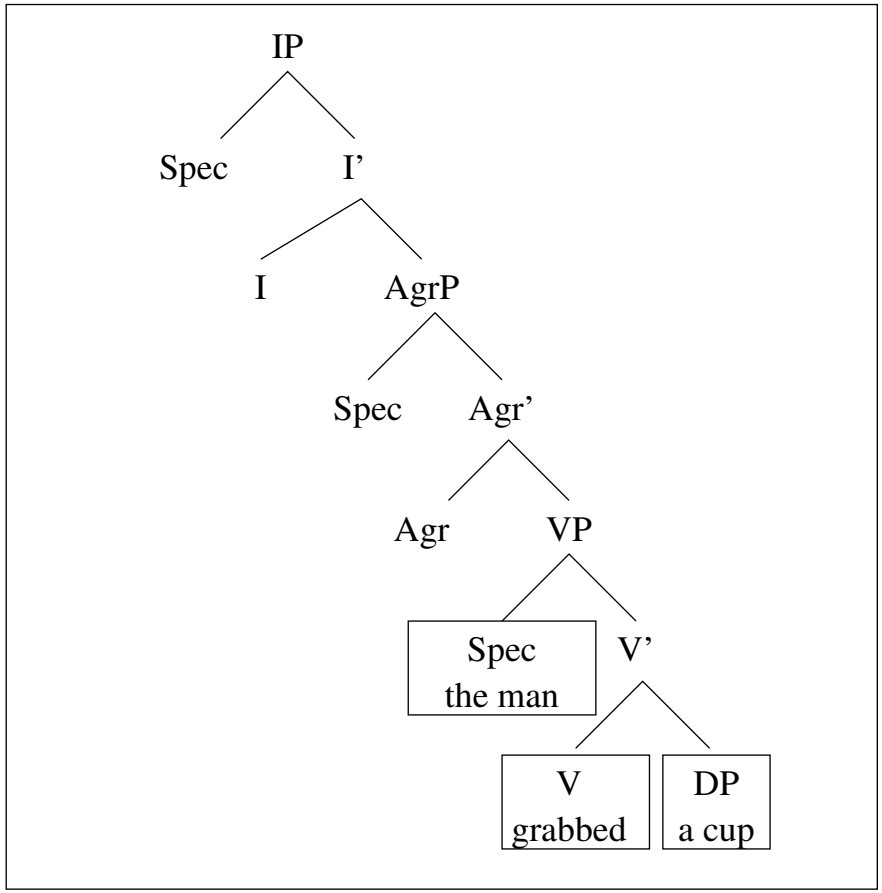
The LF of *The man grabbed a cup*

The verb and its arguments originate in the VP.



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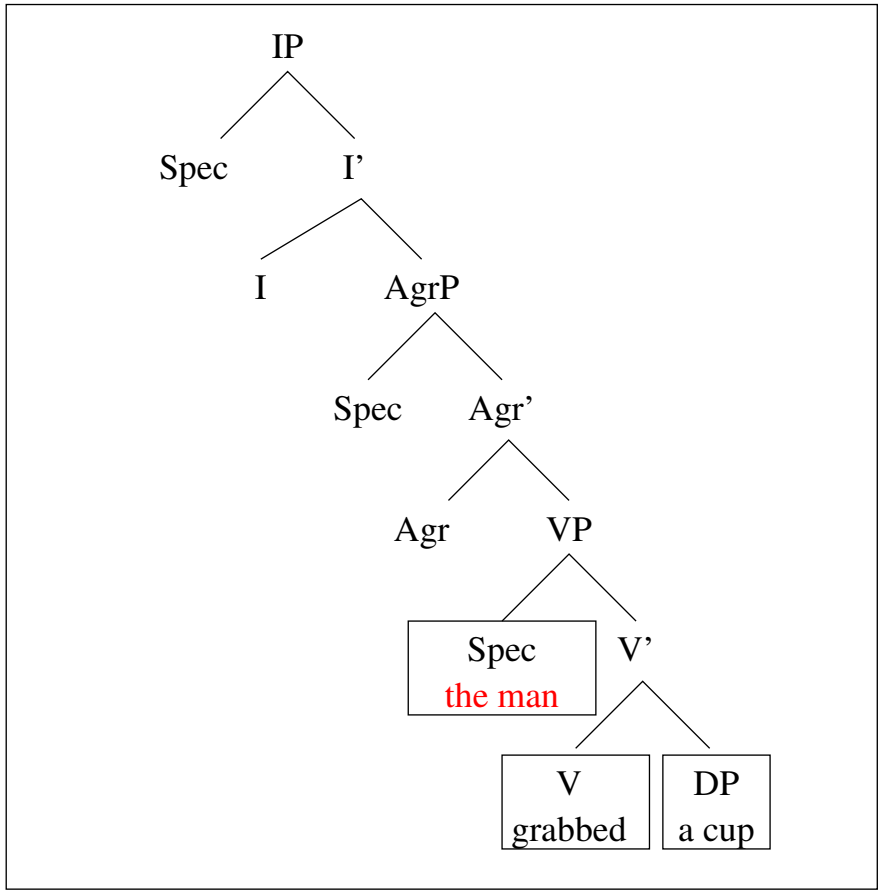

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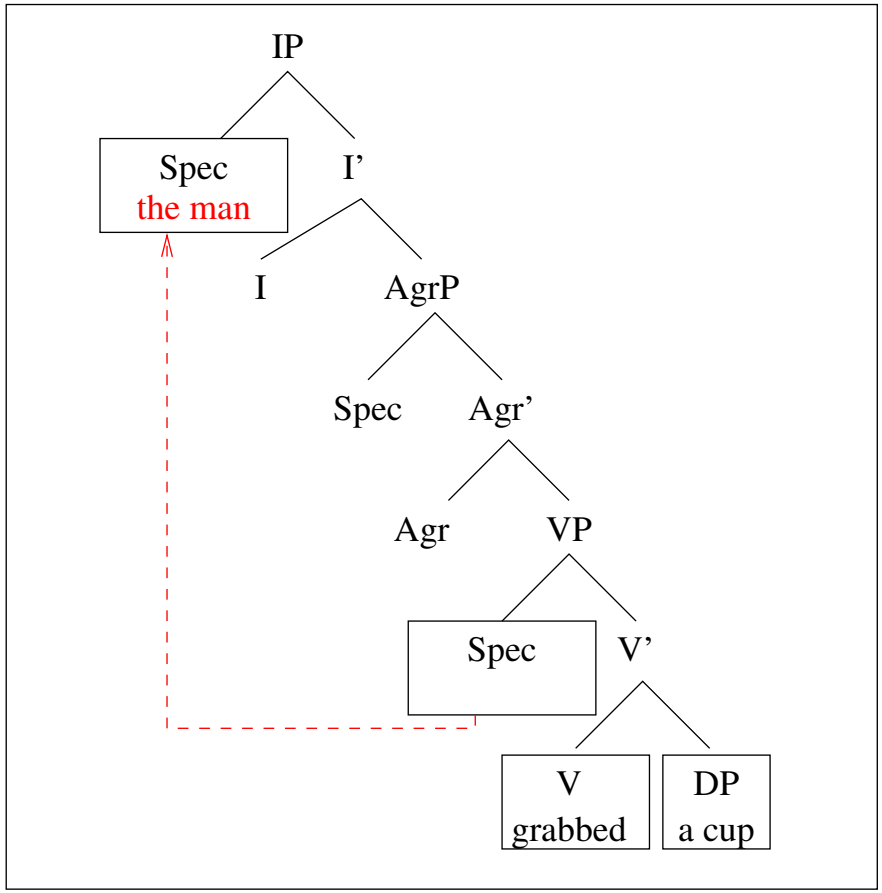

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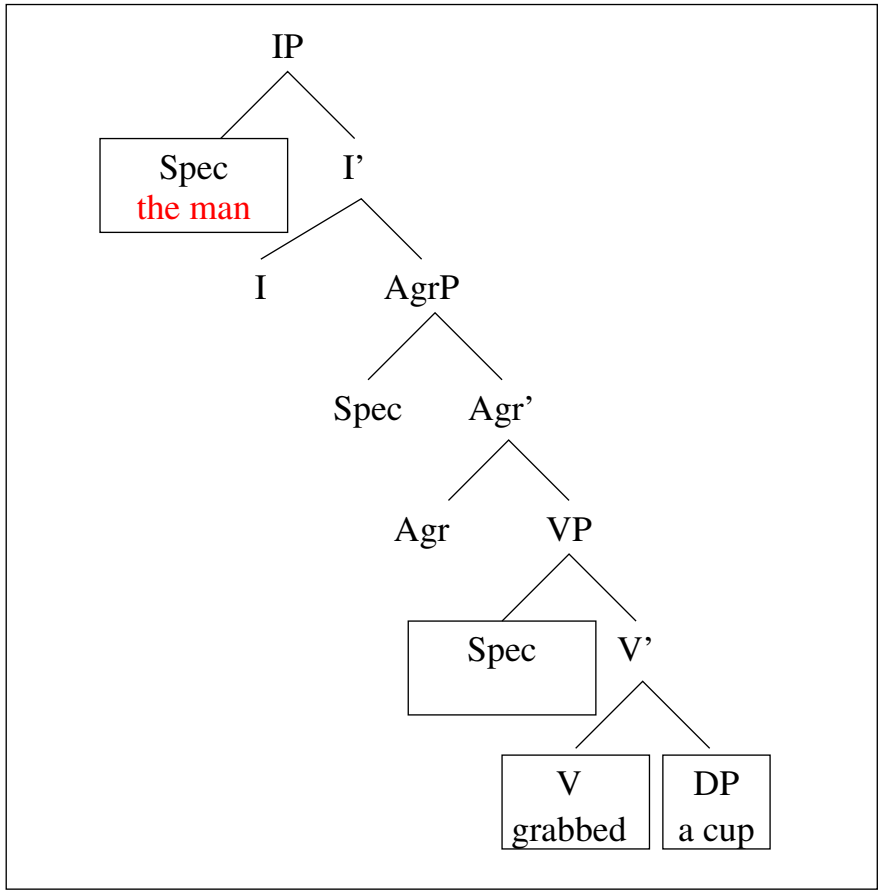

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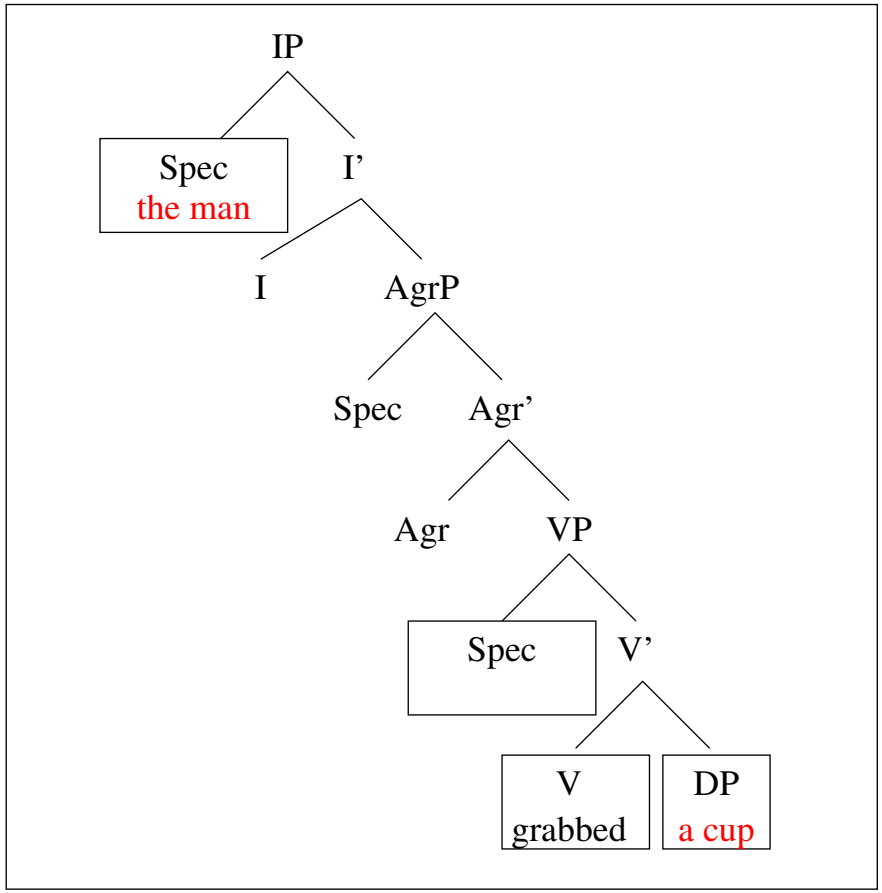
The object raises to [Spec,AgrP] to get Case.



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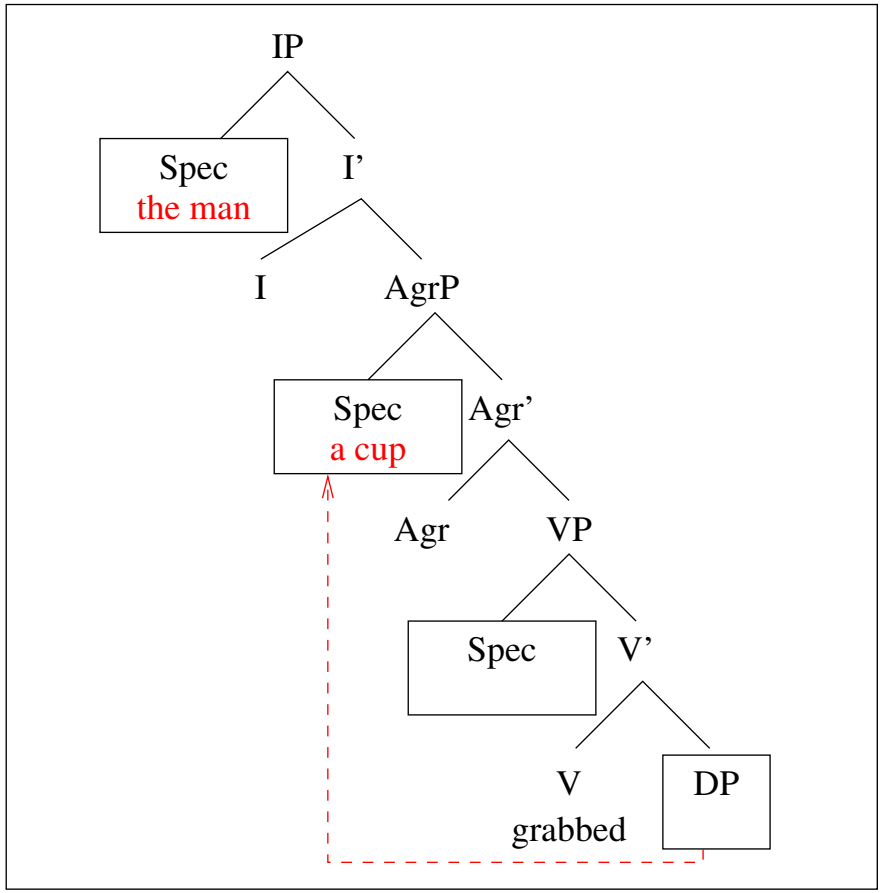

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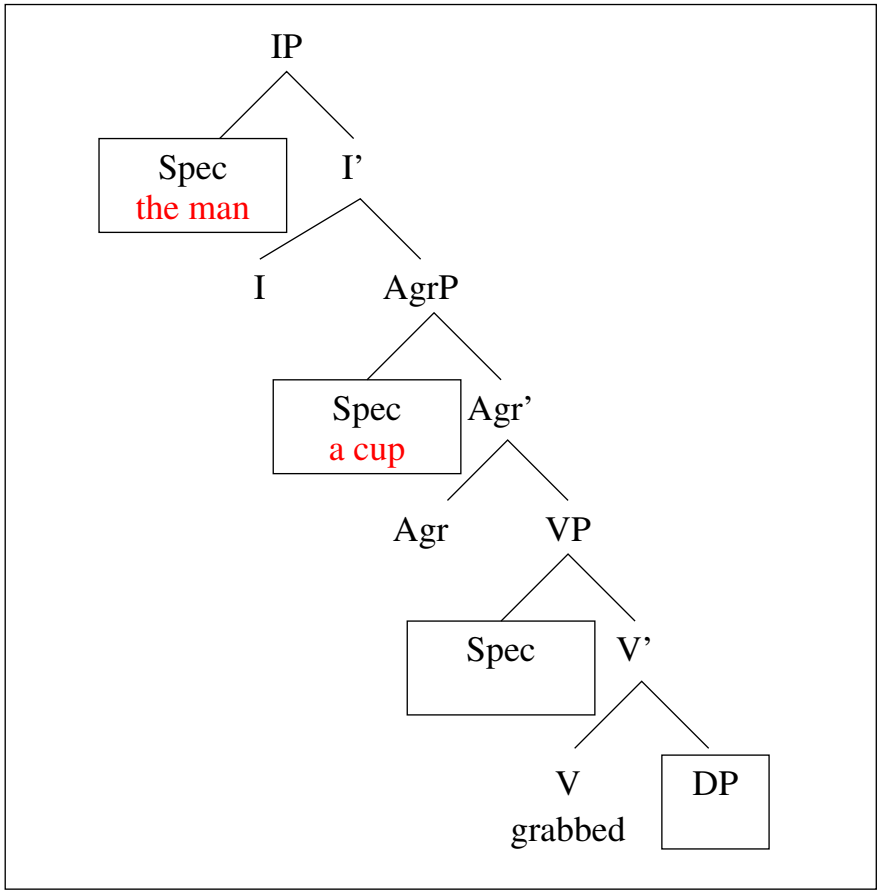

