

Processing negative polarity

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Negative polarity items

Certain words, like ‘ever’, are licensed only when they appear in some kind of “negative context” like ‘no’.

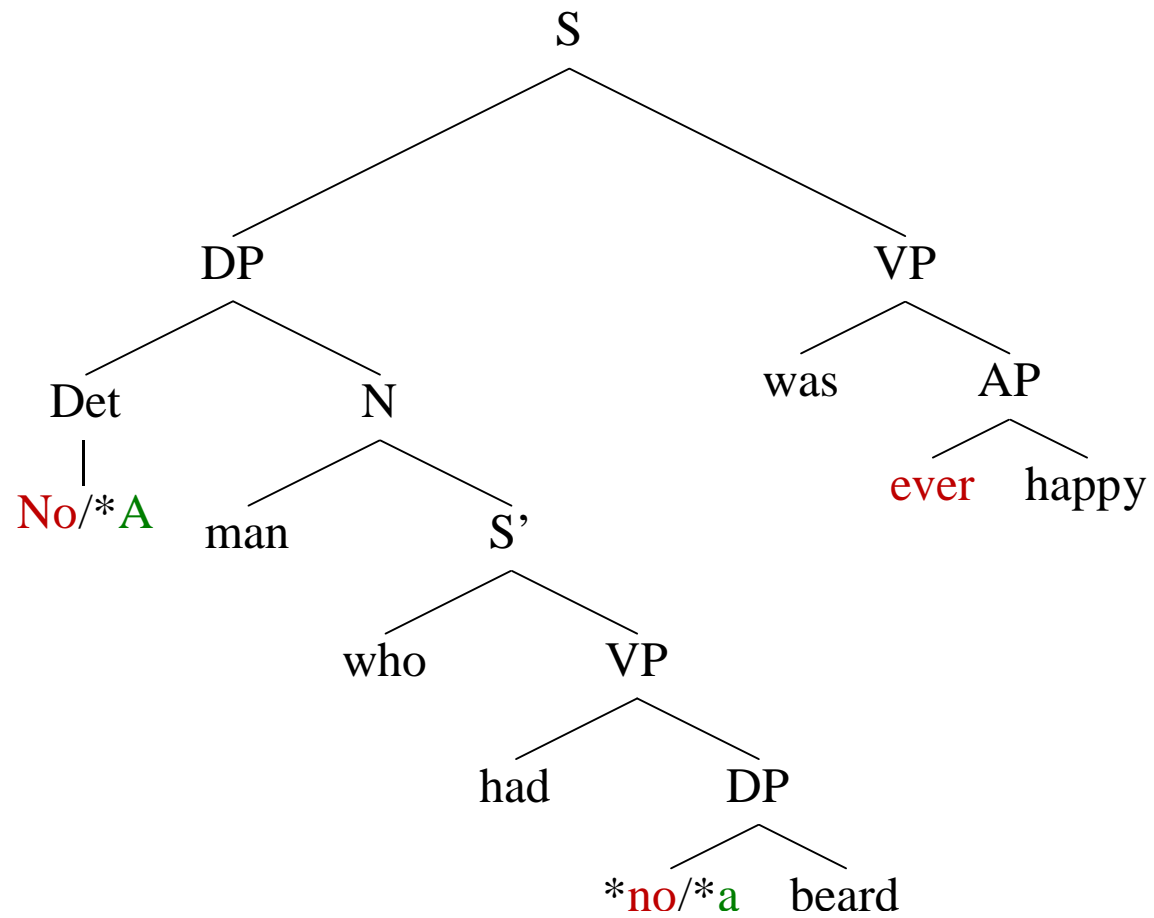
Adverbs like ‘always’ and ‘ever’ are equally happy to occur in a context like ‘No’:

- (1) a. [_{NP} No man [who had a beard]] was always happy
b. [_{NP} No man [who had a beard]] was ever happy

However, the absence of ‘No’ in ‘No man’ makes the adverb ‘ever’ unacceptable (2b), and having a ‘no’ embedded in a relative clause does not help (2c):

