Scope in an incremental context

Lecture 5: representation and computation

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WARNING: Every linguist speculated about a phenomenon.

Part 1: the time course of processing

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  - Language model expectation (less frequent = more effort; a . . . Statistics Fairy?).

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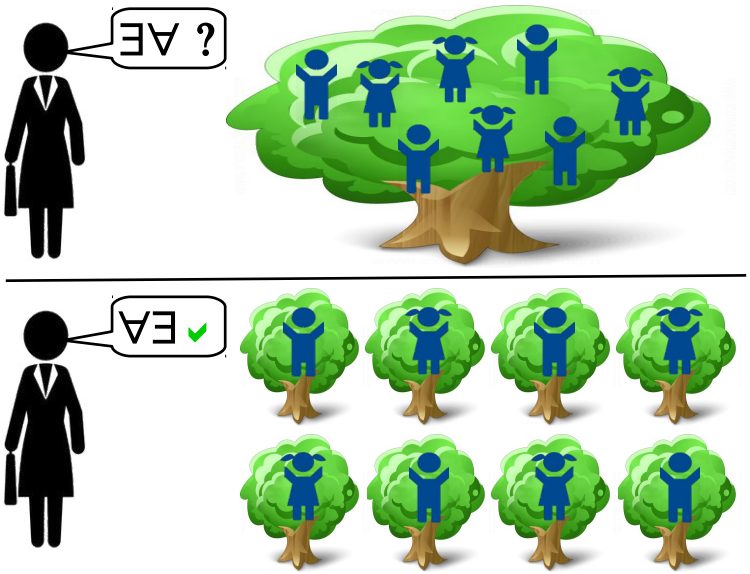

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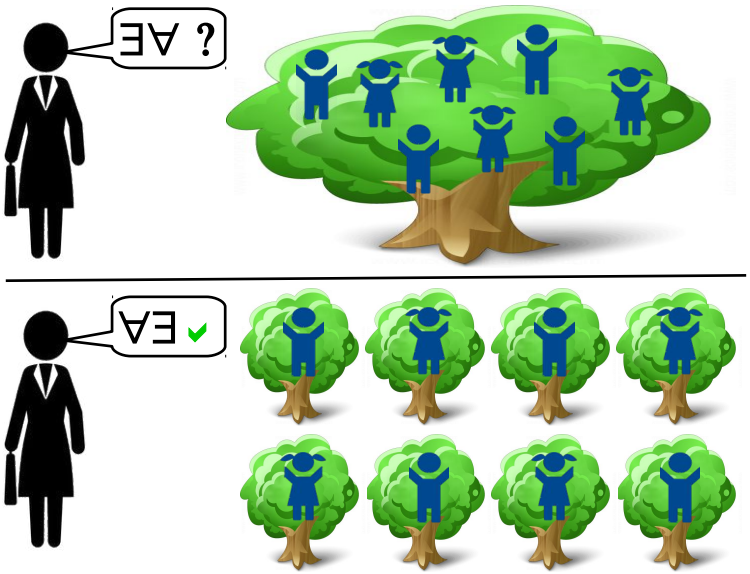

Perhaps we can use the creation of expectations about set cardinality to investigate what is "really going on".

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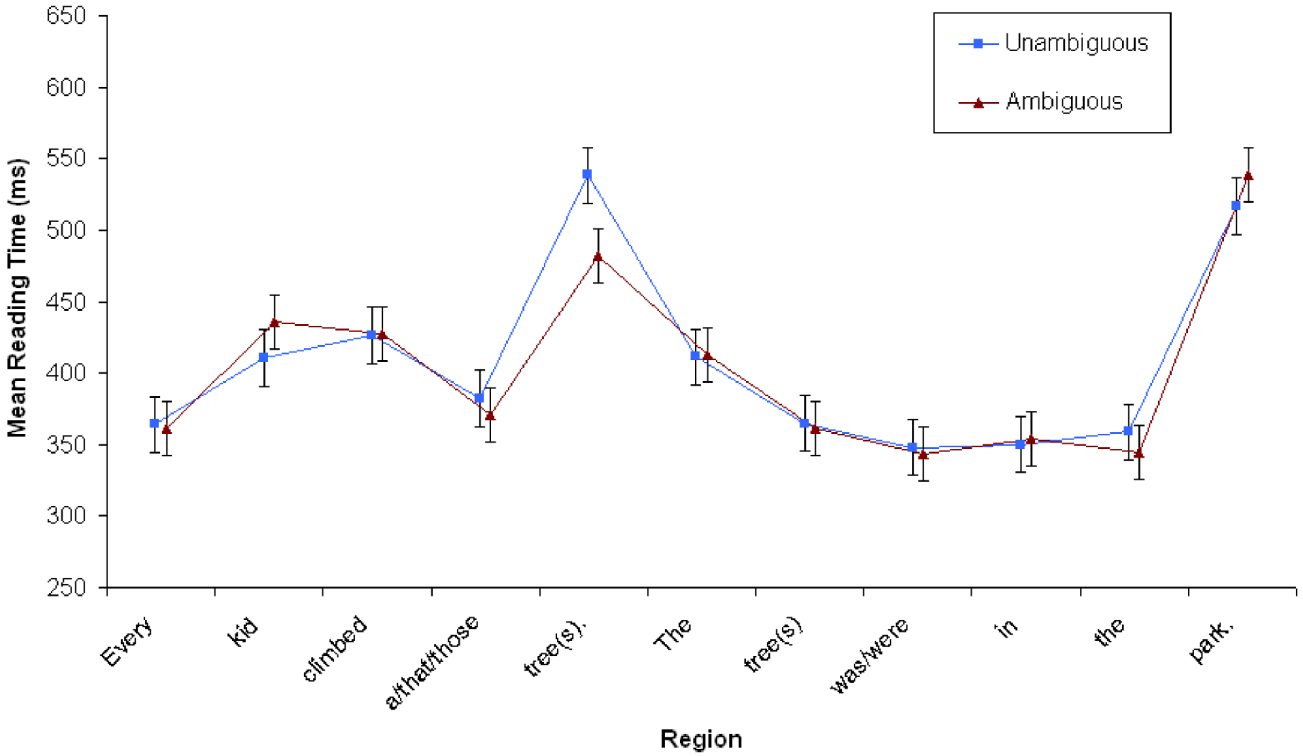