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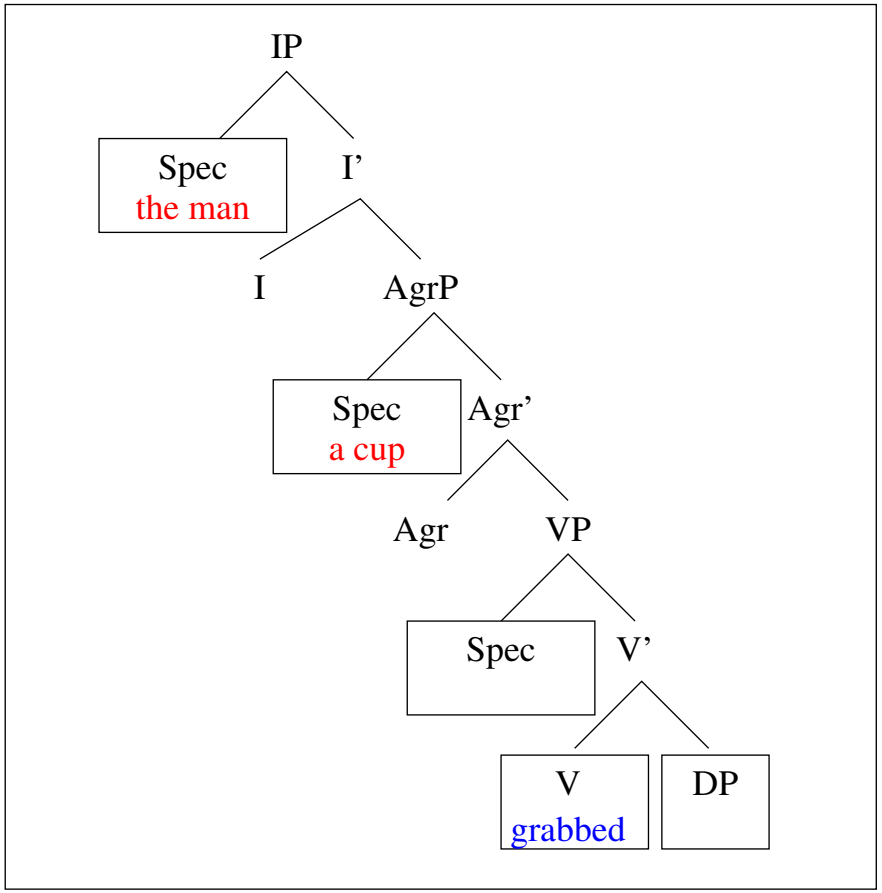

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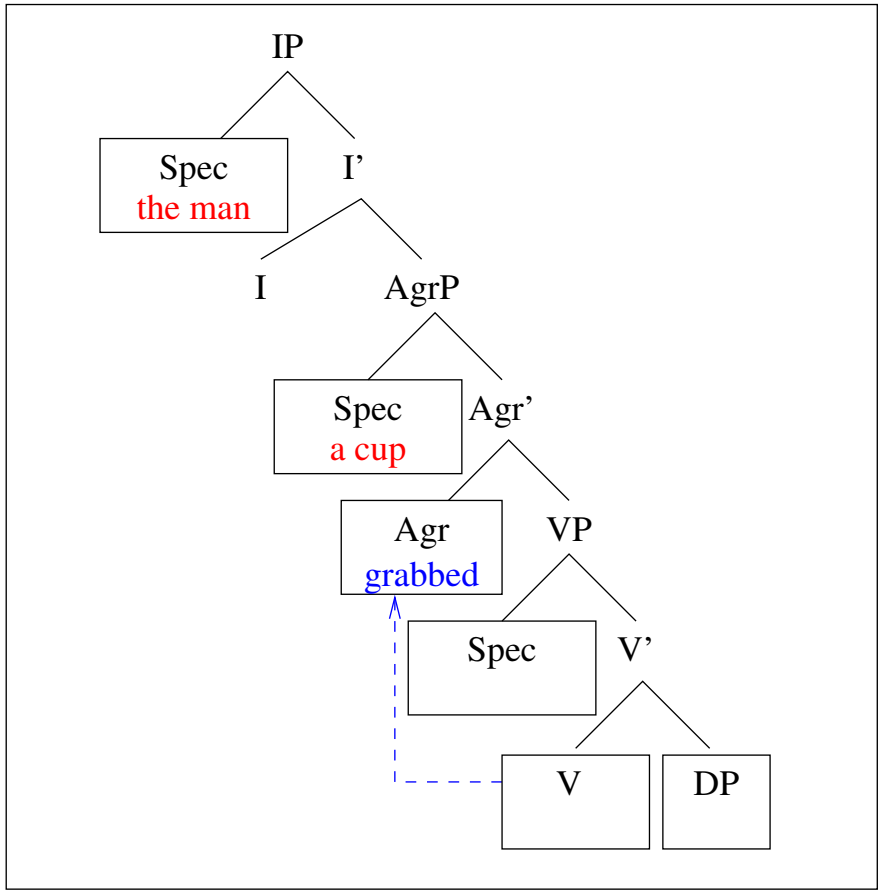

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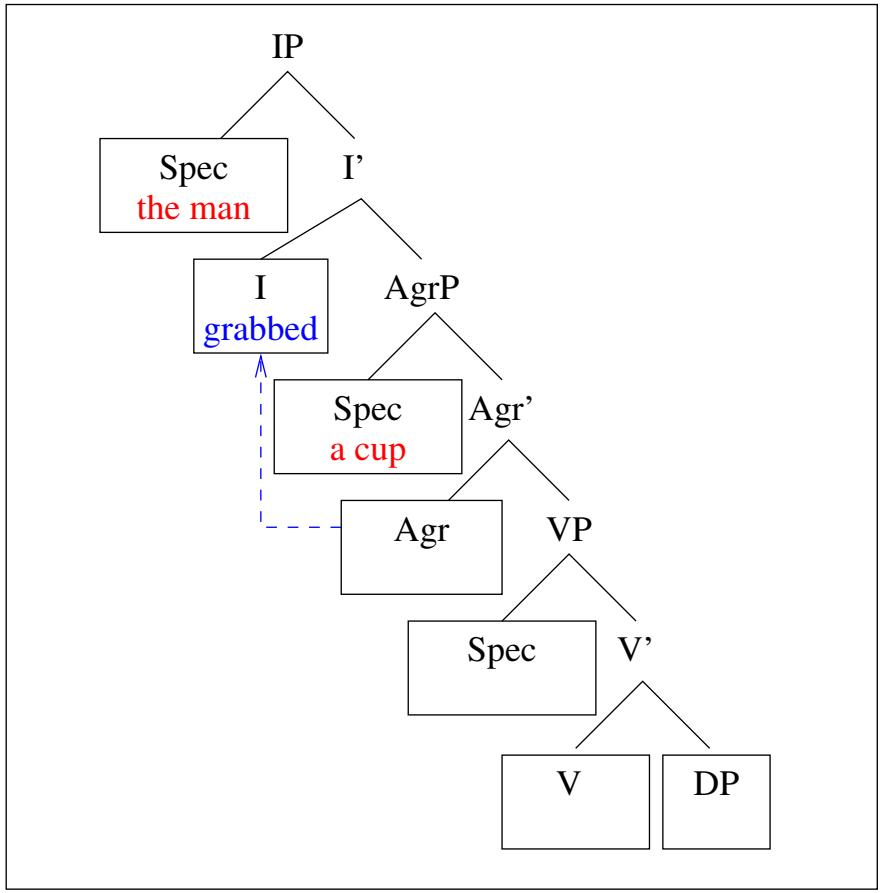

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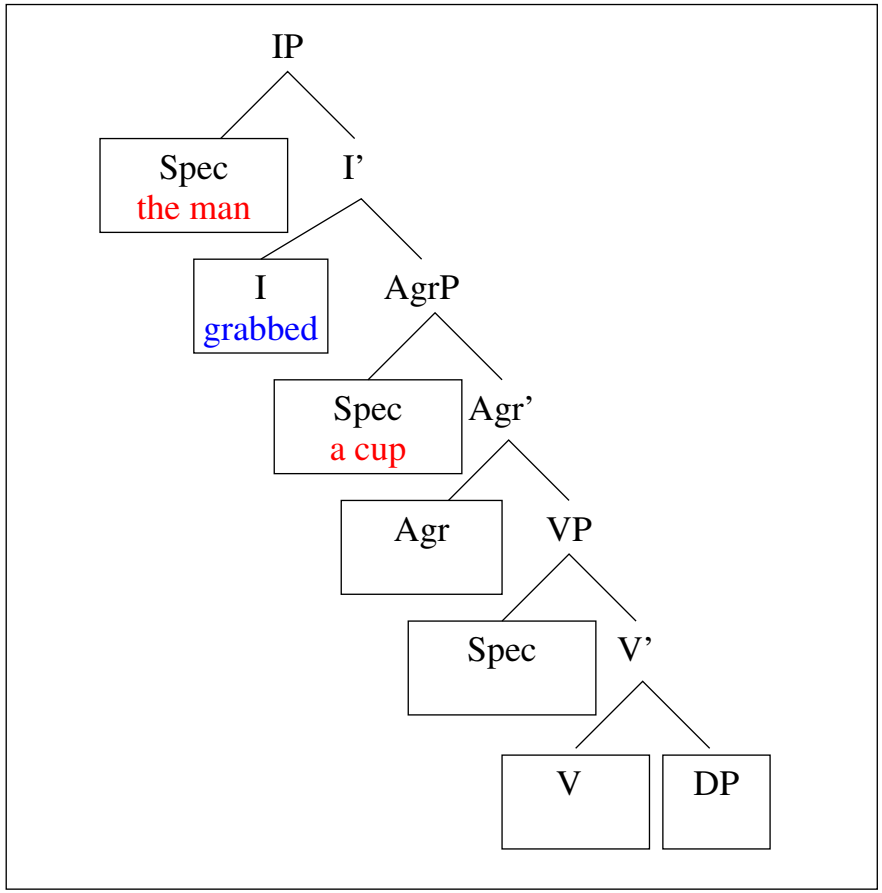
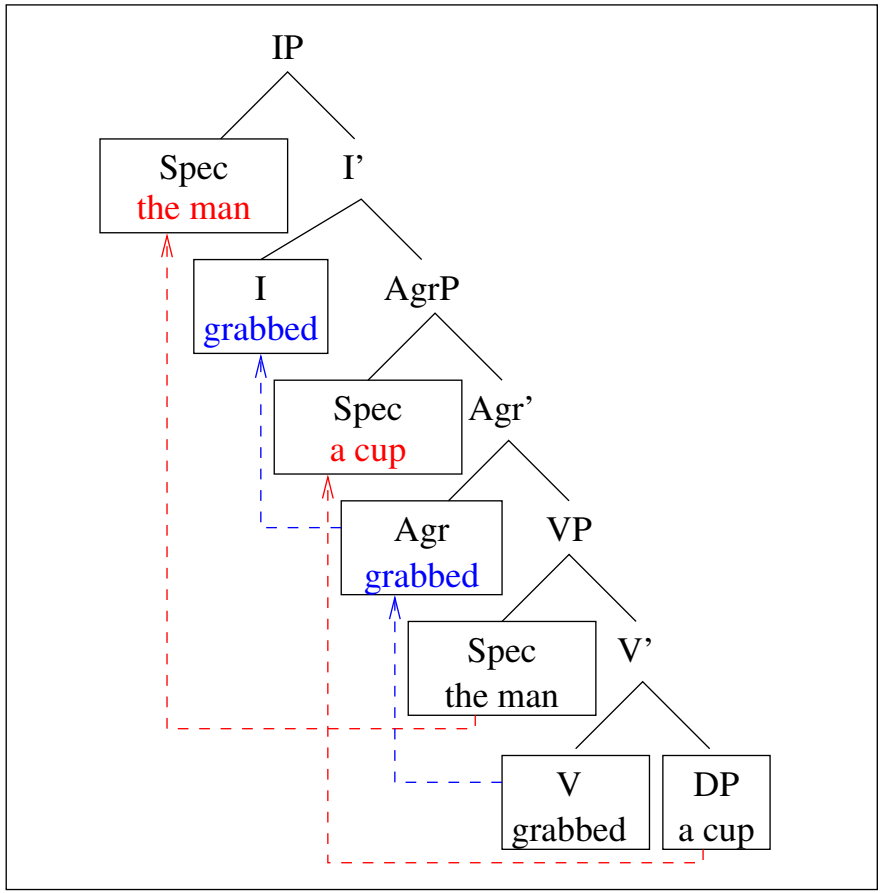


The LF of *The man grabbed a cup*

Moved elements leave traces.



Outline of today's lecture

1. What it means to give a SM interpretation of LF.
2. A SM interpretation of LF.

The idea of a SM characterisation of LF

My hypothesis:

> *'An* **LF structure** *describes* **a sensorimotor process**.'

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What does that mean?

Consider the LF structure of *The man grabbed a cup*.

What is this, for a syntactician?

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Consider the LF structure of *The man grabbed a cup*.

What is this, for a syntactician?

- It's a structure from which the 'meaning' of the sentence can be extracted.

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What does that mean?

Consider the LF structure of *The man grabbed a cup*.

What is this, for a syntactician?

- It's also a description of how the mechanism which generates *all sentences* generated *this particular sentence*.

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What does that mean?

Consider the LF structure of *The man grabbed a cup*.

What is this, for a syntactician?

- It also expresses a hypothesis about 'universal grammar': the idea that at the level of LF, all languages are the same.

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Consider the SM model of the cup-grabbing episode.

What does this provide?

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Consider the SM model of the cup-grabbing episode.

What does this provide?

- A model of how the episode is experienced.
  (Key idea: it's a sequence.)

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What does that mean?

Consider the SM model of the cup-grabbing episode.

What does this provide?

- A model of how the episode is retained in WM.
  (Key idea: it's stored as a 'replayable' sequence plan.)

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My hypothesis (more precisely):

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What has that process got to do with **sentence meaning**?

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What has that process got to do with **sentence meaning**?

Proposal:

- We 'entertain the meaning' of the sentence *The man grabbed a cup* by rehearsing its associated SM sequence.

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What has that process got to do with a description of the **generative mechanism**?

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What has that process got to do with a description of the **generative mechanism**?

Proposal:

- The SM system (and the world) place *constraints* on the SM sequences which can be experienced.
- These constraints *define the generative mechanism*.

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My hypothesis (more precisely):

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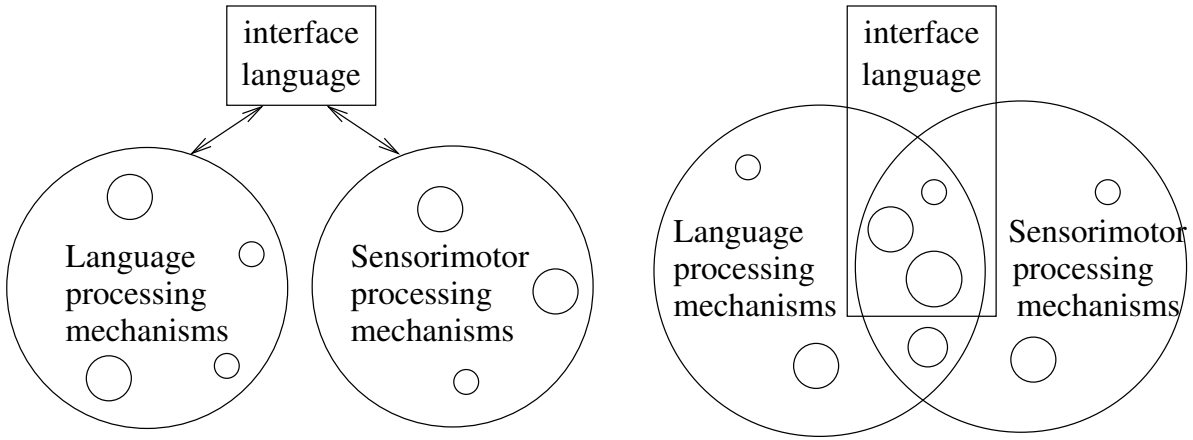
What has that process got to do with **universal grammar**?

Universal grammar revisited

Linguists tend to think of the ‘generative mechanism’ as a Fodorian module.



But that’s not the only way to think about it.

- My proposal: the generative mechanism overlaps with SM mechanisms.
- Linguistic universals are then explained by the fact that we all have the same SM mechanisms.

Reading LF as the trace of a replayed sequence

Timecourse of SM signals during the replayed cup-grabbing episode:

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Proposal:

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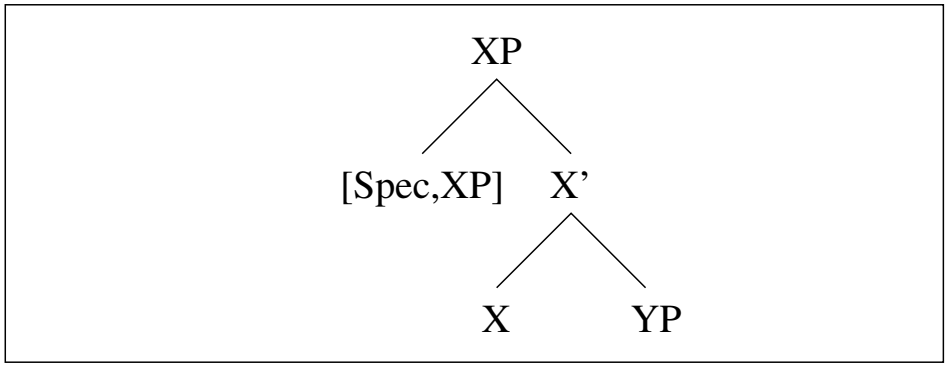
Each item in the XP schema has a SM interpretation.