- (2) a. [_{NP} A man [who had a beard]] was always happy
b. * [_{NP} A man [who had a beard]] was ever happy
c. * [_{NP} A man [who had no beard]] was ever happy

The structural and lexical constraint on NPIs



The same constraint applies for German *jemals*, 'ever'

- (3) a. **Kein** Mann, [der einen Bart hatte,] war **jemals** glücklich
No man who a beard had was ever happy
'No man who had a beard was ever happy.'
- b. ***Ein** Mann, [der einen Bart hatte,] war **jemals** glücklich
A man who a beard had was ever happy
'A man who had a beard was ever happy.'
- c. *Ein Mann, [der **keinen** Bart hatte,] war **jemals** glücklich
A man who no beard had, was ever happy
'A man who had no beard was ever happy.'

A prediction

Linguistic theory predicts that (4b,c) should both be ungrammatical/unacceptable. In (4b) there is no licenser present, and in (4c) the licenser is present but isn't accessible.

(4) a. Accessible licenser

Kein Mann, [der einen Bart hatte,] war jemals glücklich
No man who a beard had was ever happy
'No man who had a beard was ever happy.'

b. No licenser

*Ein Mann, [der einen Bart hatte,] war jemals glücklich
A man who a beard had was ever happy
'A man who had a beard was ever happy.'

c. Inaccessible licenser

*Ein Mann, [der keinen Bart hatte,] war jemals glücklich
A man who no beard had, was ever happy
'A man who had no beard was ever happy.'

This prediction is incorrect

In a speeded acceptability rating task, 24 subjects were shown sentences like (5), 8 sentences per condition and intermixed with 80 unrelated fillers.

(5) a. Accessible licenser

Kein Mann, [der einen Bart hatte,] war **jemals** glücklich
No man who a beard had was ever happy
'No man who had a beard was ever happy.'

b. No licenser

*Ein Mann, [der einen Bart hatte,] war **jemals** glücklich
A man who a beard had was ever happy
'A man who had a beard was ever happy.'

c. Inaccessible licenser

*Ein Mann, [der **keinen** Bart hatte,] war **jemals** glücklich
A man who no beard had, was ever happy
'A man who had no beard was ever happy.'

The intrusion effect

Condition	Accuracy (% correct)	Speed (msecs)
(5a) Accessible licensor	85	540
(5b) No licensor	83	554
(5c) Inaccessible licensor	70	712

1. (5c) was accuracy worse than in other conditions:

(5c) vs. (5a): $F1(1,23) = 5.11, p < .05$; $F2(1,23) = 8.89, p < .01$.

(5c) vs. (5b): $F1(1,23) = 6.11, p < .05$; $F2(1,23) = 10.80, p < .01$.

2. (5c) responses slower than in other conditions:

(5c) vs. (5a): $F1(1,23) = 10.25, p < .01$; $F2(1,23) = 8.35, p < .05$.

(5c) vs. (5b): $F1(1,23) = 26.68, p < .001$; $F2(1,23) = 11.95, p < .01$.

In sum, a linearly preceding but structurally inaccessible licensor sometimes ends up getting accessed; let's call it the INTRUSION EFFECT.

A semantic integration problem appears to cause the intrusion effect

NPI licensing violations are known to trigger an N400, suggesting semantic integration problems (Saddy et al., in press).

In an ERP version of the speeded acceptability study, we replicated the preceding experiment's results and also found an N400 in both the no-licensor and inaccessible-licensor conditions:

(6) b. No licensor

*Ein Mann, [der einen Bart hatte,] war **jemals** glücklich

A man who a beard had was ever happy

'A man who had a beard was ever happy.'

c. Inaccessible licensor

*Ein Mann, [der **keinen** Bart hatte,] war **jemals** glücklich

A man who no beard had, was ever happy

'A man who had no beard was ever happy.'

Modeling these facts in sentence processing theory

These facts pose an interesting challenge for sentence processing theories. Here's what a theory minimally has to explain:

1. A lower *proportion* of correct judgements in the inaccessible licensor condition.
2. A semantically (lexically) driven processing problem in the inaccessible licensor condition.