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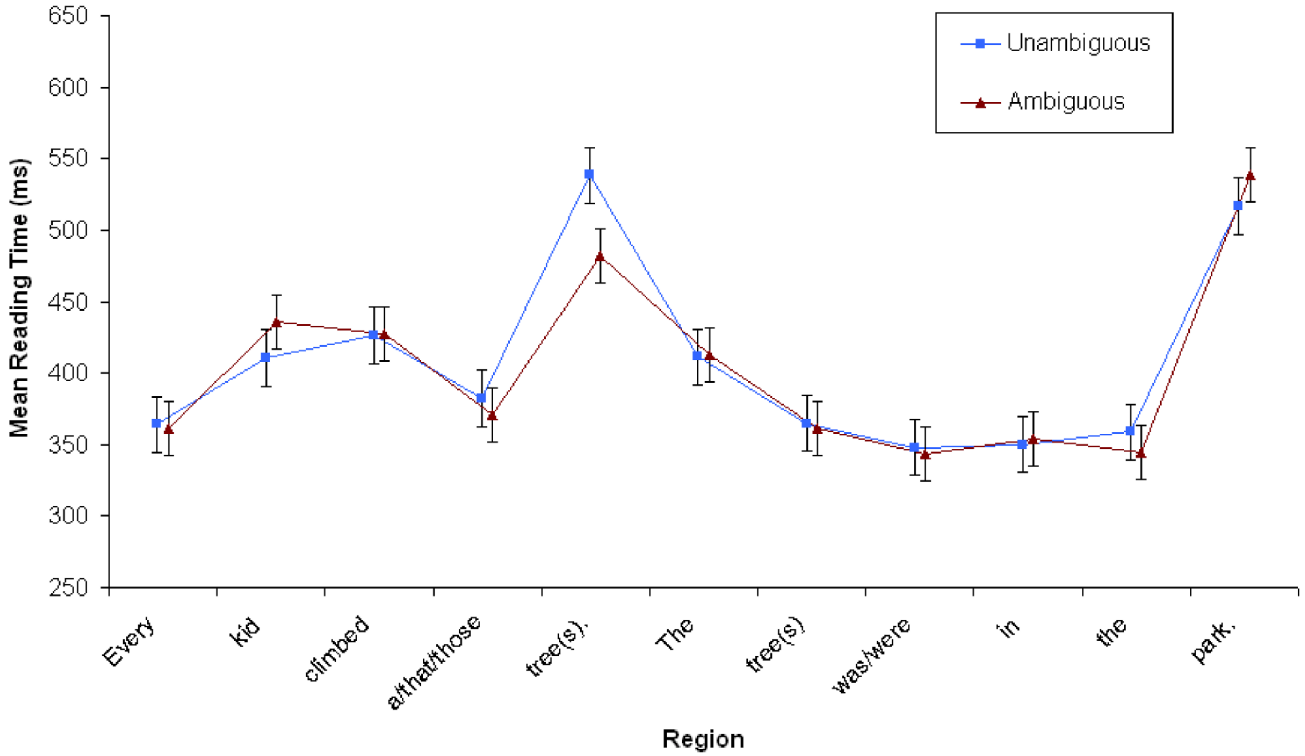

The *unambiguous* sentence takes *longer* to read, no other differences.

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- The Pragmatics Fairy? – What is different about the situation described by the definite article that would make it harder to process?
- The Statistics Fairy? – Is it really less frequent for a definite determiner to be the narrow scope under a universal?

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- **Problem**: cannot detect effect underspecificaton status with only two quantifiers.
  - At continuation sentence, you can't entirely distinguish reanalysis from violation of world knowledge expectation

Scope ambiguity in processing

Consider the following sentence and continuations [Dotlačil and Brasoveanu 2015]:

(1) A caregiver comforted a child every night.

   a. The caregiver wanted the child to get some rest.
   b. The caregivers wanted the child to get some rest.
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With three quantifiers: can investigate whether there is a preferred specified order in incremental context.