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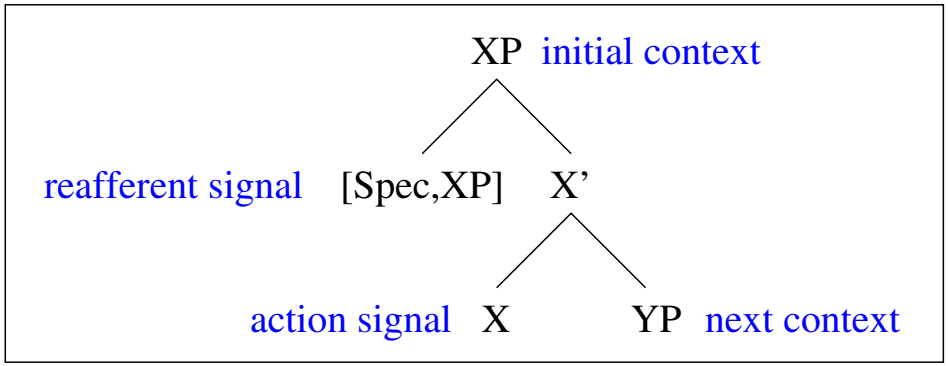

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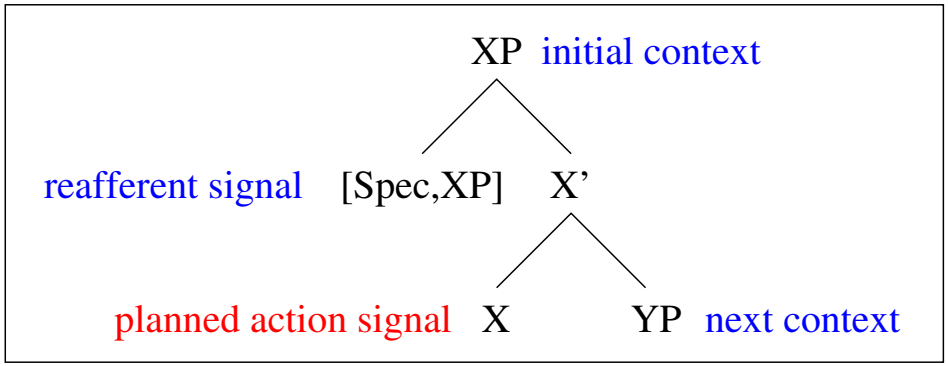

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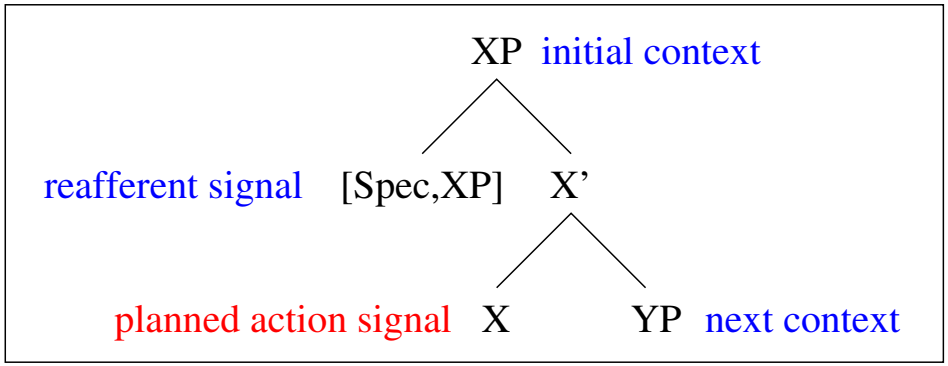

Linguists have difficulty defining the notions of 'specifier' and 'complement'. In the SM interpretation they are defined very clearly.

Right-branching structures of X-bar schemas

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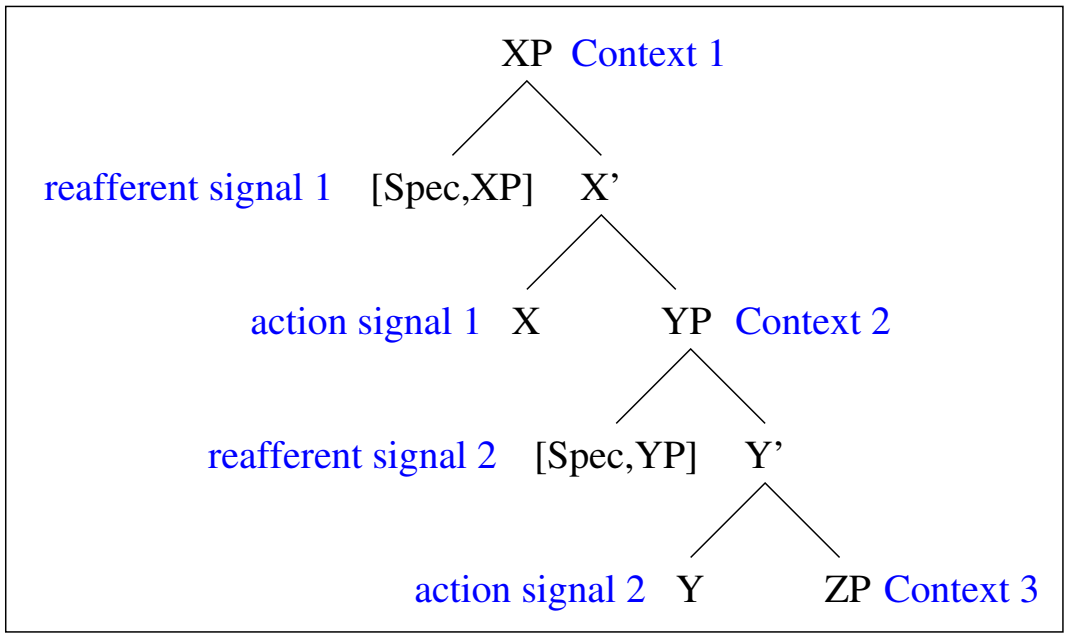
So by definition, a right-branching structure of XPs describes *successive iterations* in the sequence.



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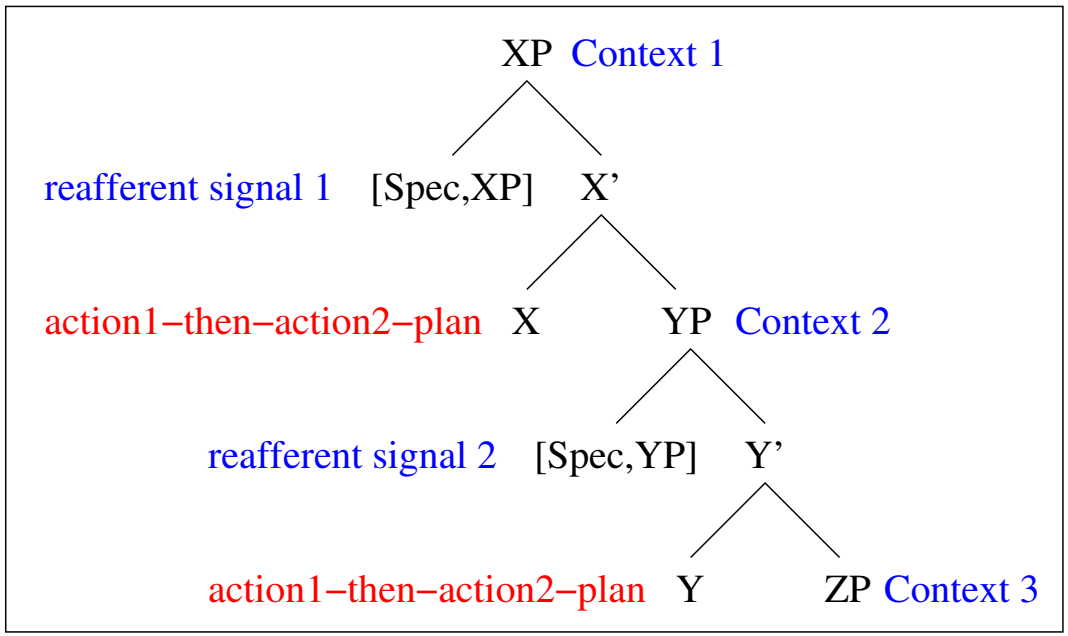
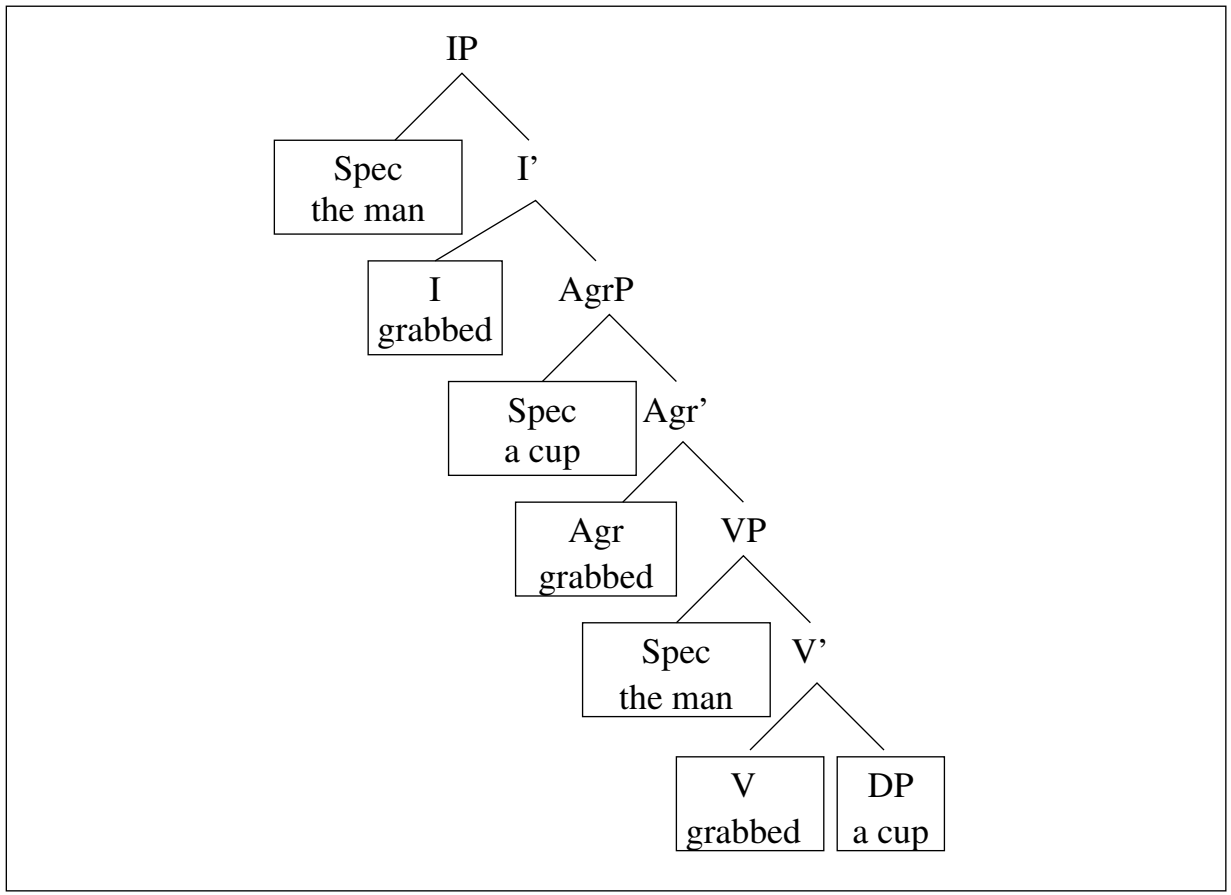


SM interpretation of a transitive clause

The four LF projections map onto the four stages of the SM sequence.



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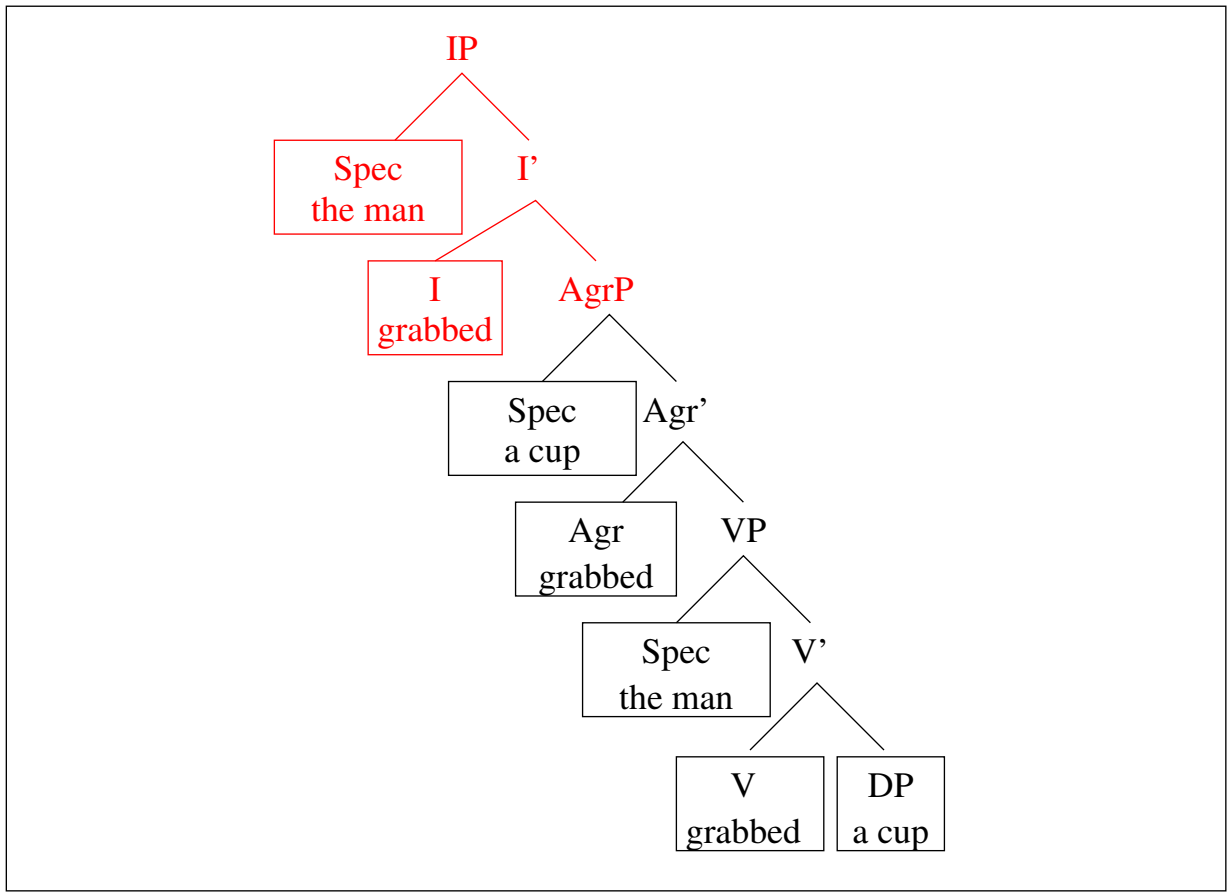

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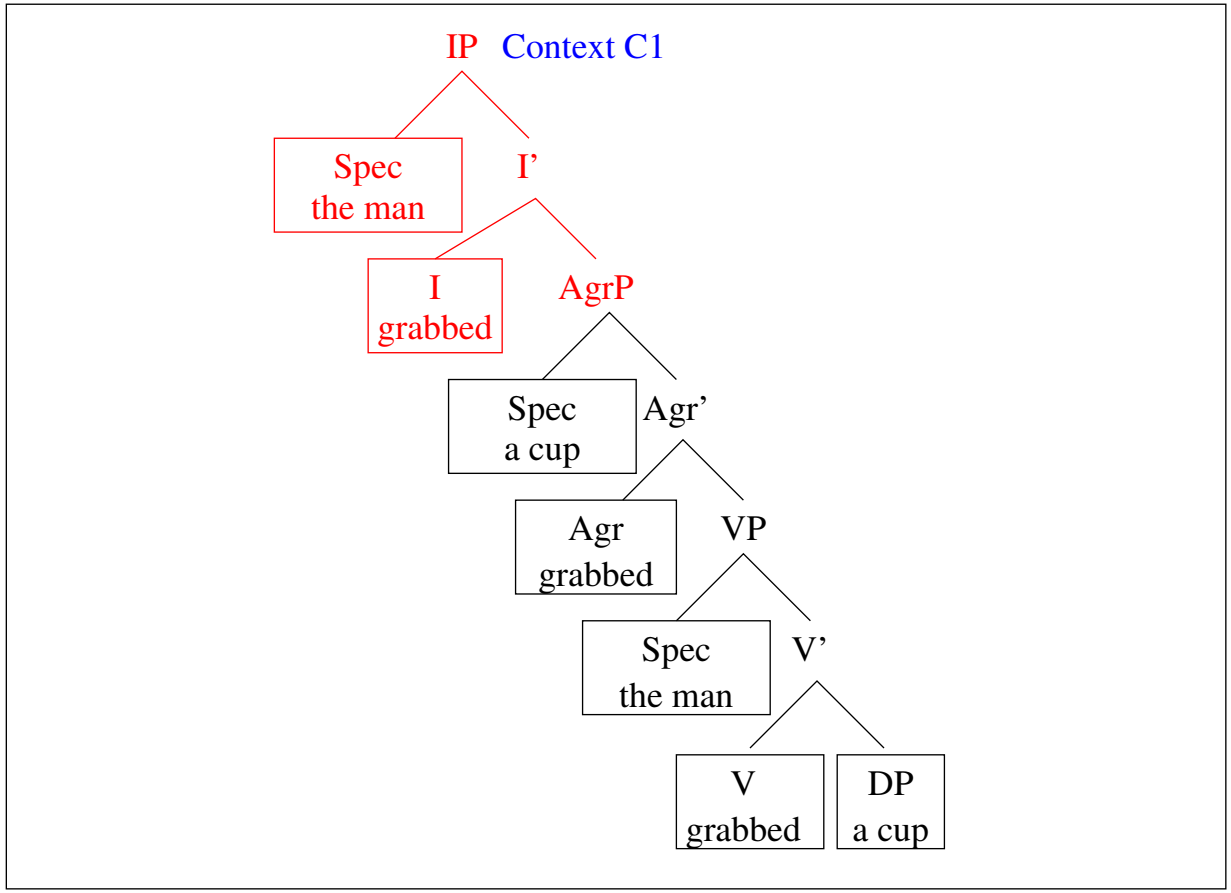