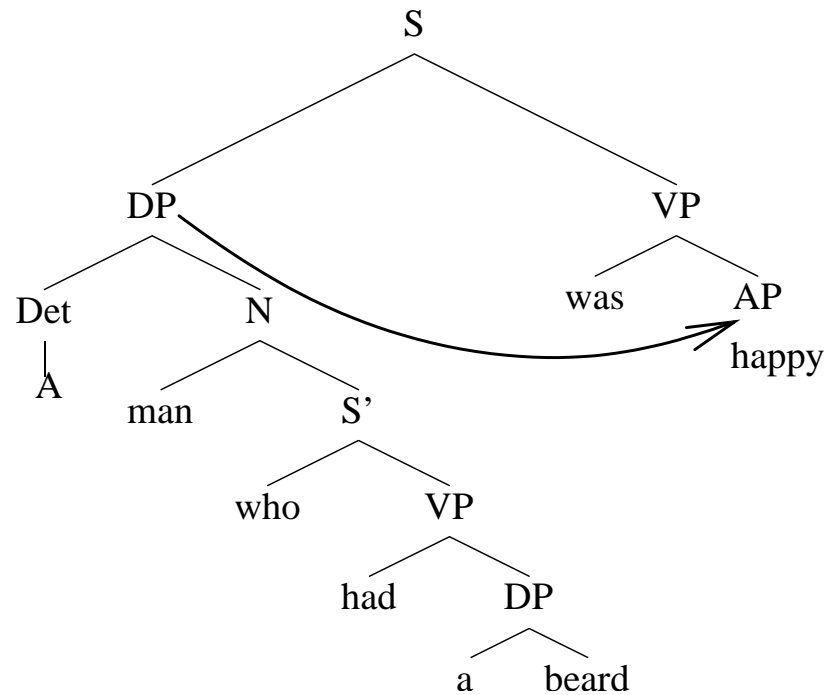
**An activation-based model of sentence processing
as skilled memory retrieval
(Lewis and Vasishth, 2005, Cognitive Science)**

Theory = ACT-R principles + serial left-corner parsing
The poster tomorrow presents details.

The main properties of ACT-R relevant here:

- Cue-based retrieval.
- Activation modulated by usage, decay, and noise.
- During a retrieval attempt, cues boost activation.
- Retrieval is based on a partial (soft) match; activation boost is reduced when cues do not match perfectly, possibly resulting in retrieval failure.

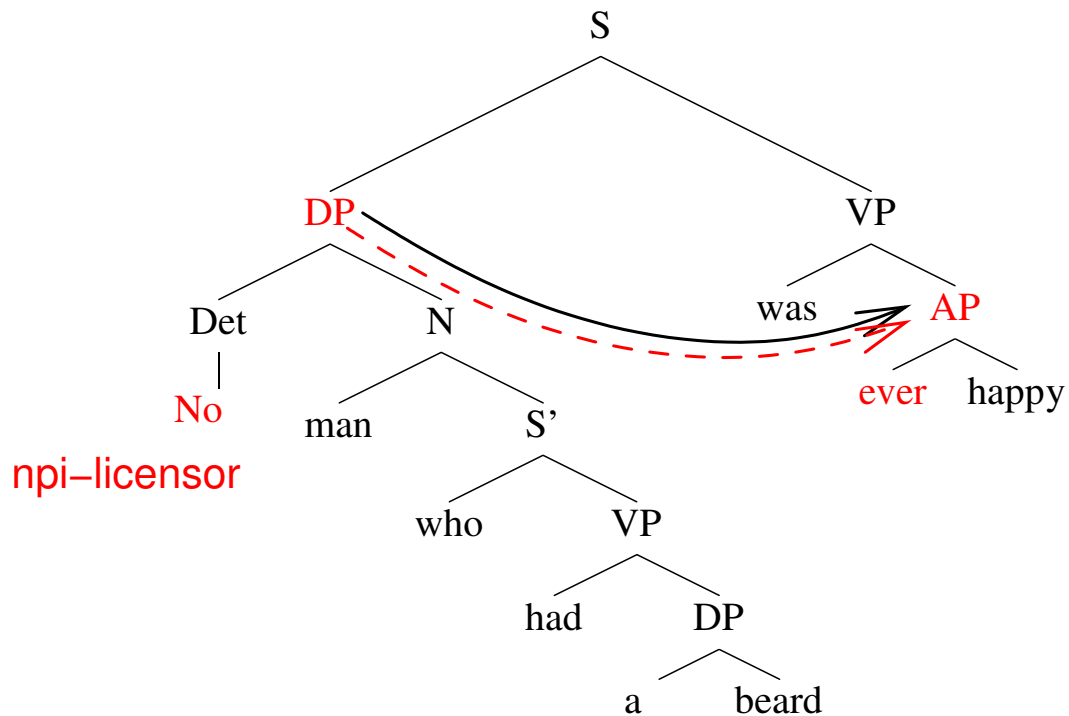
**Syntactic-semantic constraint:
AP must integrate with subject of verb**