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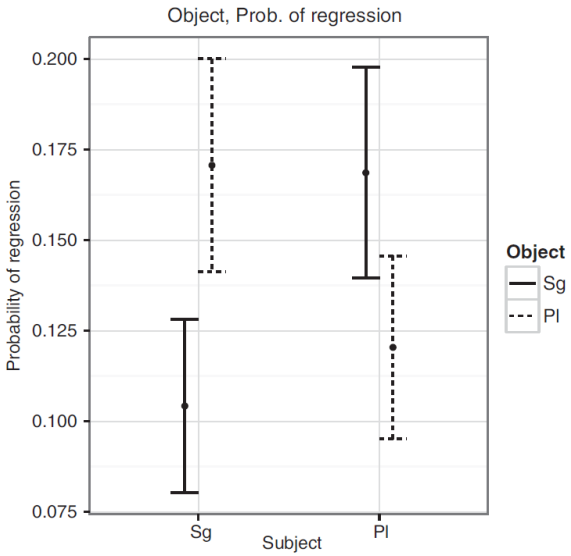

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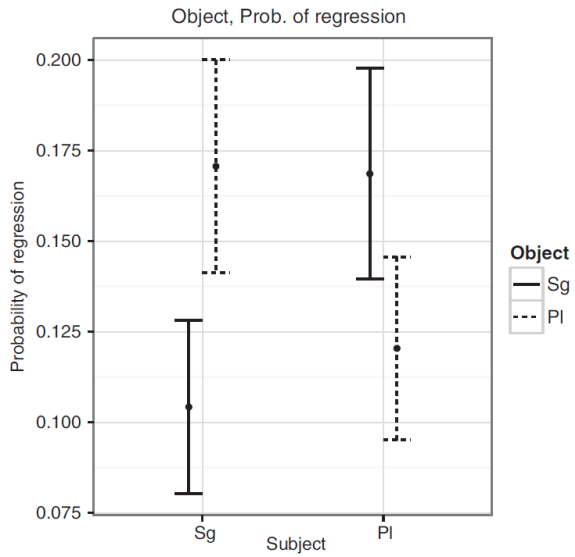

Evidence for algorithmic processing (as opposed to purely pragmatic considerations).

Part 2: sources of effort

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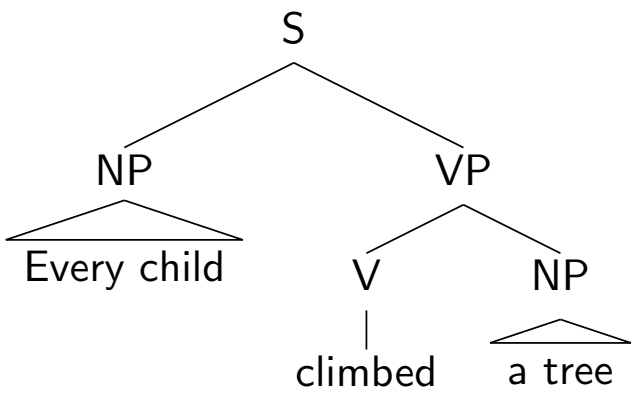

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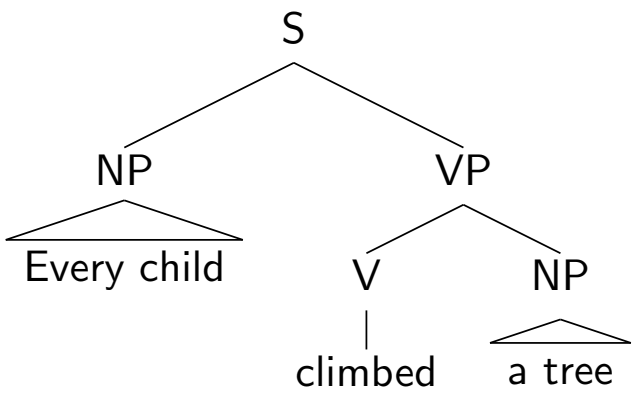

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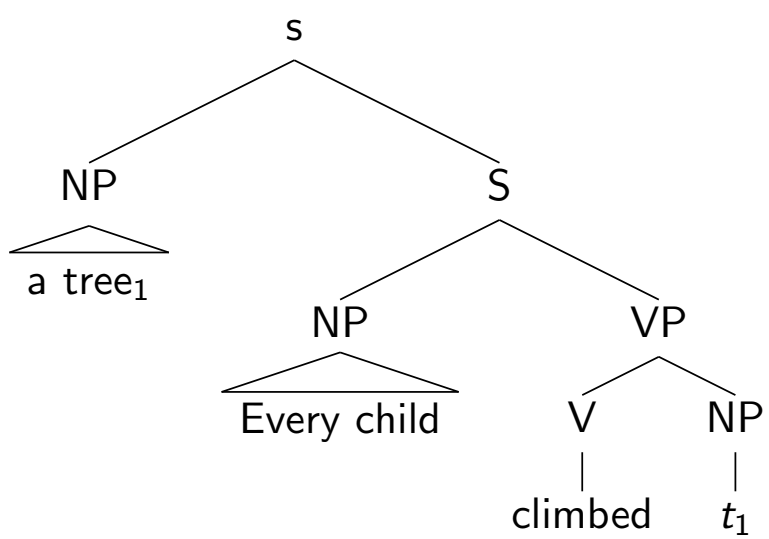

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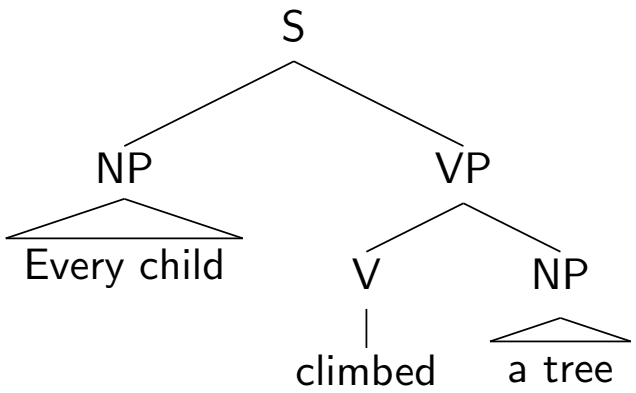