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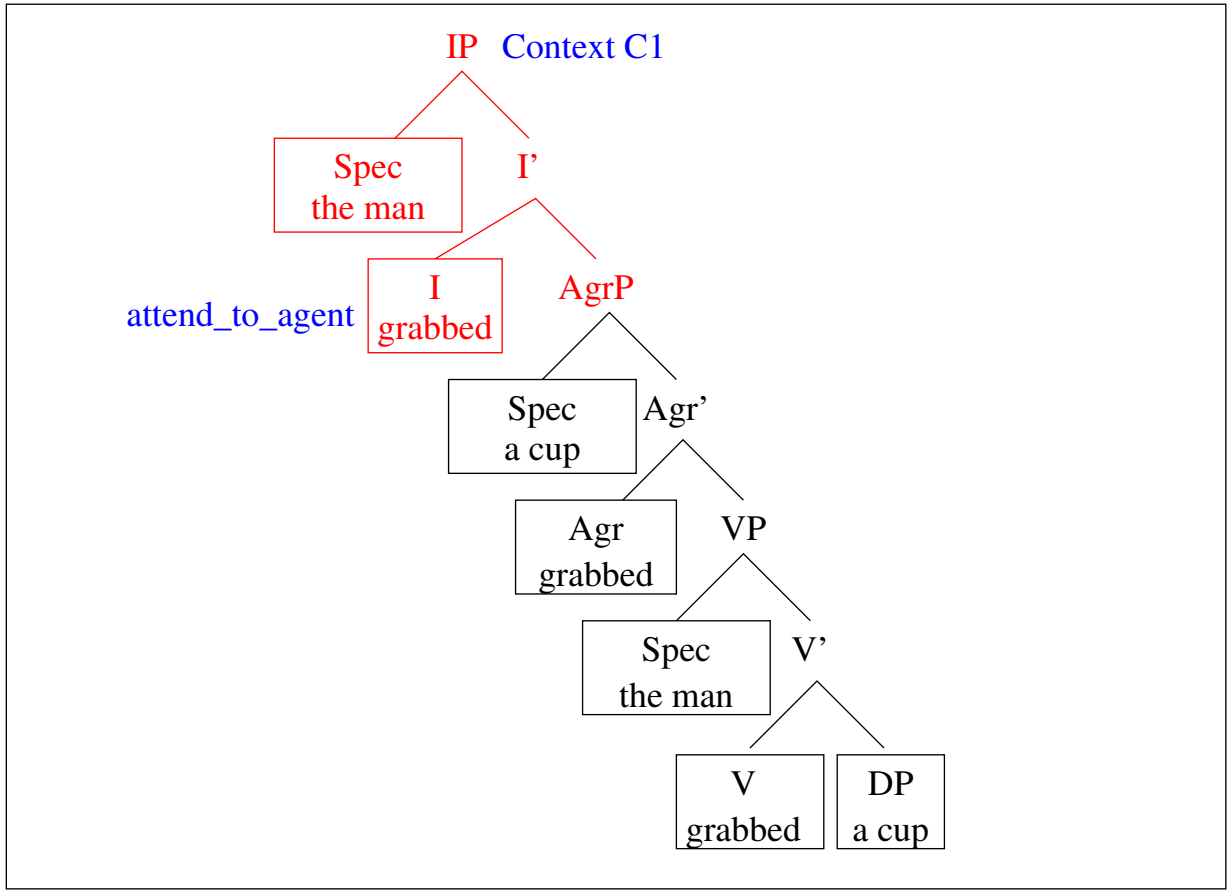

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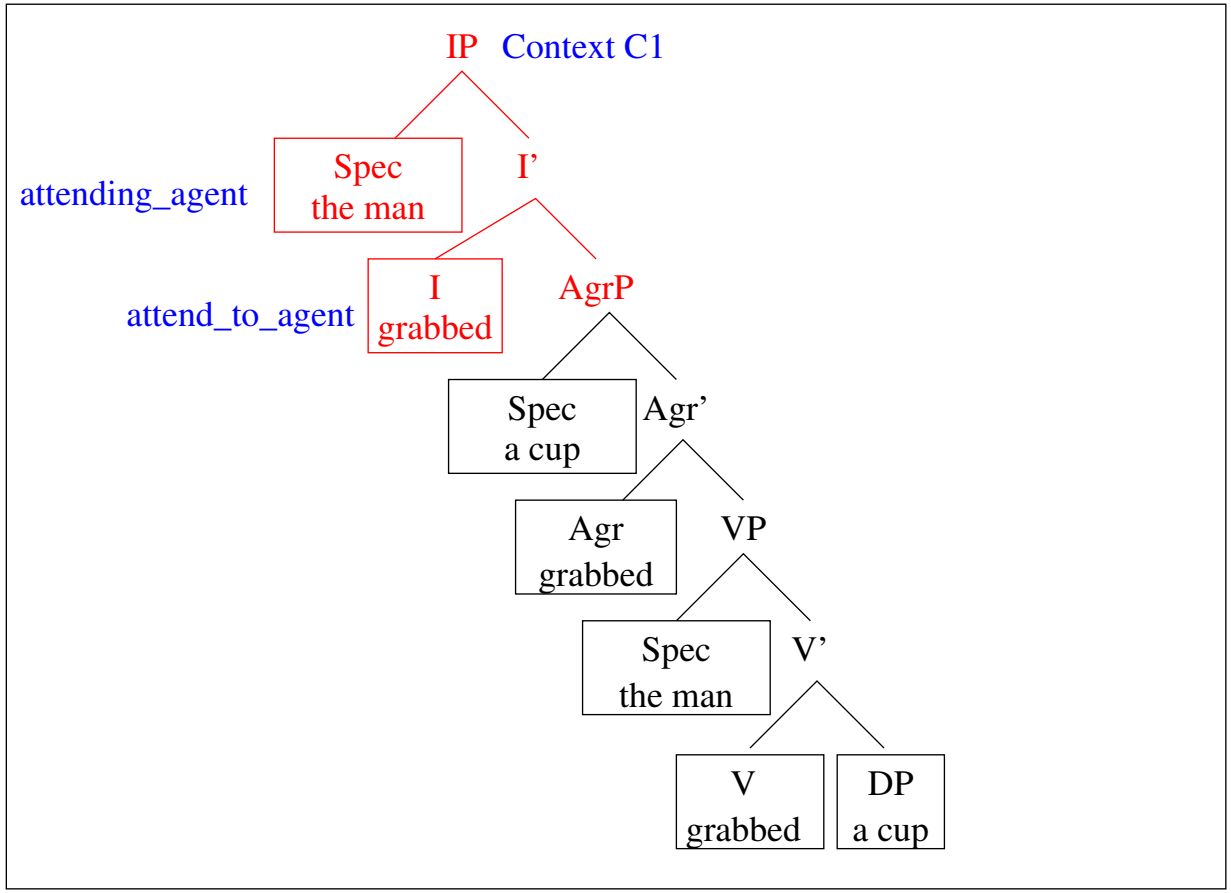

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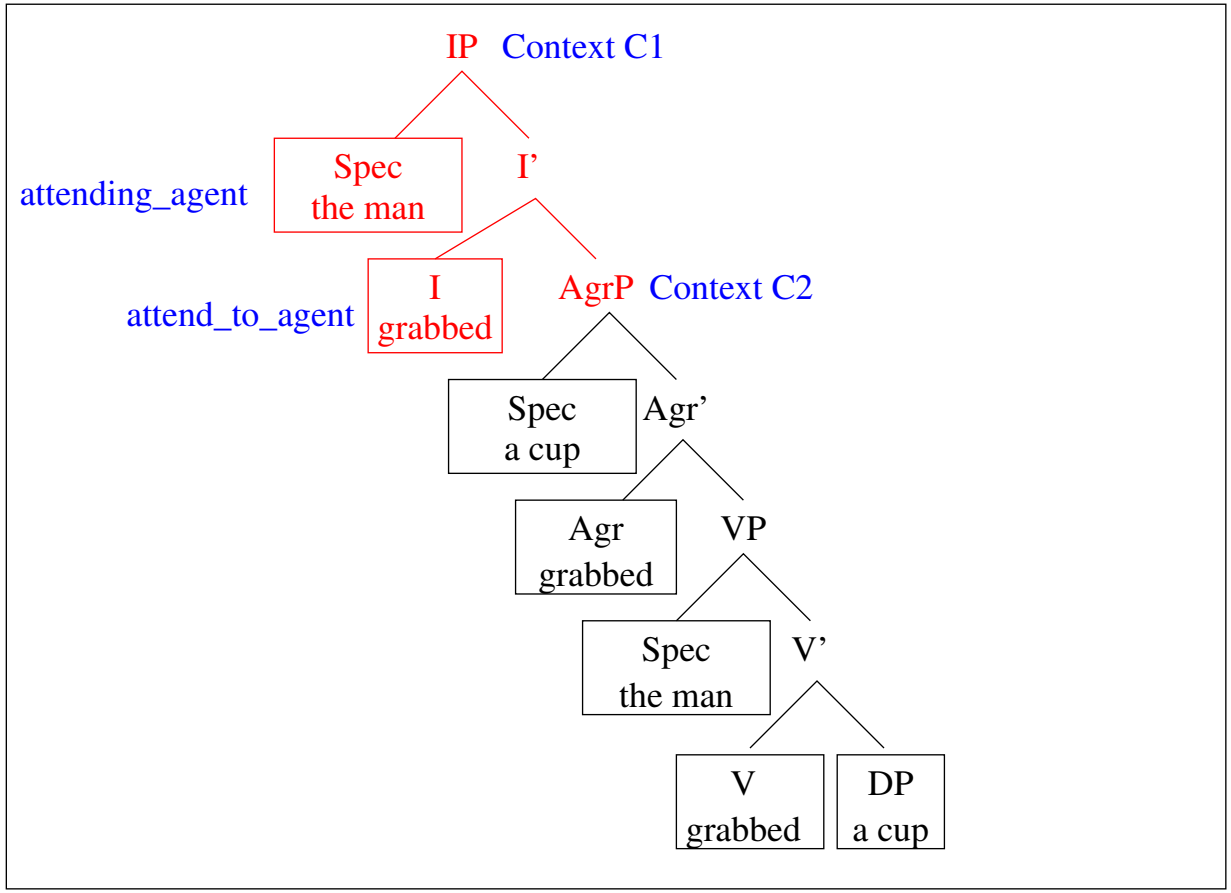

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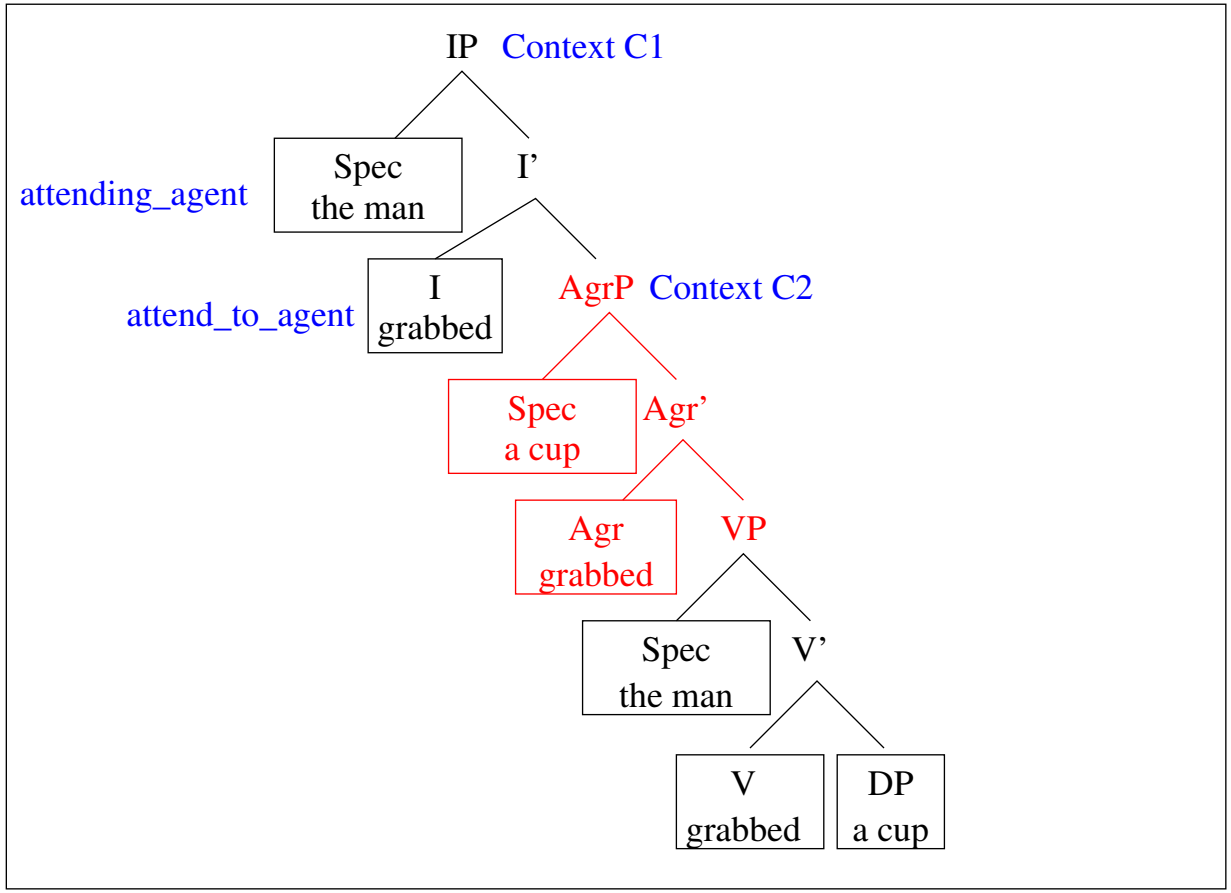

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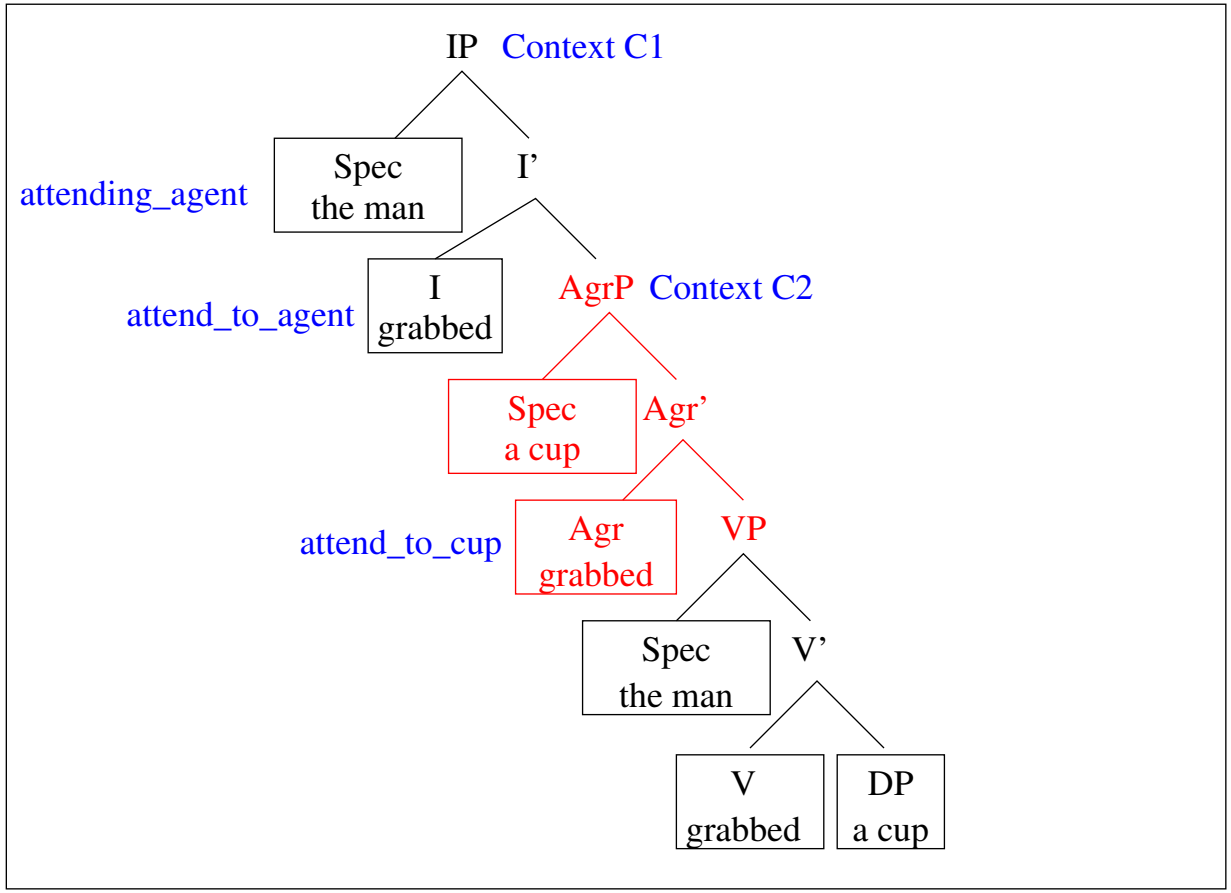