(Syntactic-semantic) retrieval cue # 1: retrieve subject of main predicate

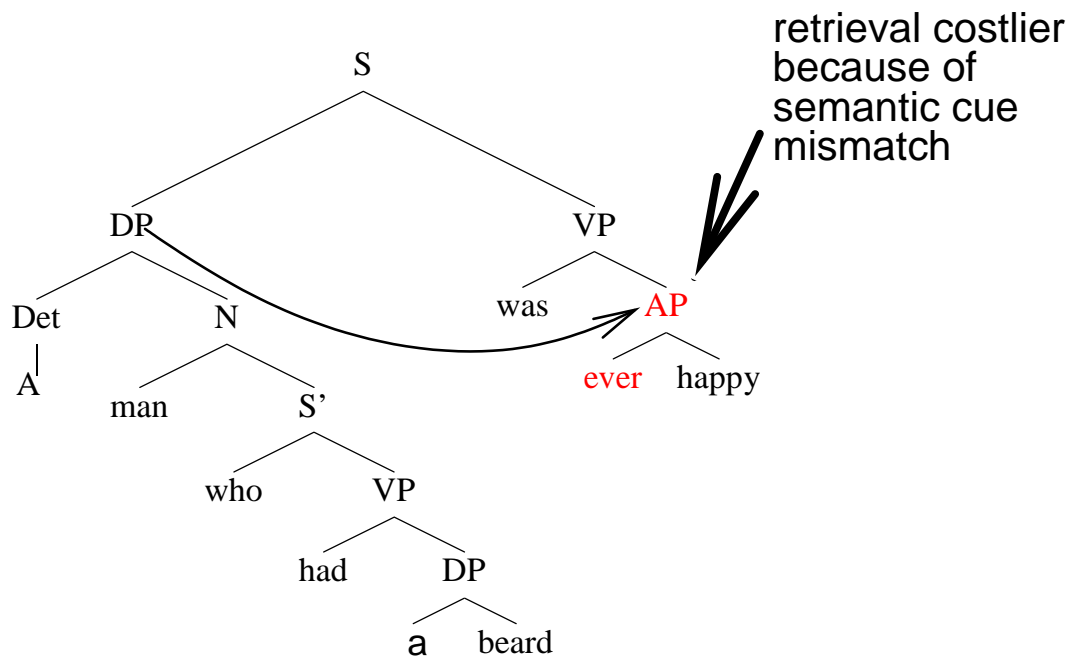
MATCH

**When licenser is present and is in correct location:
An additional semantic constraint boosts activation of subject DP**