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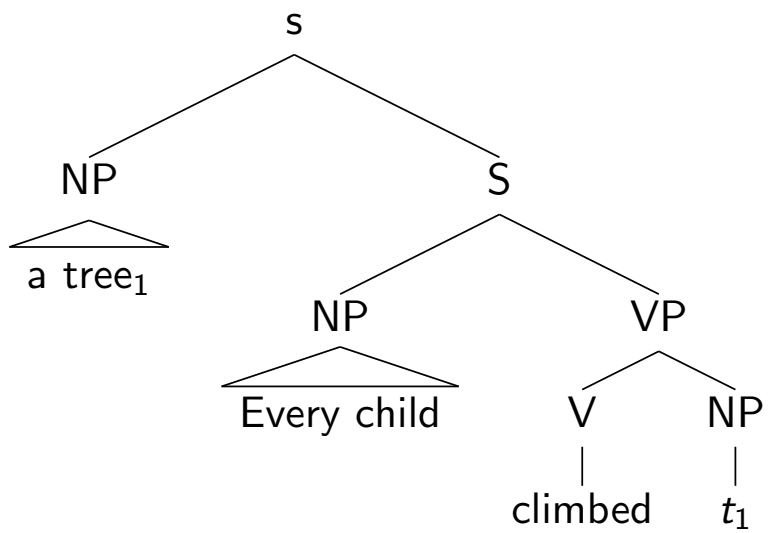

Captures intuition that inverse reading should be harder – extra step.

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When evidence for precedence shows up, $x_1 > x_2$ or $x_1 < x_2$.

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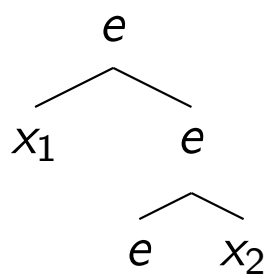

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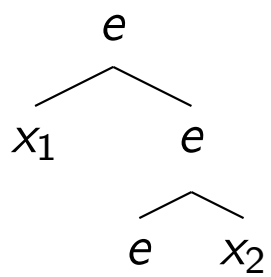

  - Small number of constraints allow raising of x_2 without requiring involvement of full syntax.

The event can be deployed as a sort of "ceiling".

But what can we do with VSTs?

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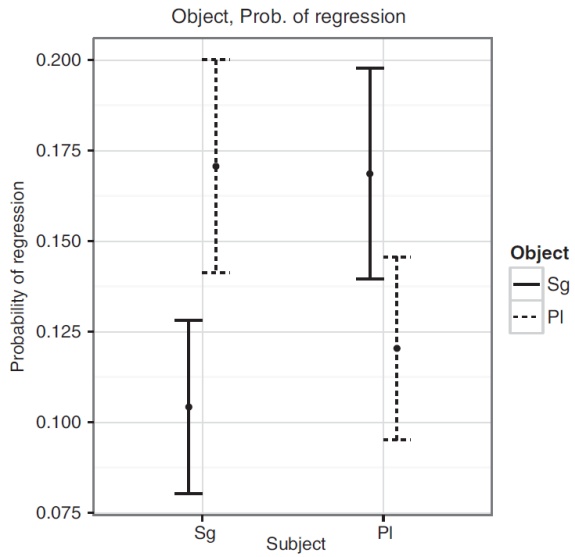

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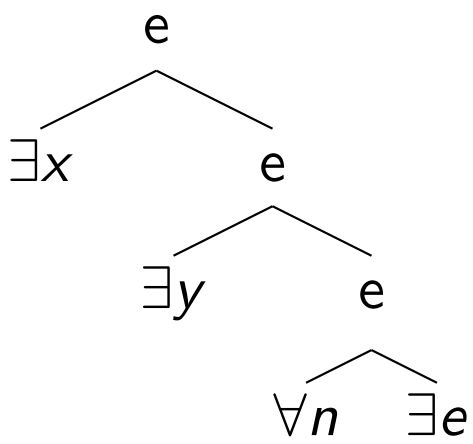
"A caregiver comforted a child every night.":

(7) caregiver($x^{\exists}$) • comfort($e^{\exists}$) • agent(x, e) • child($y^{\exists}$) • patient(y, e) • night($n^{\forall}$) • OCCUR(n, e)

The linear order:

(8) a. The caregiver wanted the child to get some rest. ($\exists x \exists y > \forall n$)

b.



VST-move

"A caregiver comforted a child every night.":
One step:

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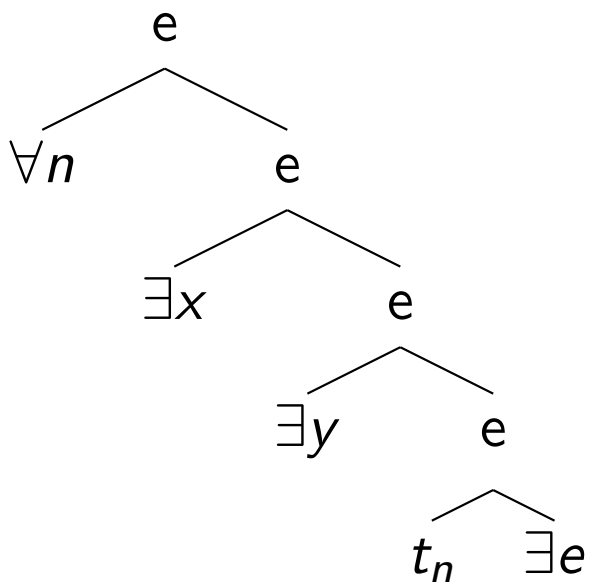

VST-move

"A caregiver comforted a child every night.":
Two steps for number-mismatched reading:

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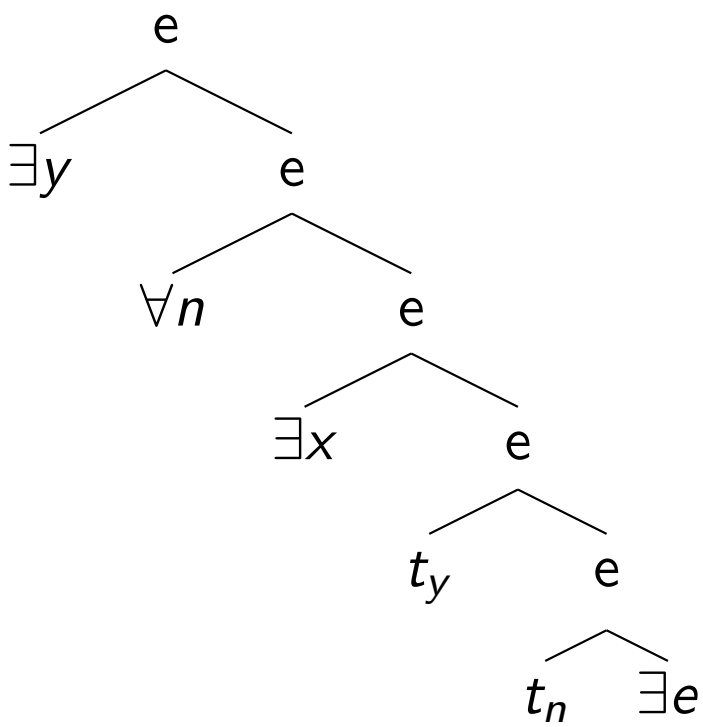
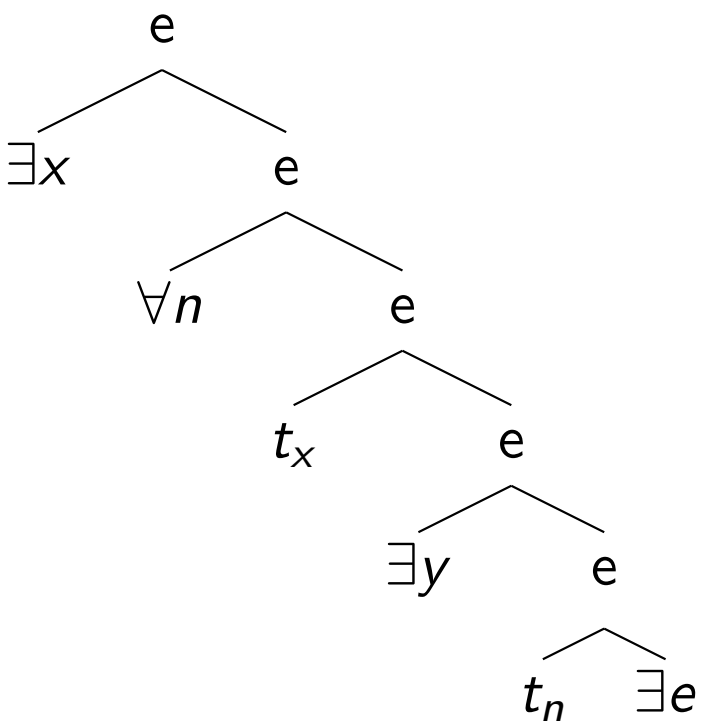


VST-move

"A caregiver comforted a child every night.":
Two steps for alternate number-mismatched reading:

(11) a. The caregiver wanted the children to get some rest. ($\forall n > \exists y$)

b.



VST-move matches difficulty

The number of VST-move steps matches the difficulty of each Dotlačil and Brasoveanu reading:

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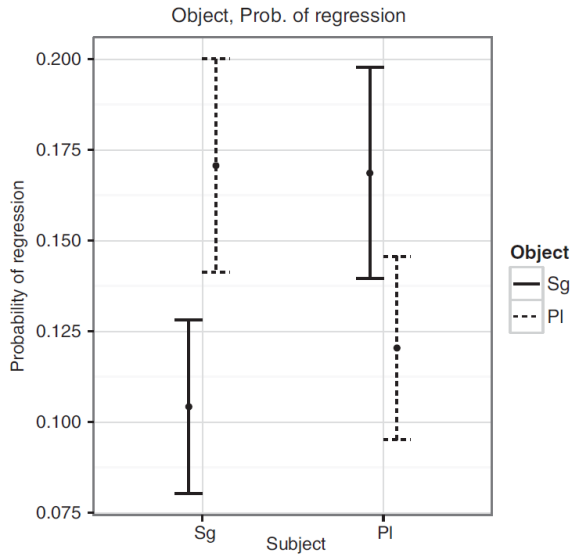

Pros and. . . cons?

Advantages:

- Rightward/incrementally constructible, only does work when scope ambiguities call for it (rather than constraining the entire processing machinery).
- VST-move is highly constrained, possible psycholinguistic response to Fox and Lappin's critique [2010] of NP-completeness in fully underspecified scope processing mechanisms.

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Critique:

- Why bother with the neo-Davidsonian event variable/misuse it as a structural element?
- Can represent the same thing in e.g. CCG?
  (But. . . underspecification. . .)

Part 3: event variable speculations

The event as structural ceiling

First role of the event variable: prevent infinite movement.
Radó and Bott [2012]: self-paced reading with picture task in German.

(12) Genau ein Affe ist auf allen/jeder Karte(n) zu finden.
Exactly one monkey is on all/each card(s) to find.