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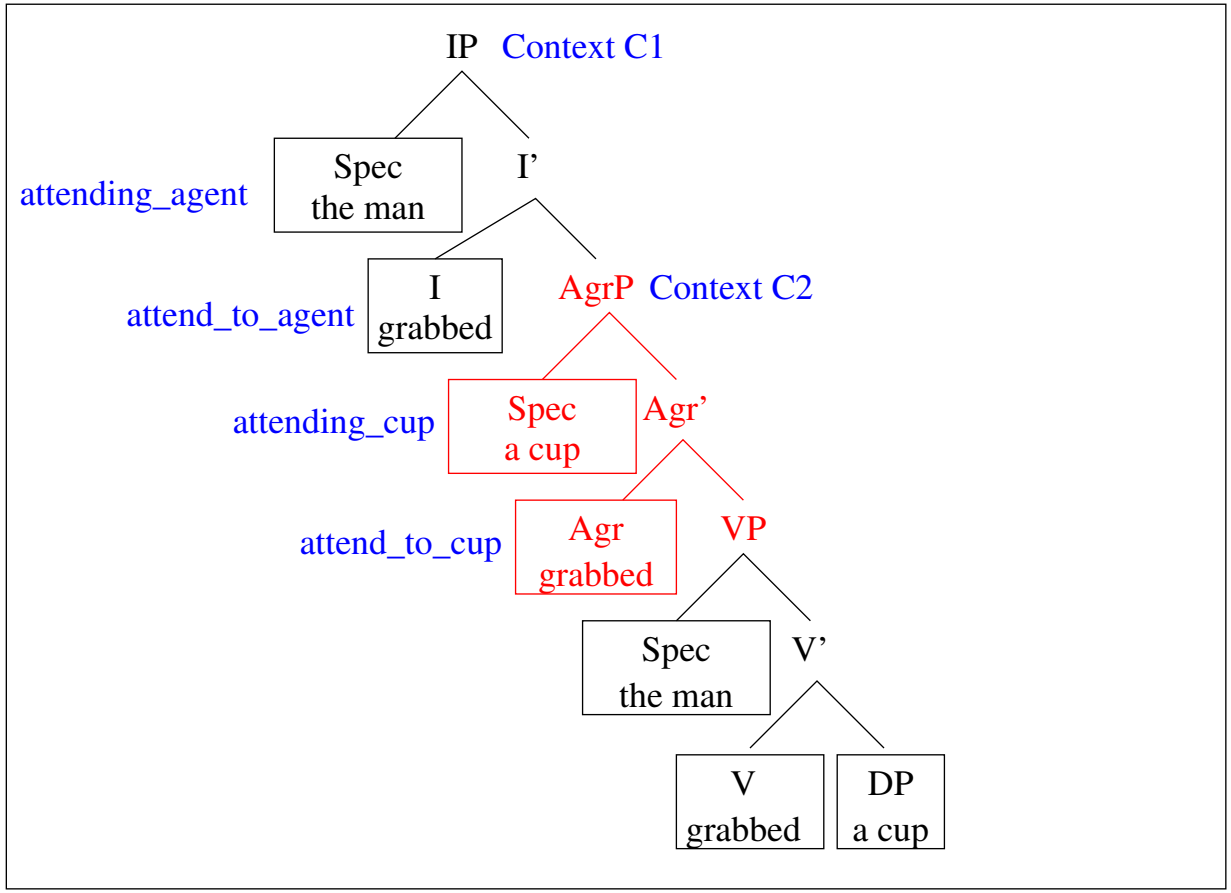

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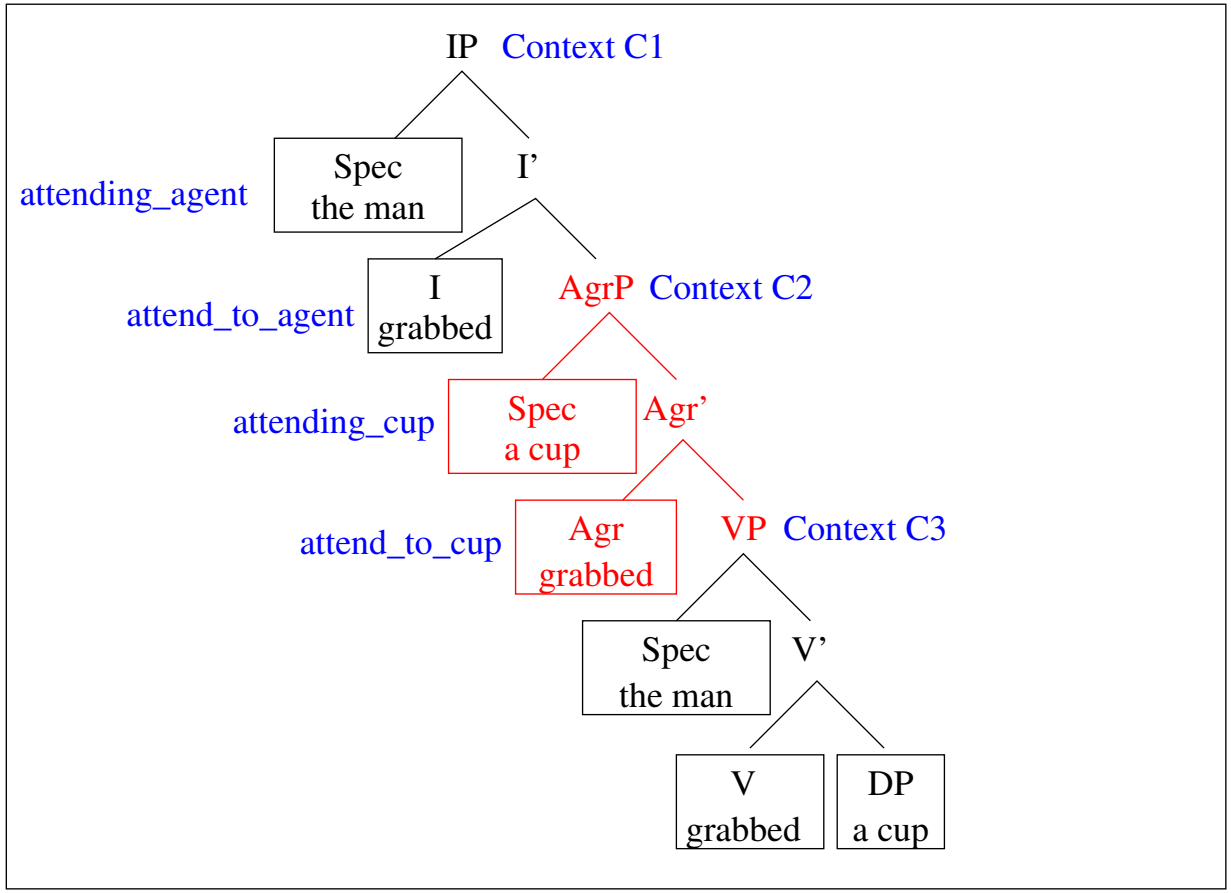

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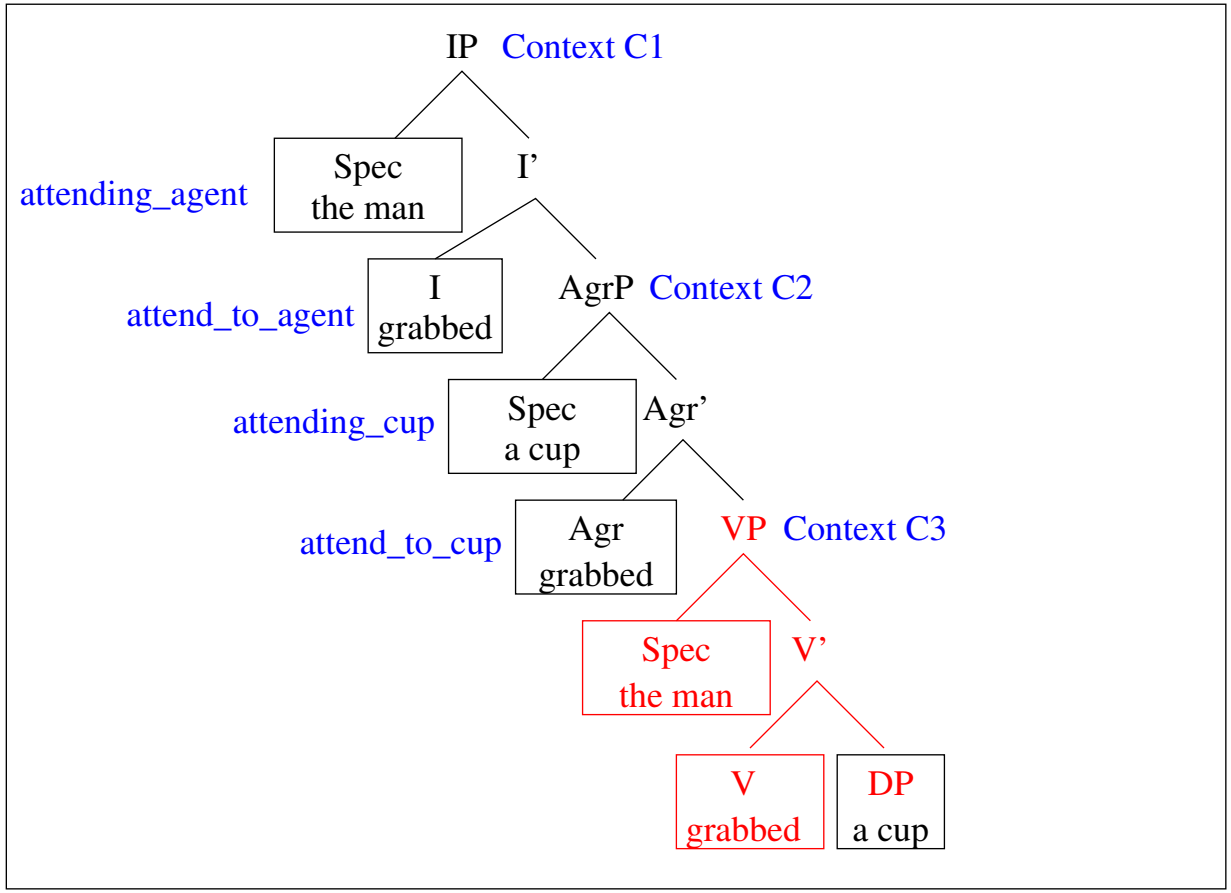

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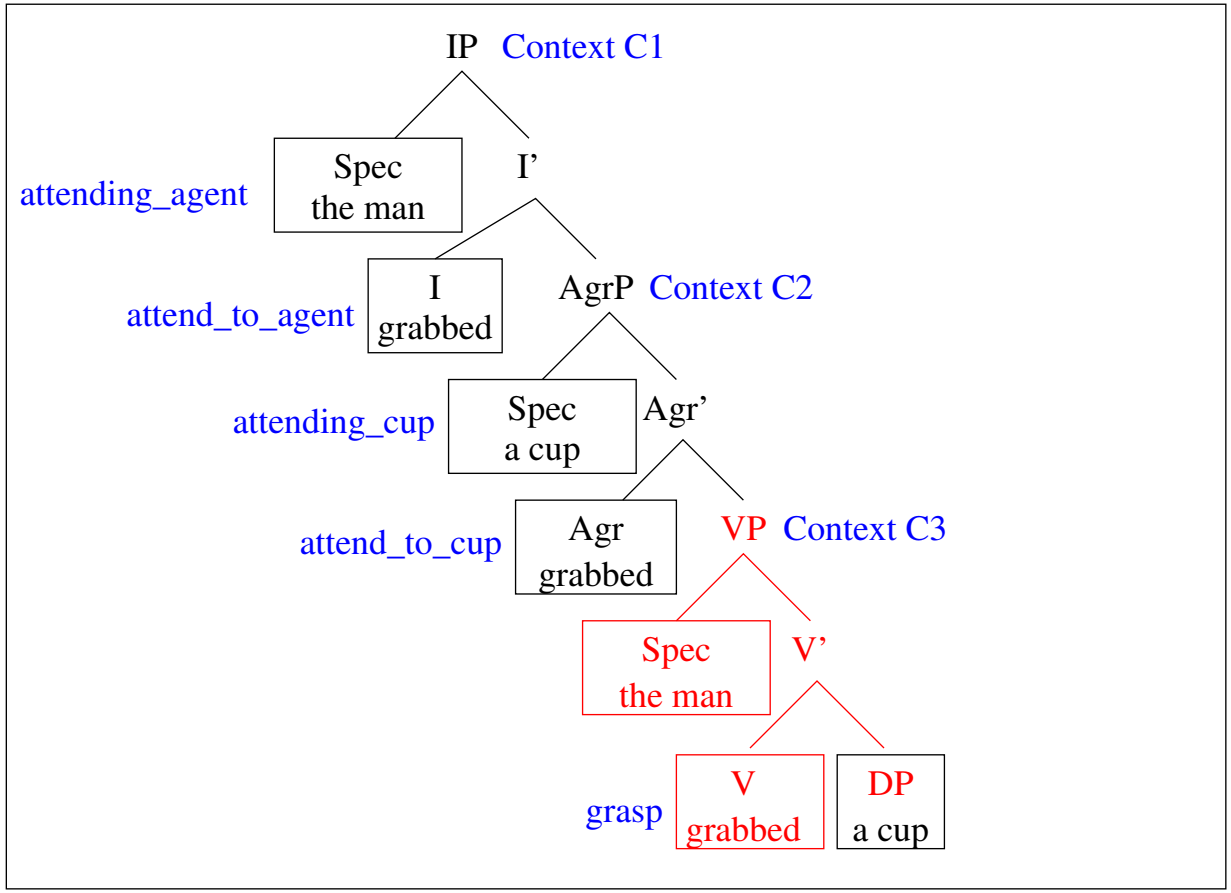

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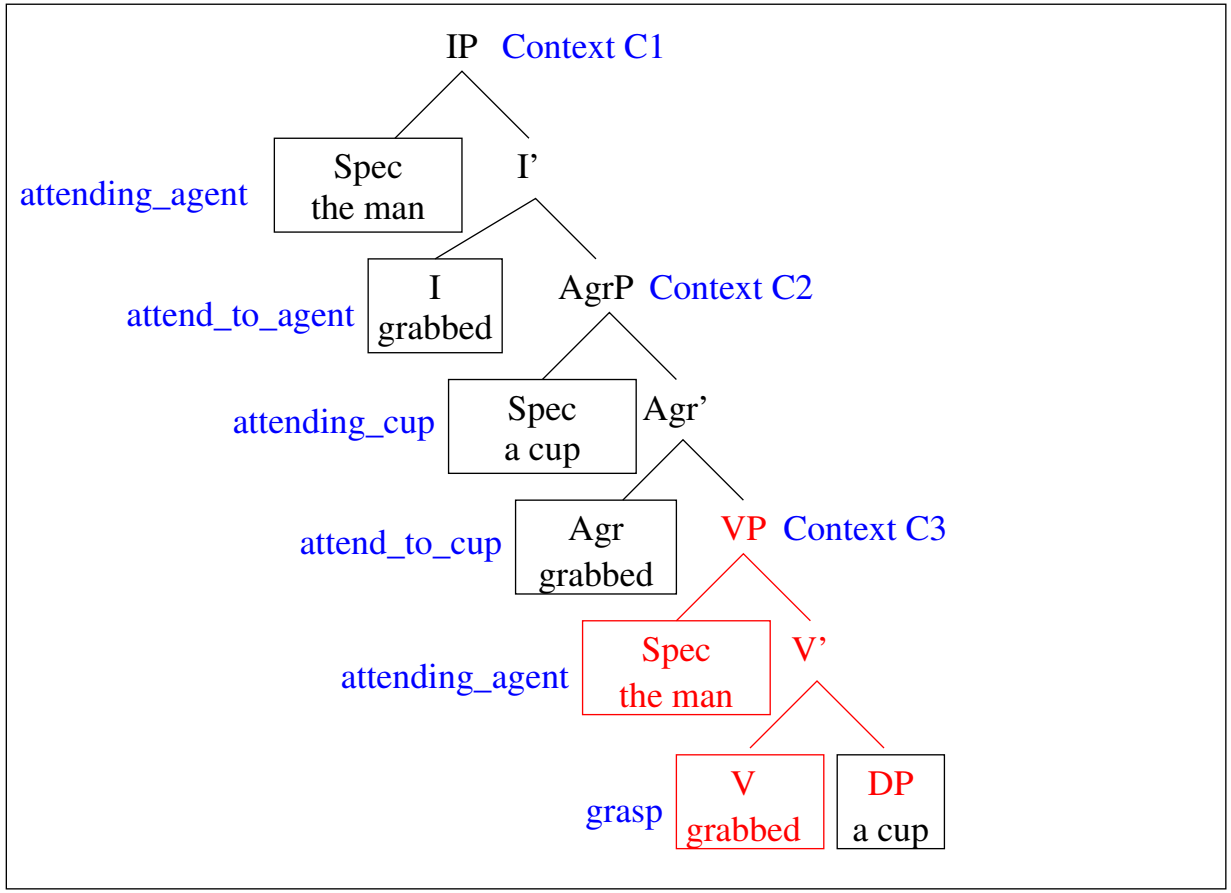