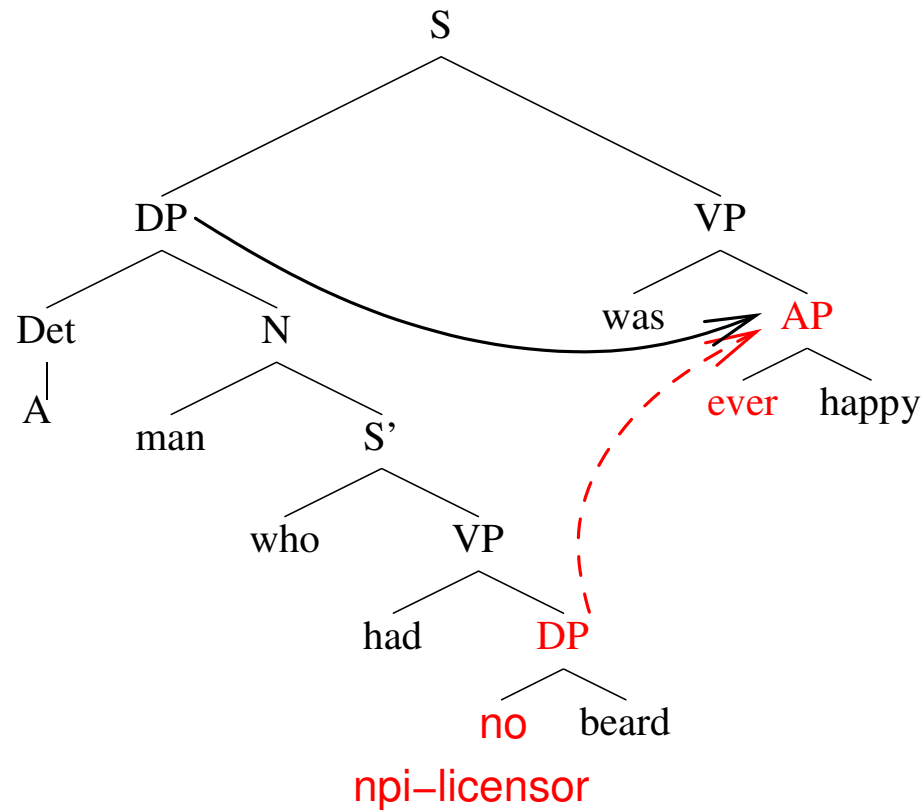
(Syntactic-semantic) retrieval cue # 1: retrieve subject of main predicate MATCH
 (Semantic) retrieval cue # 2: the retrieved element should be an NPI-licensor MATCH

When no licenser is present



(Syntactic-semantic) retrieval cue # 1: retrieve subject of main predicate MATCH
 (Semantic) retrieval cue # 2: the retrieved element should be an NPI-licensor MISMATCH

When the licenser is present but in the wrong structural location



(Syntactic-semantic) retrieval cue # 1: retrieve subject of main predicate MATCH

(Semantic) retrieval cue # 1: NPI-licensor MATCH WITH EMBEDDED DP

The key claims

- There is a functional requirement for the AP to initiate a retrieval of a DP from the subject position: this syntactically driven retrieval is necessary for carrying out semantic integration.
- In the case where an NPI is present in the AP, an additional semantic cue will:
 - Boost activation of accessible licenser DP
No man who had a beard was ever happy
 - Fail to boost activation of accessible non-licenser DP
A man who had a beard was ever happy
 - Occasionally (in conjunction with noise) boost activation of the inaccessible licenser DP
A man who had no beard was ever happy

Modeling percentage of correct judgements: Results of Monte Carlo simulations (50 runs)

Condition	Data	Model
(5a) Accessible licenser	85	96
(5b) No licenser	83	96
(5c) Inaccessible licenser	70	68

Note that our claim is not about the quantitative fits *per se*. The main point is that the explanation for the NPI facts follow naturally from the independently developed cognitive architecture and sentence processing model.

Concluding remarks: Two main points

- **An amazing fact about processing negative polarity items:** NPI licensors that are disqualified by linguistic theory from allowing NPIs tend to allow them occasionally, and ERP data shows that there is some kind of semantic processing failure involved. Explaining these facts *in a principled manner* falls outside the capabilities of any existing linguistic theory of NPI licensing.
- **An explanation of the NPI facts falls out of an independently developed theory of human sentence processing:**
 - The underlying cognitive architecture is highly constrained both structurally and quantitatively by existing cognitive theory.
 - The computational model generalizes to a range of phenomena gathered by different methods and with severely reduced degrees of freedom.

For a detailed exposition of the model, and quantitative fits of six sets of experiments involving self-paced reading, (speeded) acceptability ratings, and rapid serial visual presentation, see the two posters by Lewis and Vasishth tomorrow.