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- Visual task afterwards: set of cards with pictures of monkeys on it.
  $\Rightarrow$ Participant decides if the statement was true for the cards.
- Long story short: by comparison against control scope-unambiguous sentences, participants slow down during card task to remember the scope order.
- Suggests creation of minimal domain of scope interpretation.

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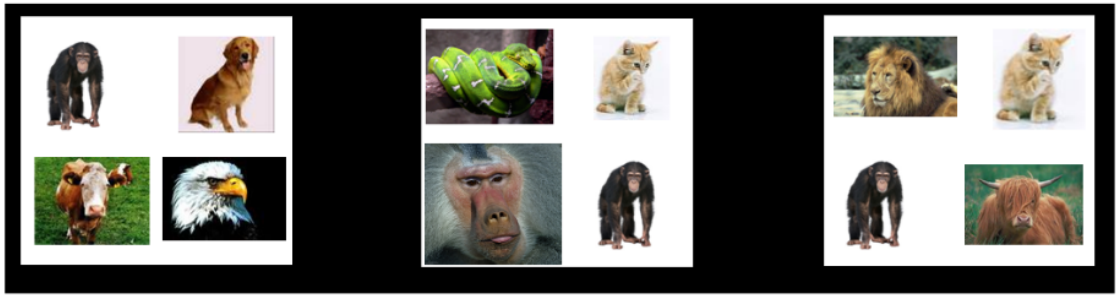

(a) ∃!∀ card display

(b) ∀∃! card display

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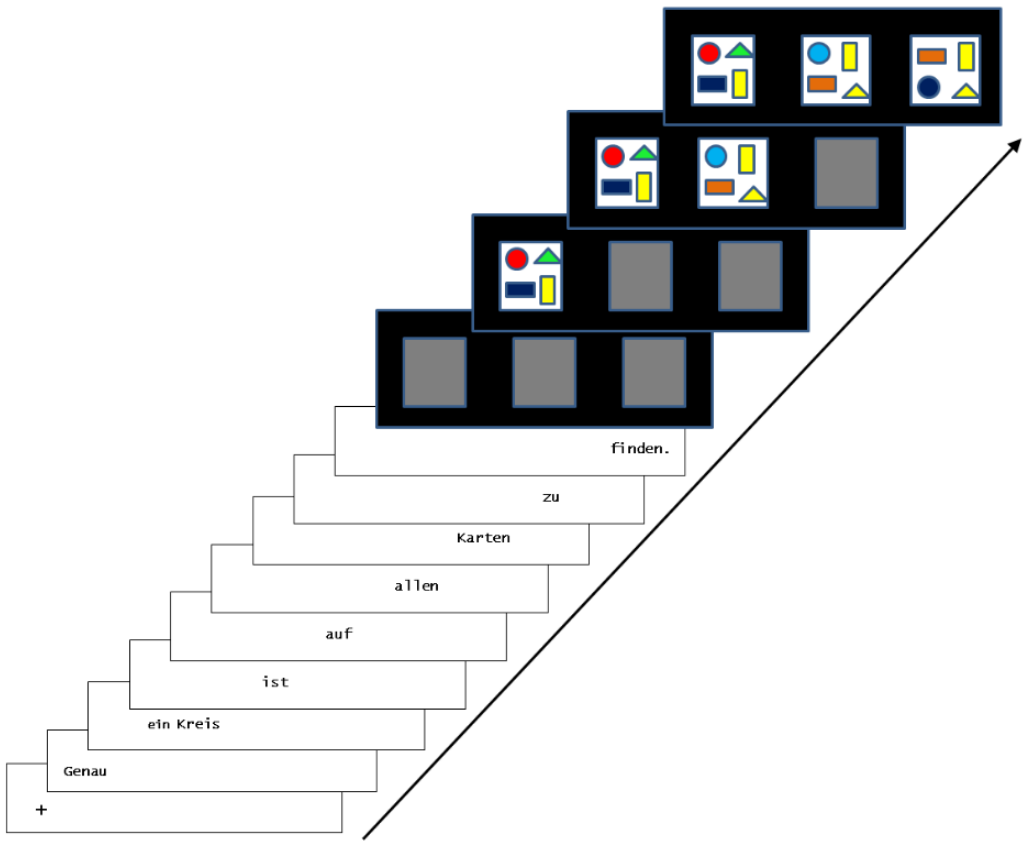

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As VST in linear order:

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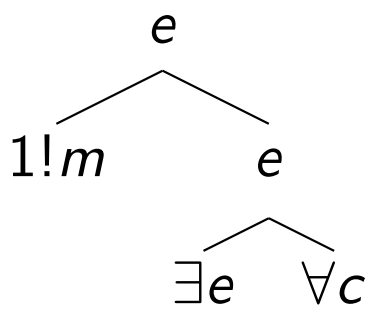

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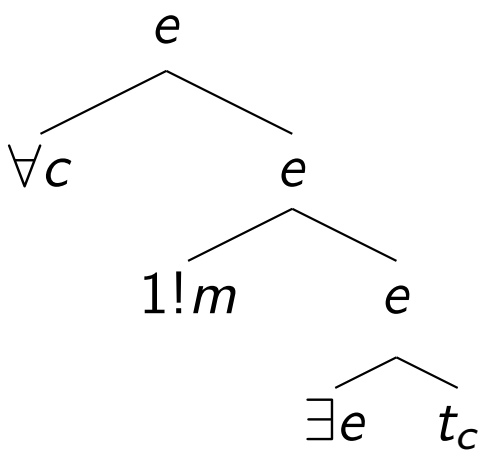