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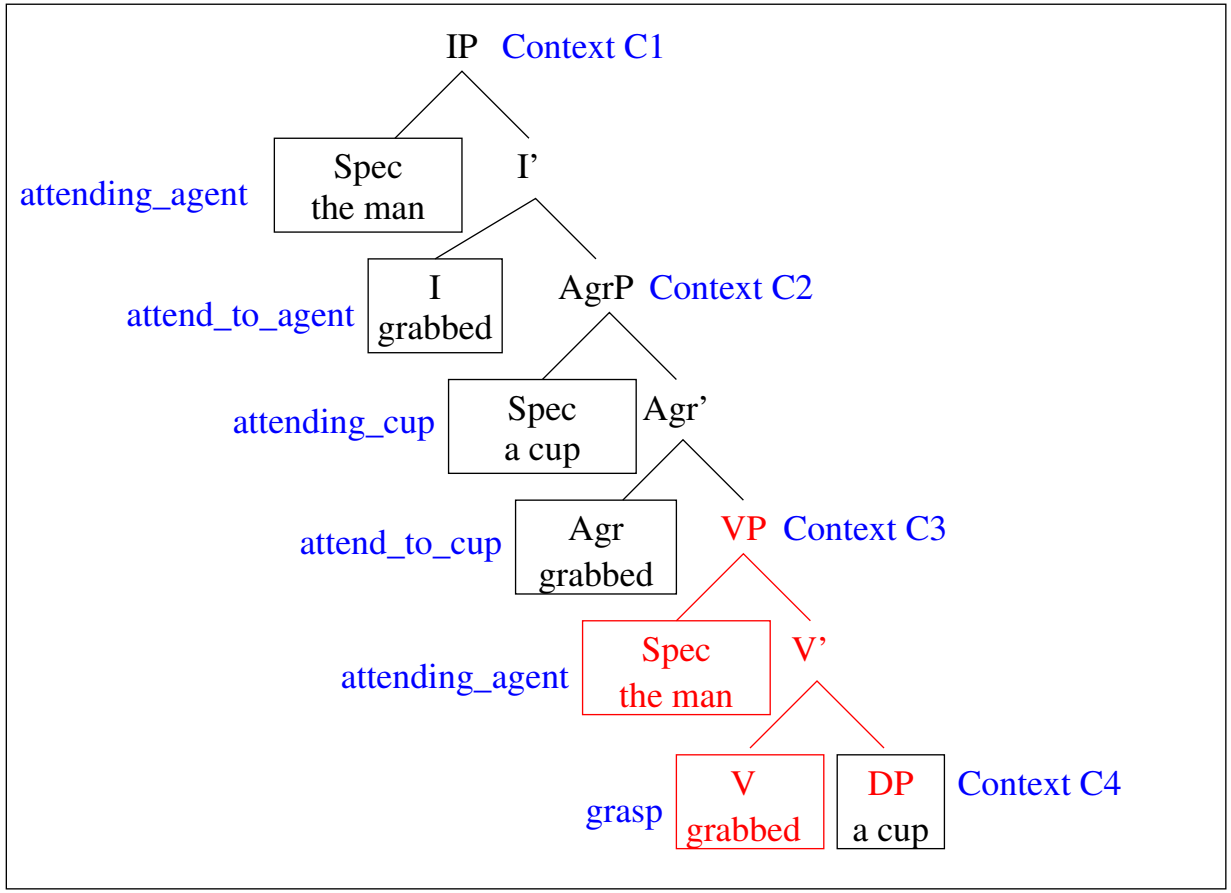

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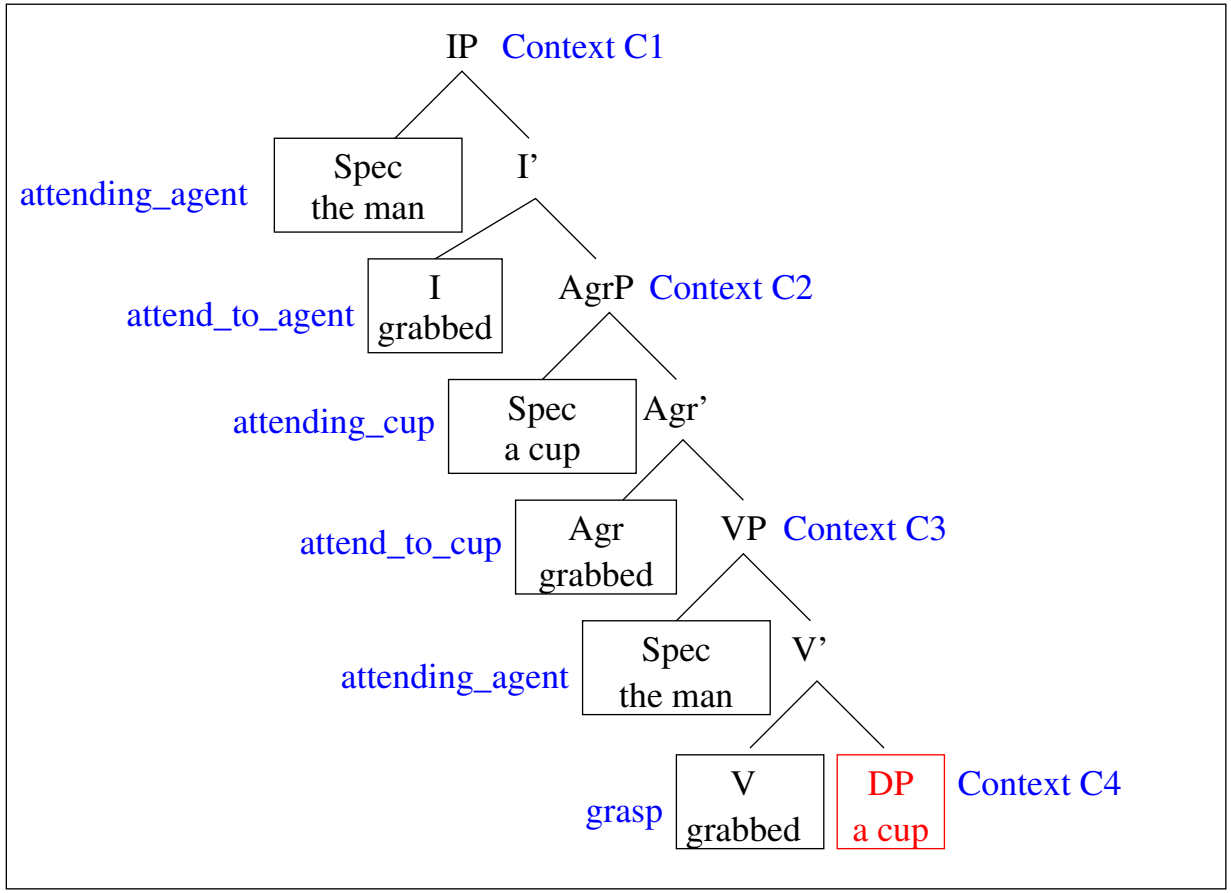

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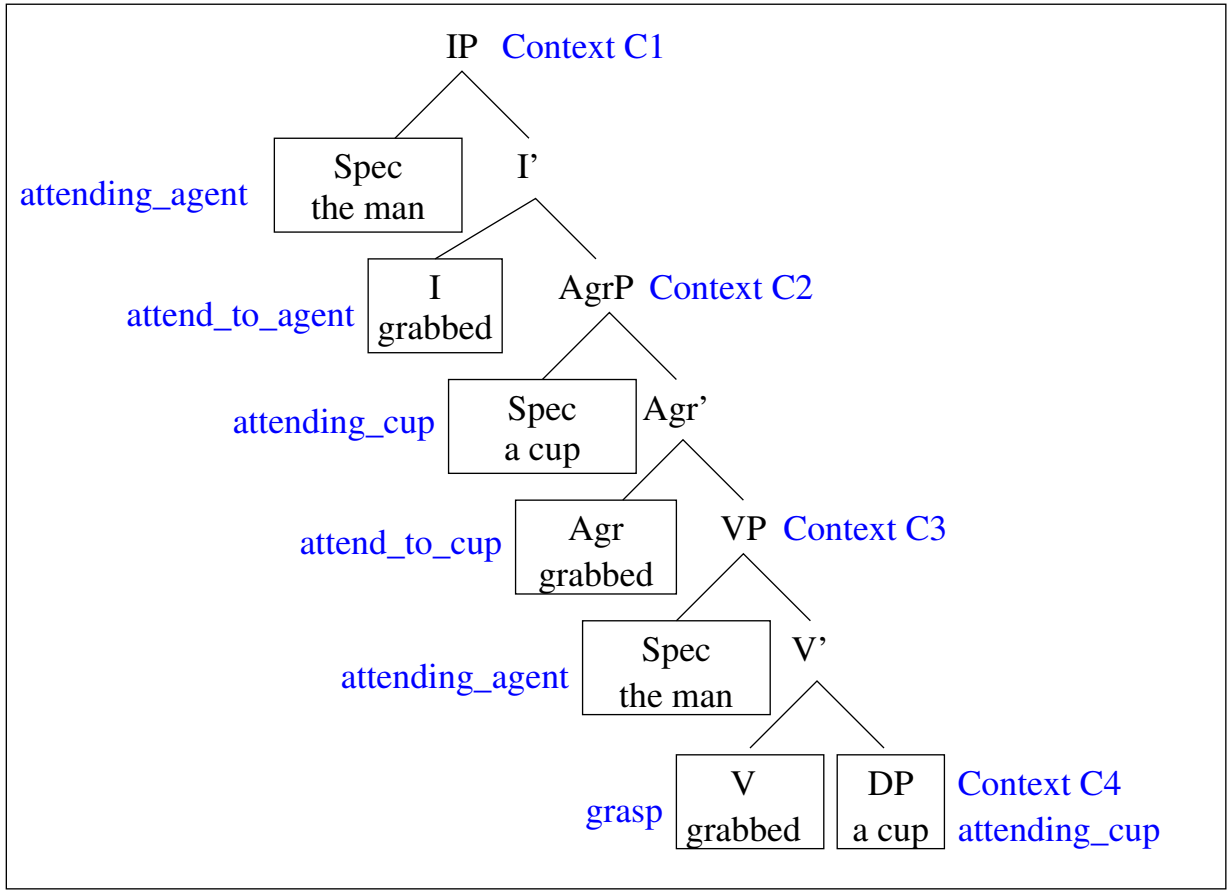

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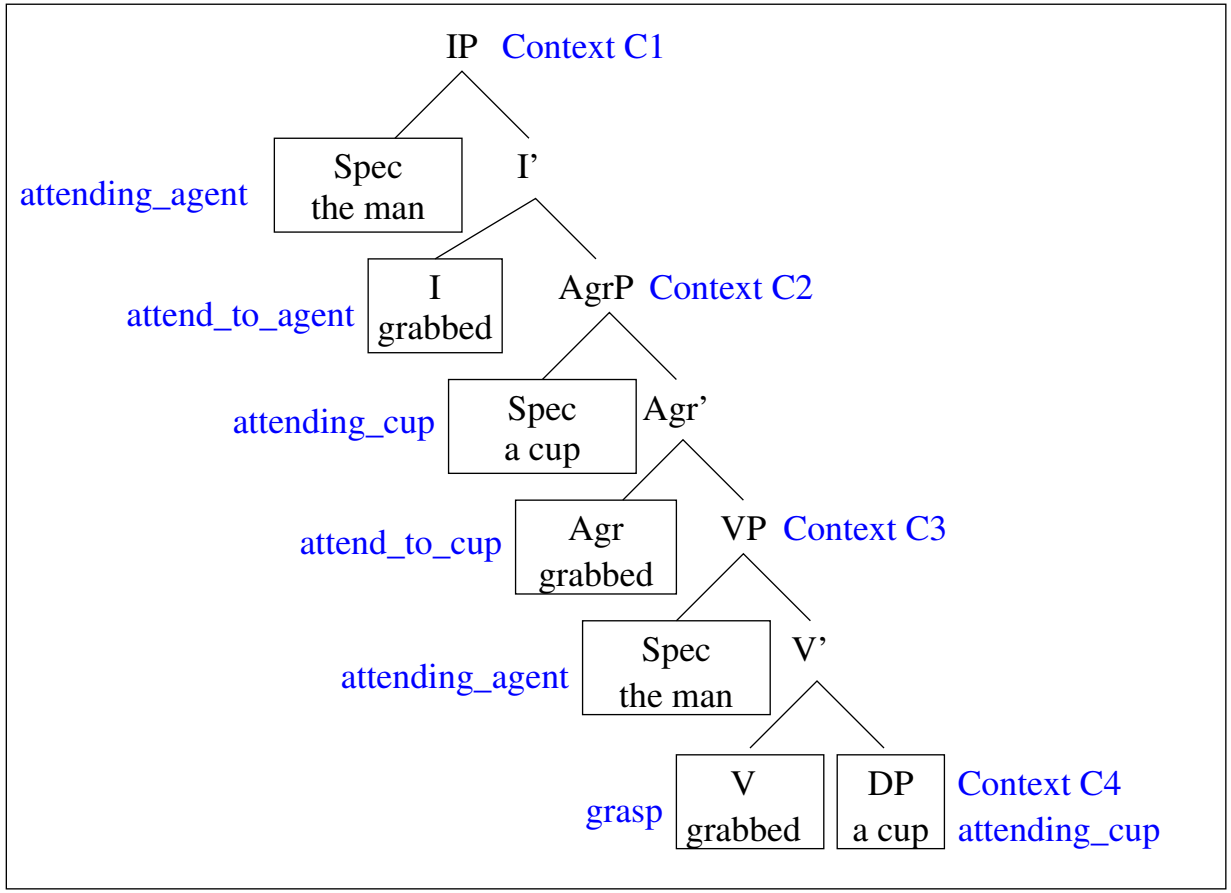
DP raising reflects operations of *re-attention to agent and patient*.



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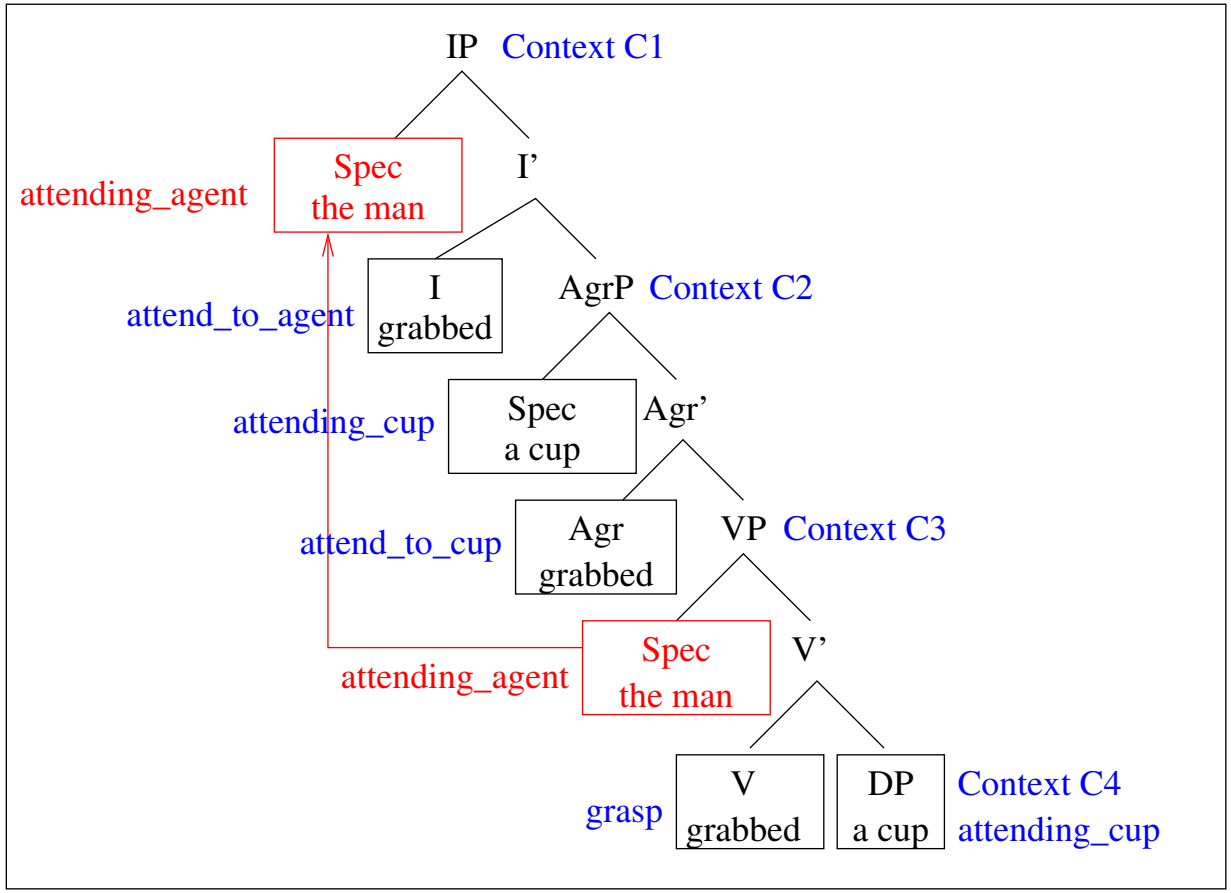