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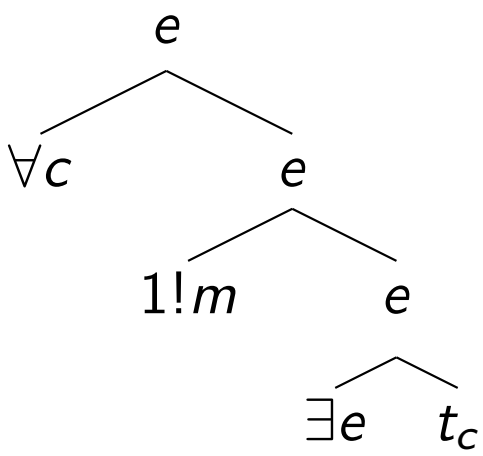
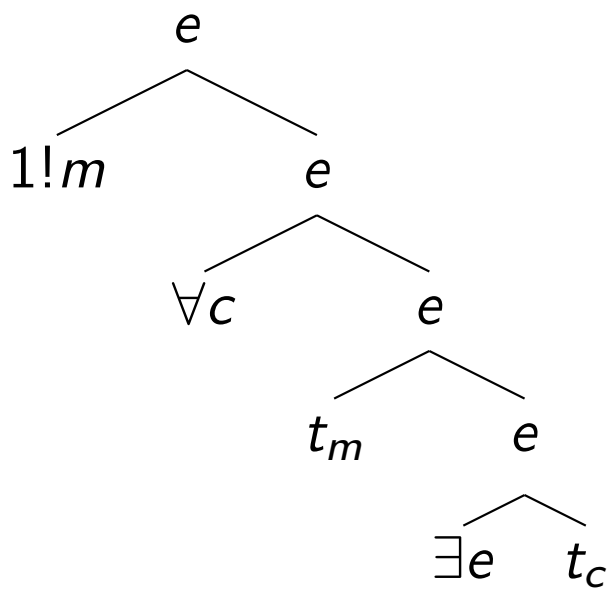


(The "trace" records that this is not the linear state, formally your mileage may vary.)

The event as structural ceiling

However, but the visual task can force the linear reading, which is a step harder:

(16)



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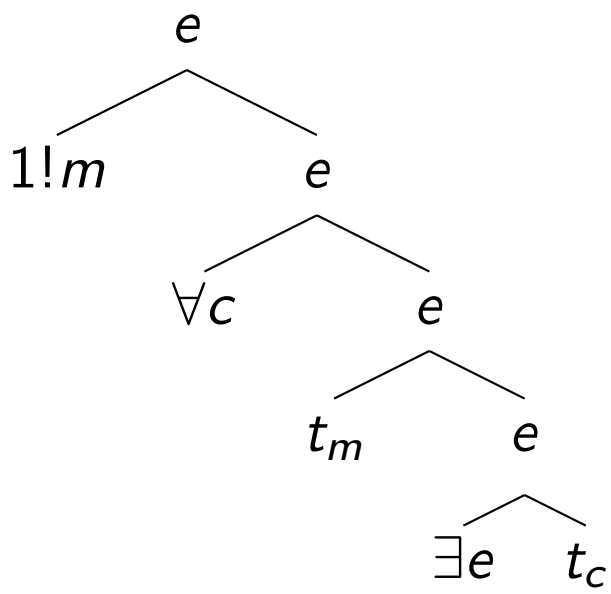

This is strongly disfavoured by the parser, because it contains an image of the initial state, since the "traces" contain no semantic content.

Part 4: beyond the clause

Antecedent-contained deletion (ACD)

Consider:

(17) Bob demands that he ride every car that Bill did.

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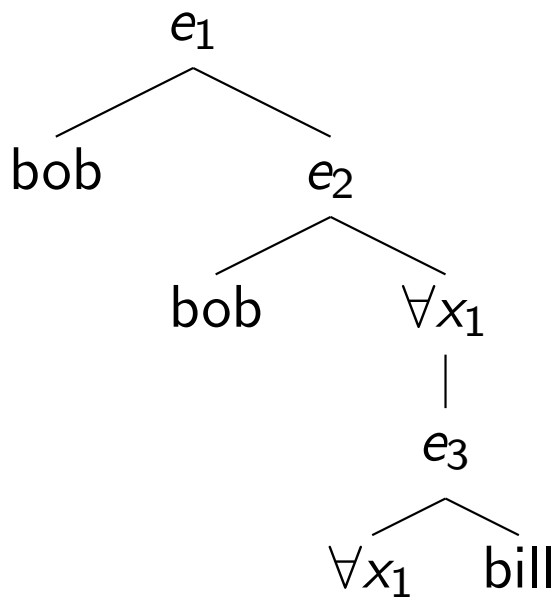
$\Rightarrow$ "Tensed clause barrier" – higher scope cannot be obtained

Antecedent-contained deletion (ACD)

(18) Bob demands$_1$ that he ride$_2$ every car that Bill did$_3$.