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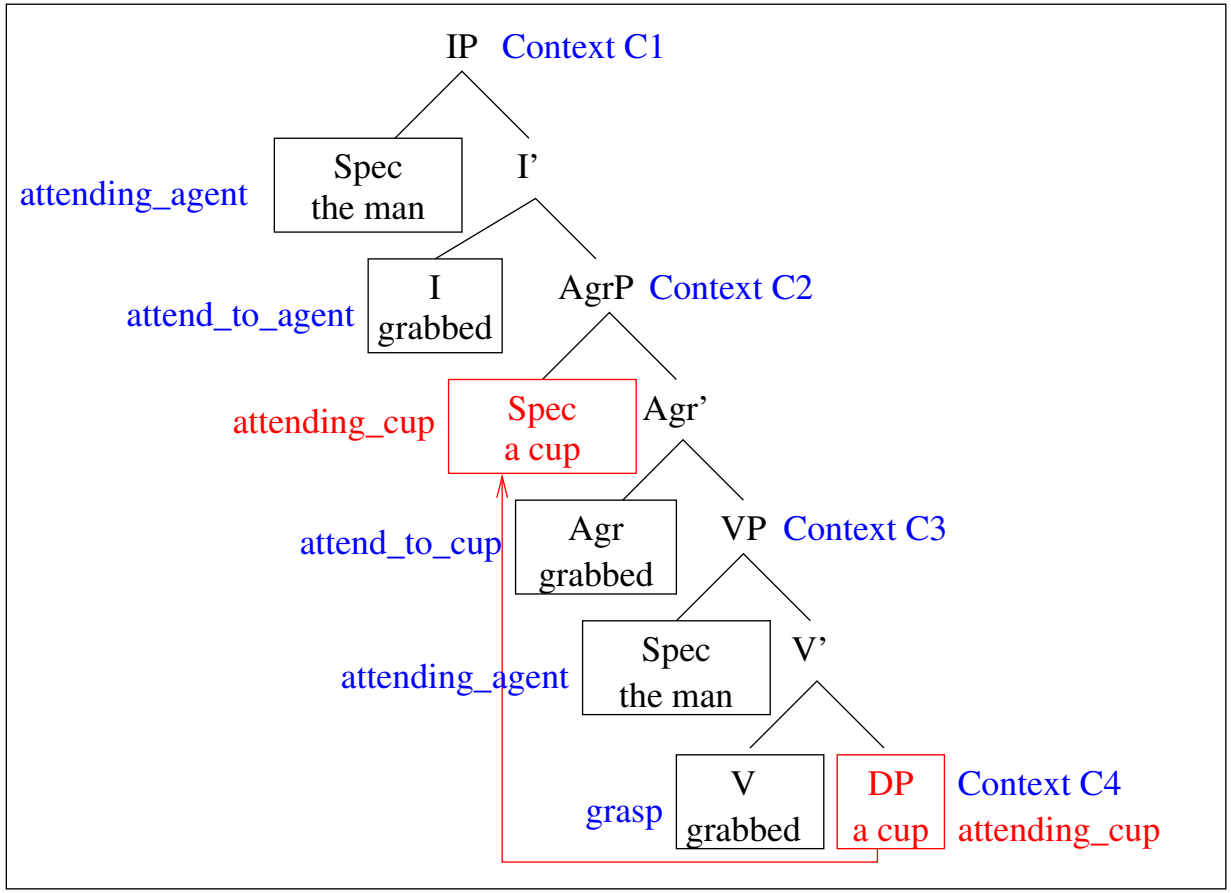

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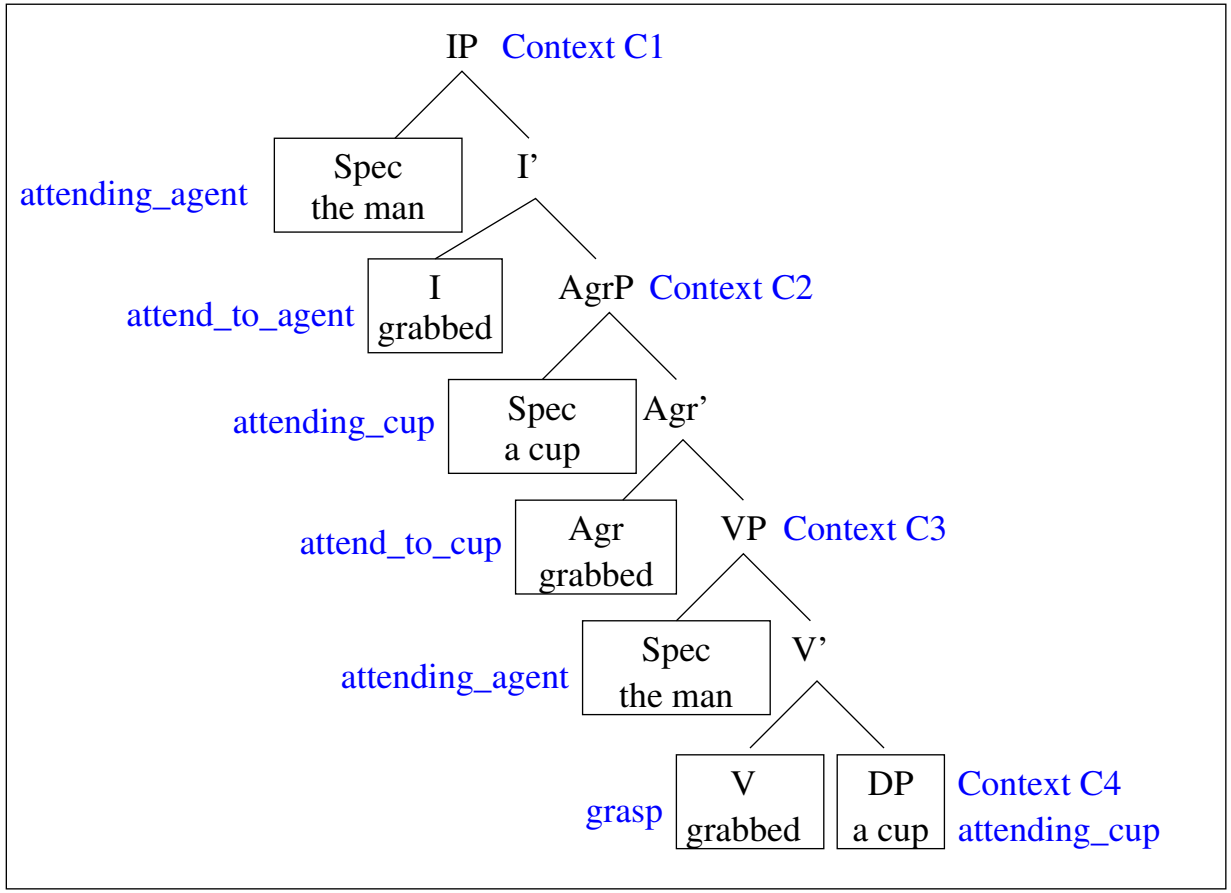

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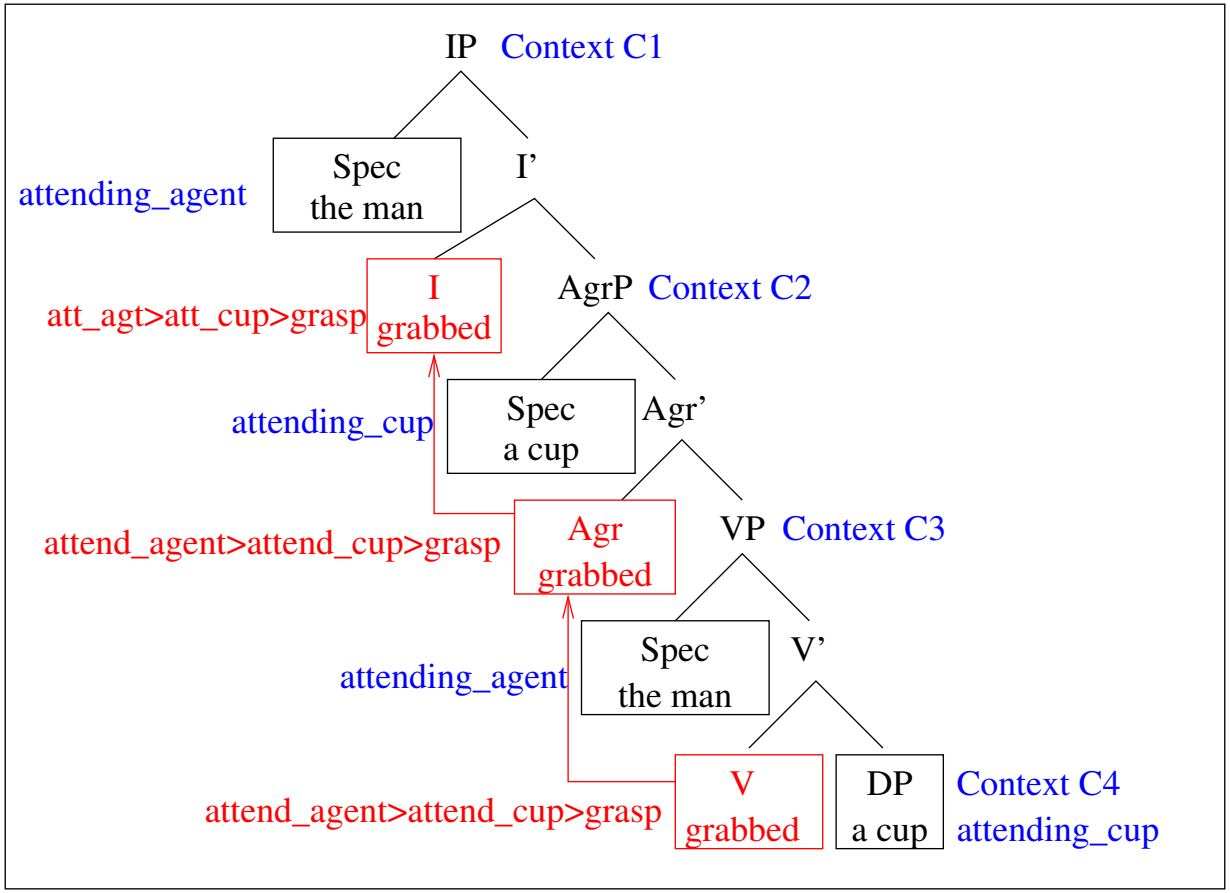

SM conceptions of thematic roles

In Minimalism, subject and object DPs are assigned thematic roles (AGENT and PATIENT) by the verb, within the VP.

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In the SM interpretation of LF, AGENT and PATIENT positions in the VP are associated with distinct motor representations of objects:

- AGENT is the representation of an object as a pattern of movement;
- PATIENT is the representation of an object as a motor affordance.

SM conceptions of DP-movement and Case

In Minimalism, there's a general principle that forces DPs to raise out of the VP to get 'Case'.

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In the SM interpretation of LF, there's an analogue of this principle:

- 'Objects have to be attended to as objects before they can participate in motor routines.'

SM conceptions of head movement

In Minimalism, the V head has to raise to each successively higher head position in the clause in turn.

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In the SM interpretation of LF, there's a SM analogue of this principle:

- Verbs (and their inflections) are linguistic signals of tonically active *planning representations*, rather than of transiently active motor representations.

A reality check

This model makes some concrete proposals about the semantic contributions of different types of lexical/morphological item.

- A verb stem like *grab* contributes a (planned) motor operation.
- An agreement inflection like ‘first person singular’ contributes a (planned) attentional operation.
- A DP contributes the reafferent sensory consequence of an attentional or motor operation. [First approximation.]

Do these make sense?

Some assumptions

These proposals can be thought of as hypotheses about connections between SM/WM areas and surface linguistic forms.

Planned motor operations	Planned attentional operations	(Pre)motor operations	Attentional operations	Reafferent sensory consequences of attentional operations	Reafferent sensory consequences of motor operations	Context repres– entations

Some assumptions

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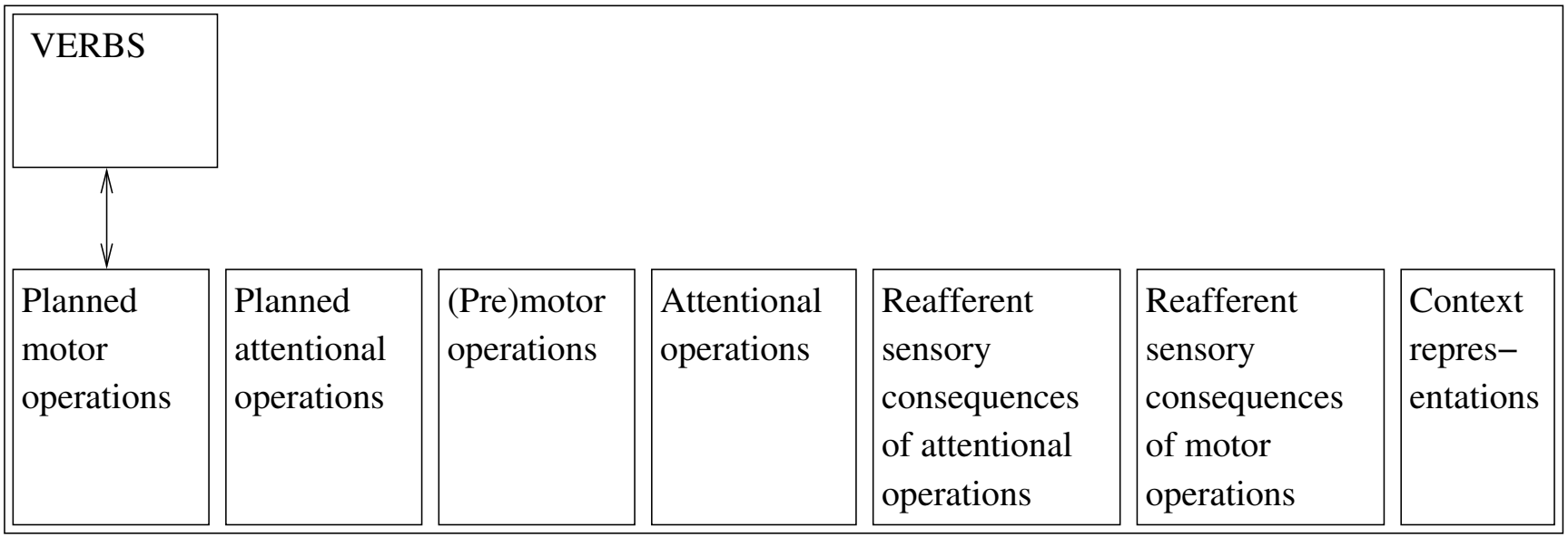

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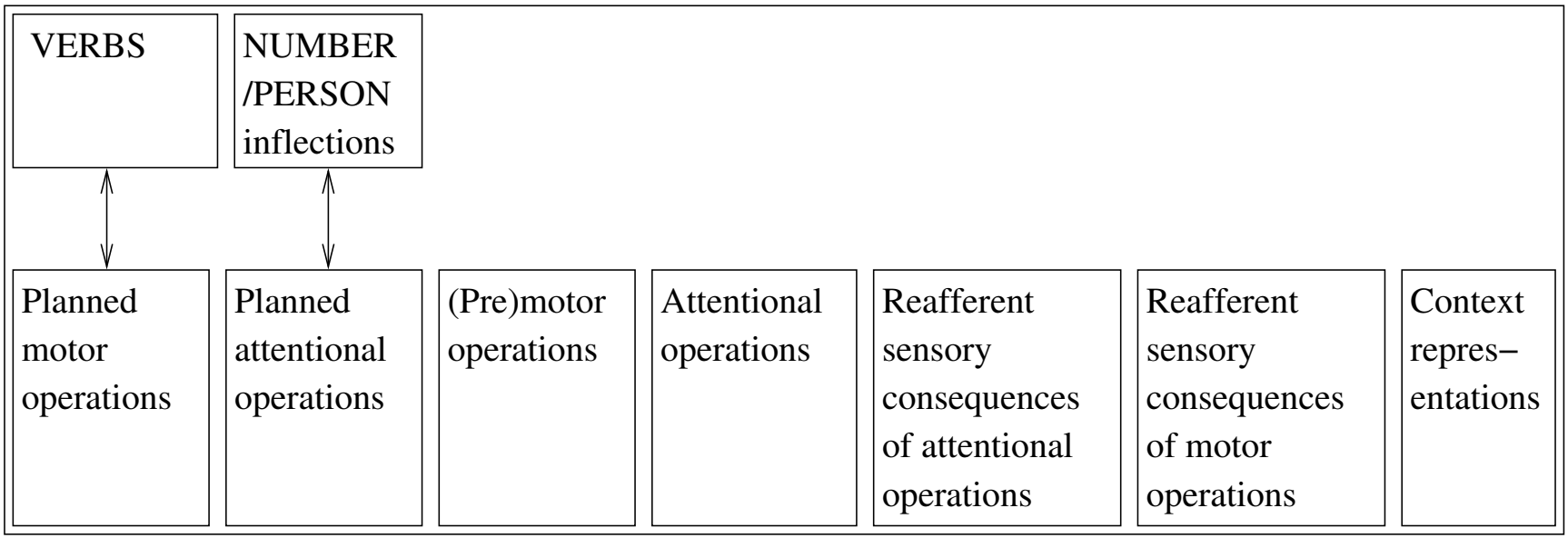