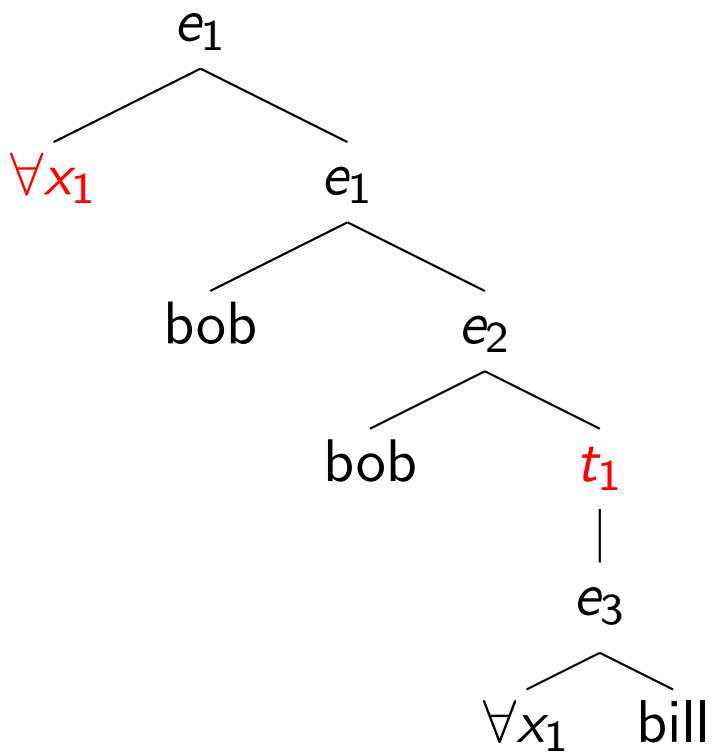
Lower scope reading (correct):



Antecedent-contained deletion (ACD)

(19) Bob demands$_1$ that he ride$_2$ every car that Bill did$_3$.

Higher scope reading:



(left out $\exists$es for space)

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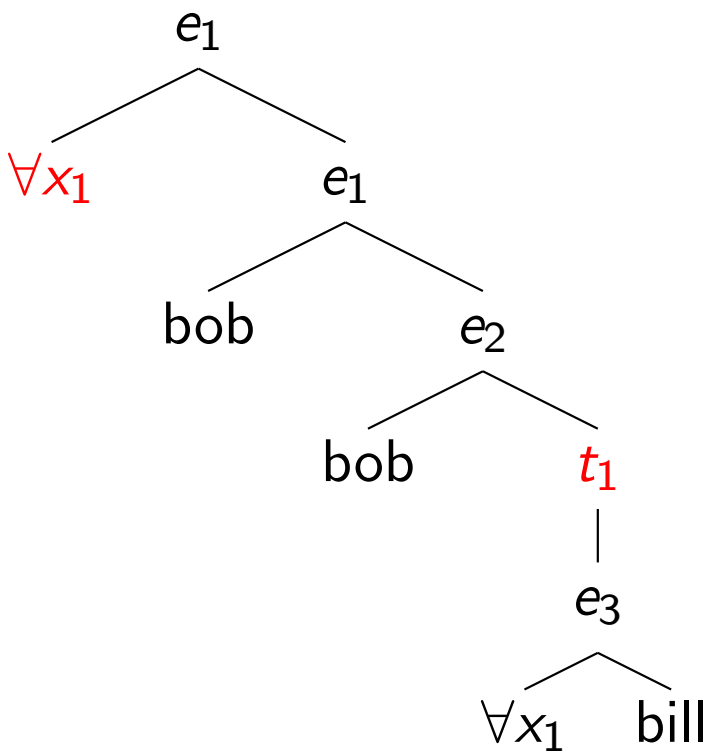

(left out $\exists$es for space)Normally banned: drastic change to e_2 if "every car" is part of "demand" event.

Antecedent-contained deletion (ACD)

- Syrett and Lidz (2010): children (and many adults) do not respect tensed clause barrier.
- Why do the majority of adults find tensed clause blocks higher reading? Syrett and Lidz suggest processing constraints.

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Experimental evidence: Role of working memory in propositional content, Caplan and Waters (1999). Role of memory decay in sentence processing, Lewis et al. (2006).

Each and every

Events and quantifiers

"Each" and "every" are $\forall$ but still not created the same.
Beghelli and Stowell [1996].

(20) a. It took all the boys to lift the piano.
b. It took every boy to lift the piano.
c.*It took each boy to lift the piano.
d. One boy ate almost every apple.
e.*One boy ate almost each apple.

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It's as though "each" is quantifying events of eating/lifting, which are infelicitous here.

“Each” and “together”

Patson and Warren (2010): self-paced reading/timed judgement study.

(21) a. Each of the men carried a box/some boxes.
b. Together the men carried a box/some boxes.

The distributed “each” reading has slower judgement time in the singular condition than the collective “together” reading.

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$\Rightarrow$ distinction is distribution over events.

Back to "every"

Dwivedi and Gibson [2017]:

- Attempt to replicate Patson and Warren, but with different stimuli and in an ERP setting.
- Conclude (similar to Dwivedi [2013]) that computation of distribution dominated by heuristic/pragmatic factors.

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Stimuli

(22) a. Every kid climbed a/the tree(s).
b. The kid climbed a/the tree(s).

Back to "every"

Dwivedi and Gibson's result may simply be due to the distributivity of the event.

- Patson and Warren constrast ("together" vs. "each") involve an ambiguous scope over the event variable in the "each" case.
- Dwivedi and Gibson's result comes from computation strictly over entity variables, so replicates Dwivedi [2013].

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No matter what, some portion of the representation must remain *under-specified*:

1. How can we most easily acquire the sources of world knowledge needed to represent processor decisions?
2. Is there a role for *generalized event knowledge* and thematic role representation?
3. Theoretical syntax has spent a lot of effort in identifying constraints on "covert" phenomena – how many of these can be accounted for purely information-theoretically?

Thanks and enjoy ESSLLI!
http://bit.ly/esslli19scope