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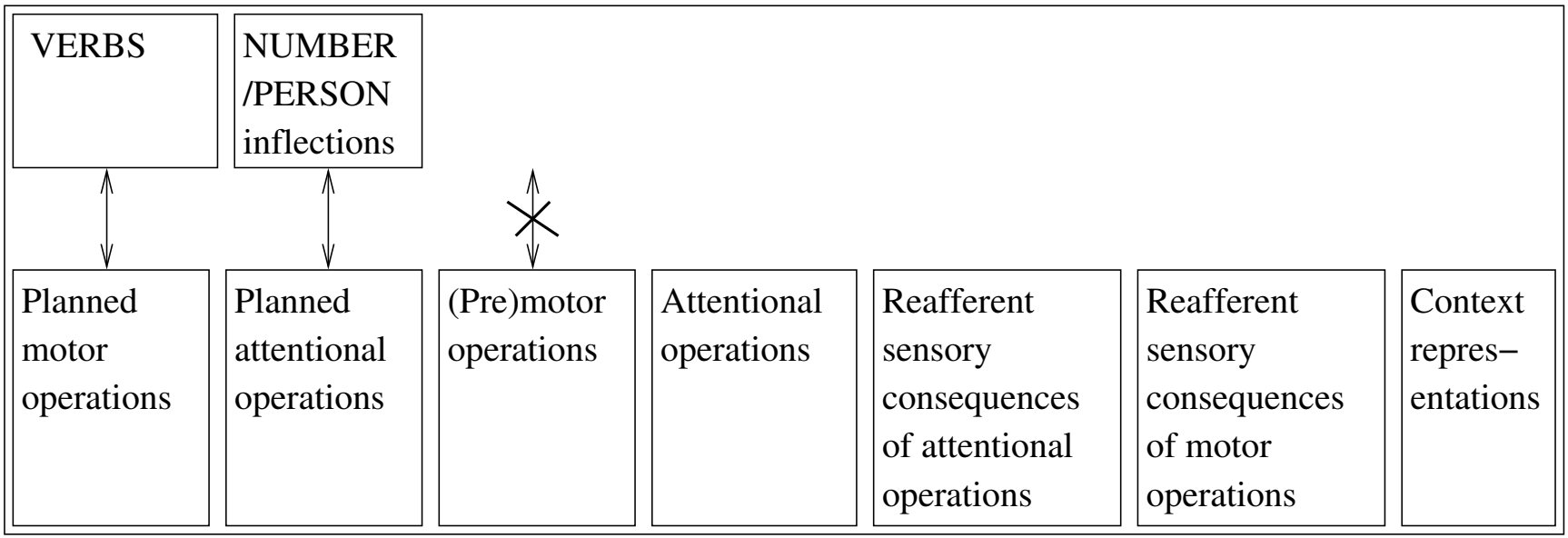

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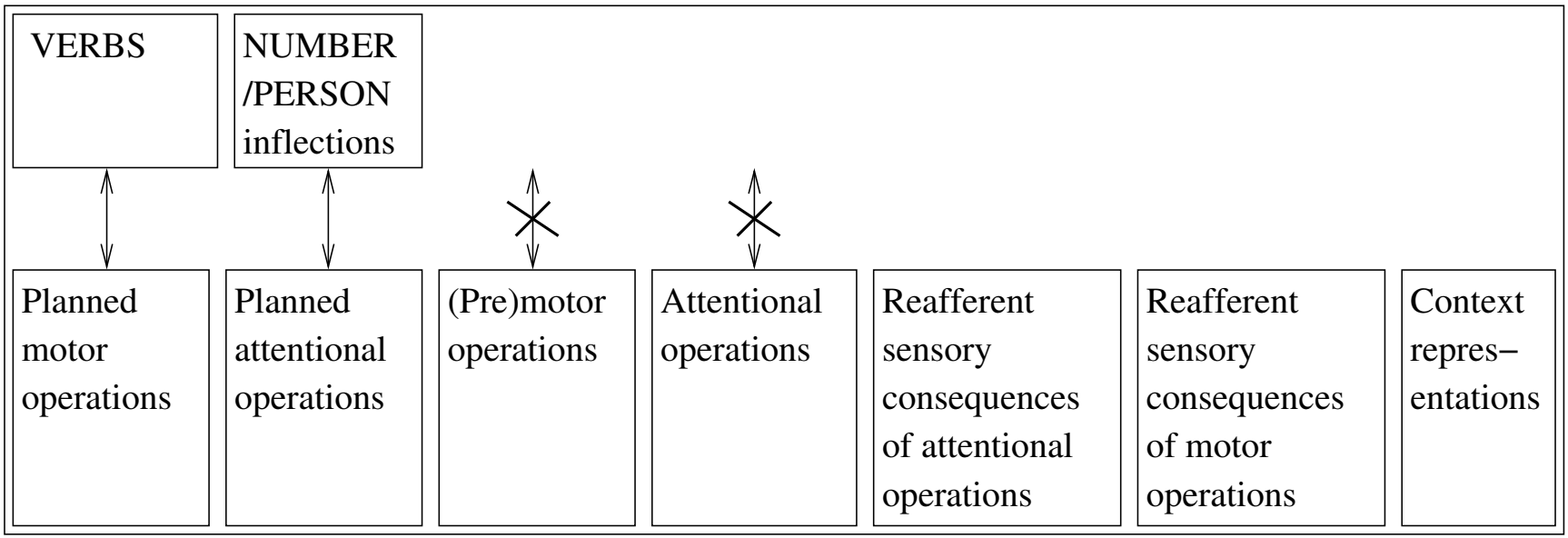

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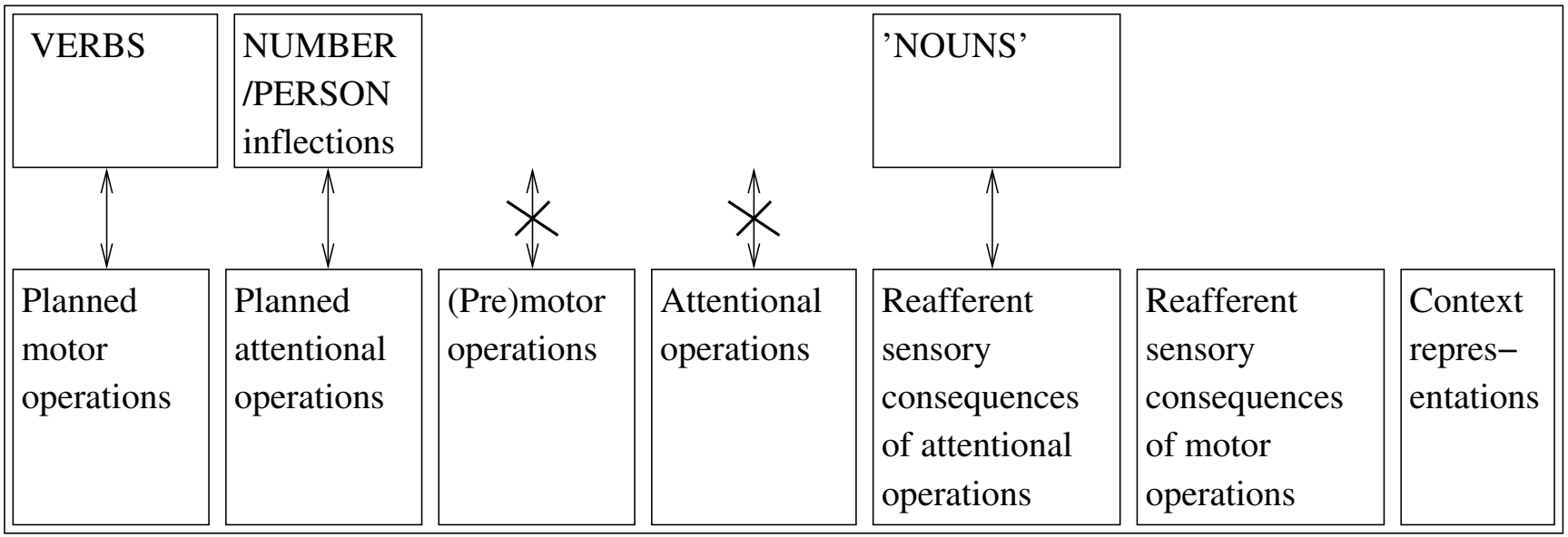

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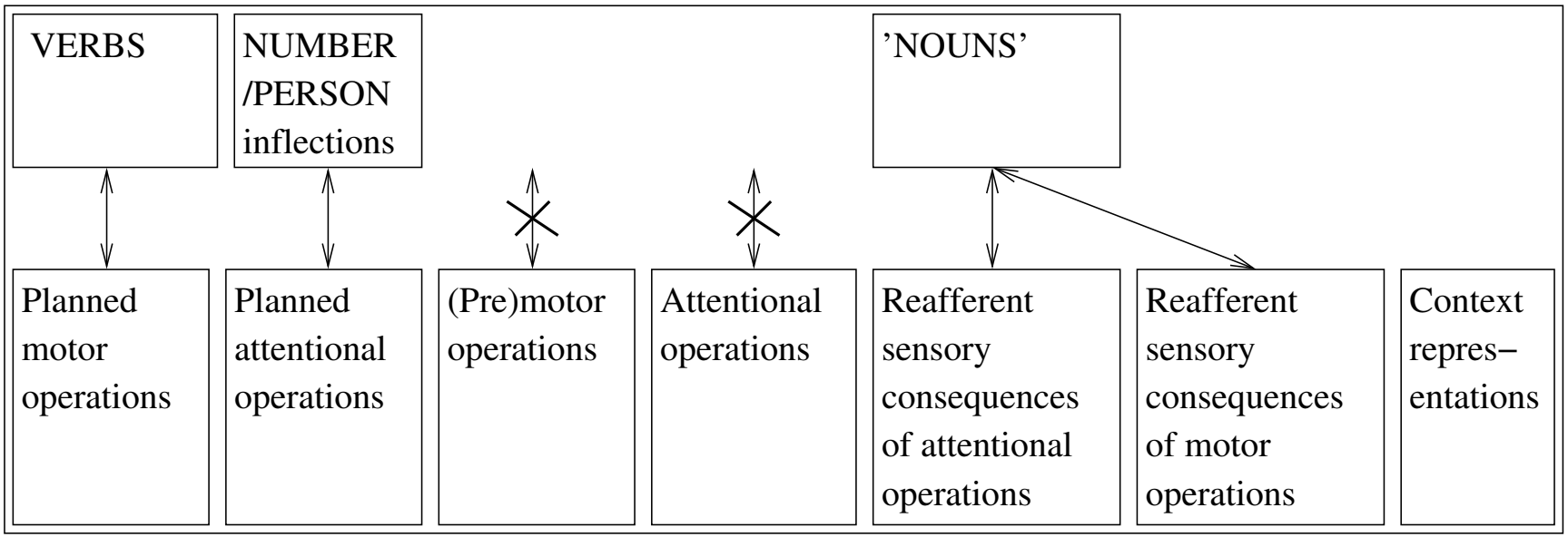

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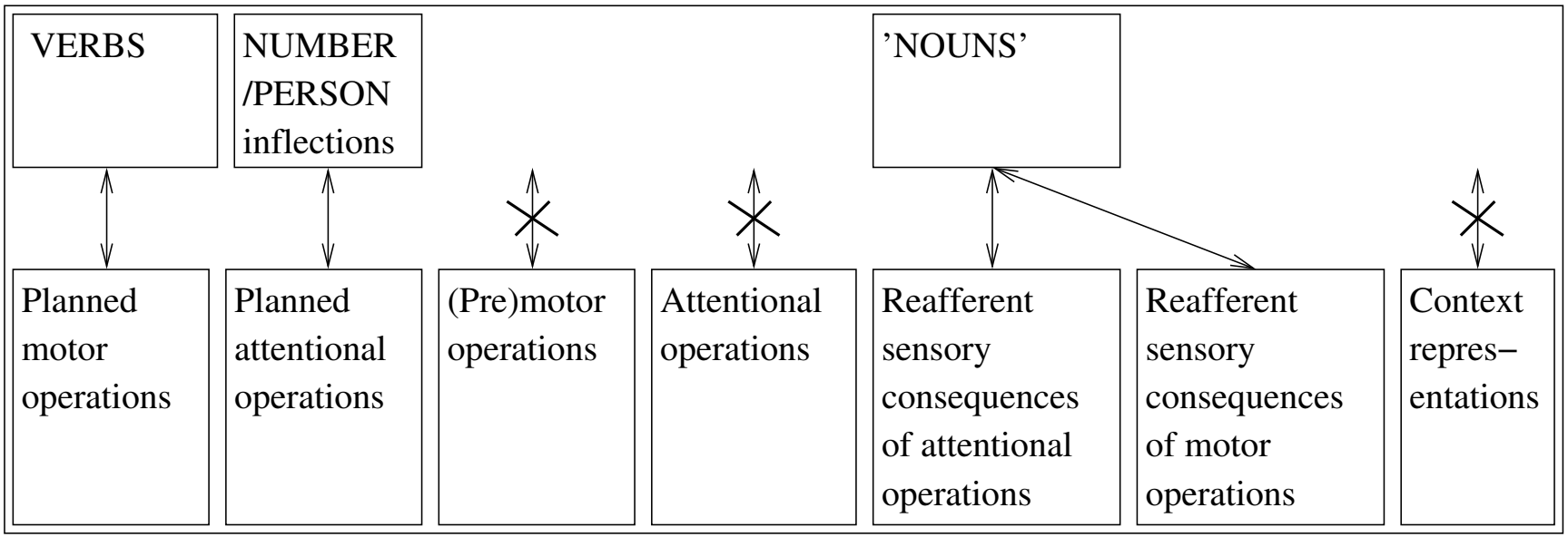

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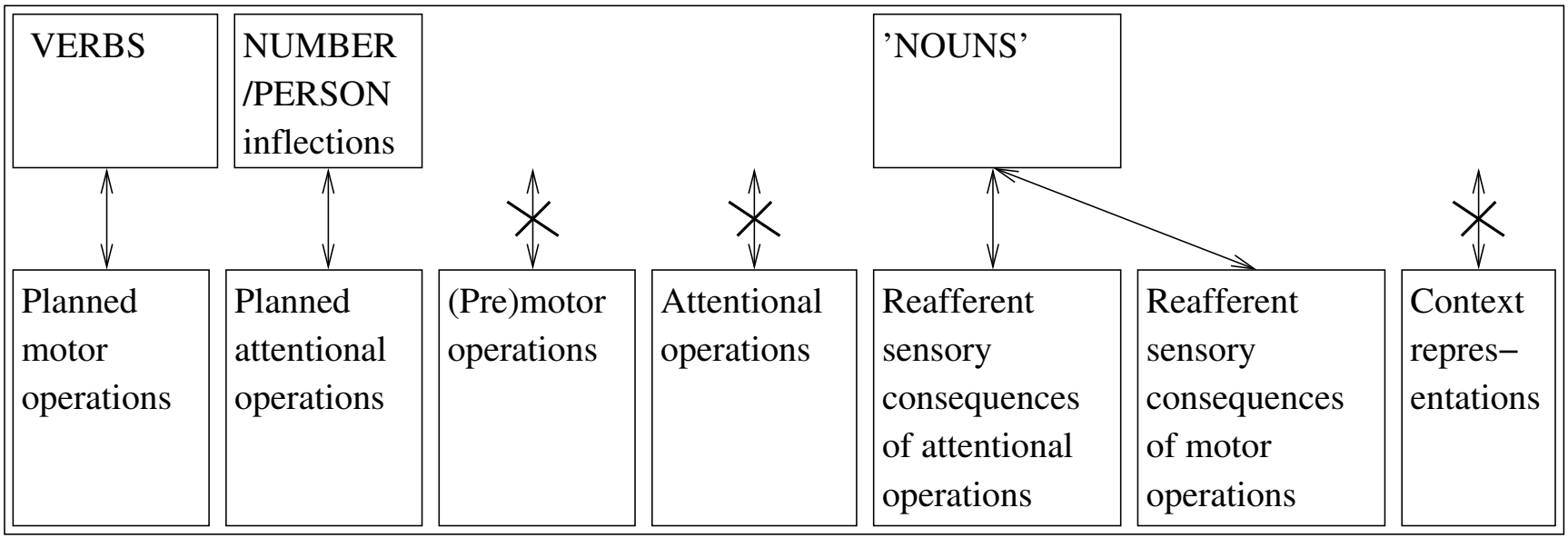

Idea: these are the basic interfaces which evolution happened to find.

Towards a model of sentence processing

I've proposed a SM interpretation of (parts of) Minimalism.

Remember: one criticism of Minimalism is that it's just a model of 'syntactic competence': it doesn't have anything to say about *sentence processing*.

Note that the SM interpretation of Minimalism allows a very natural account of sentence processing as well.

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In the next lecture, we'll look at connectionist models of syntax / sentence processing.