Where am I?

- HUL242: **Fundamentals of Language Sciences**
- Week 13: **Semantics (Lecture-3)**
- Monday, April 21st

Review: Interpretation of simple sentences

- **Set membership relation between two sets, namely N and VP**
- A simple sentence (the subject as a proper name) with a simple VP:

  Deepak <u>teaches linguistics</u>.

  $[\![\text{NP VP}]\!] = [\![\text{NP}]\!] \in [\![\text{VP}]\!]$

- A simple sentence with VP conjunction:

  Deepak <u>teaches linguistics **and** likes semantics</u>.

  $[\![\text{NP VP1 and VP2}]\!] = [\![\text{NP}]\!] \in [\![\text{V1}]\!] \cap [\![\text{V2}]\!]$

- A simple sentence with negated VP

  Deepak **doesn't** speak Farsi.

  $[\![\text{NP not VP}]\!] = [\![\text{NP}]\!] \in U - [\![\text{VP}]\!]$

Semantics of Quantifiers

Sentences with Quantifier: Every

Consider the following sentence:

1. Every student passed the test.

- What does it take for *(1)* to be true?
  - (1) will be true in the situation where if you check every single student, you won't be able to find even one that didn't pass.
- How could we put this relation between sets ⟦student⟧ and ⟦passed the test⟧ into the theory?
  - **Subsethood**
- *Every student passed* guarantees us that ⟦student⟧ $\subseteq$ ⟦passed the test⟧

A small scenario

$$U = \{a, b, c, d, j\}$$

$$[\![\text{Human}]\!] = \{a, b, c, d, j\}$$

$$[\![\text{student}]\!] = \{a, b, c, j\}$$

$$[\![\text{male student}]\!] = \{a, j\}$$

$$[\![\text{female student}]\!] = \{b, c\}$$

$$[\![\text{passed the test}]\!] = \{a, b, c\}$$

A rule

$$[\![\text{every N VP}]\!] = [\![\text{N}]\!] \subseteq [\![\text{VP}]\!]$$

- Let's see how this works on data:

Every student passed the test.

$$[\![\text{Every student passed the test}]\!] = [\![\text{student}]\!] \subseteq [\![\text{passed the test}]\!]$$
$$= \{a, b, c, j\} \subseteq \{a, b, c\}$$

- In the present scenario, this sentence is **False**.

Another example

1. Every female student passed the test.

$$[\![\text{Every female student passed the test}]\!]$$

$$= [\![\text{female student}]\!] \subseteq [\![\text{passed the test}]\!]$$

$$= \{b, c\} \subseteq \{a, b, c\}$$

- In the present scenario, this sentence is **True**.

Quantifiers ‘a’ and ‘no’

$U = \{b, m, s\}$

$[\![\text{Student}]\!] = \{b, m\}$

$[\![\text{Prof.}]\!] = \{s\}$

$[\![\text{read a book}]\!] = \{b, m, s\}$

1. A student read a book. ? T

2. No student read a book. ? F

Rules for quantifiers: every, a, no

- The rule we discovered for ‘every’ works for any quantifiers.
- That is, quantified statements express some **relationship that holds between two sets**, namely N and VP.

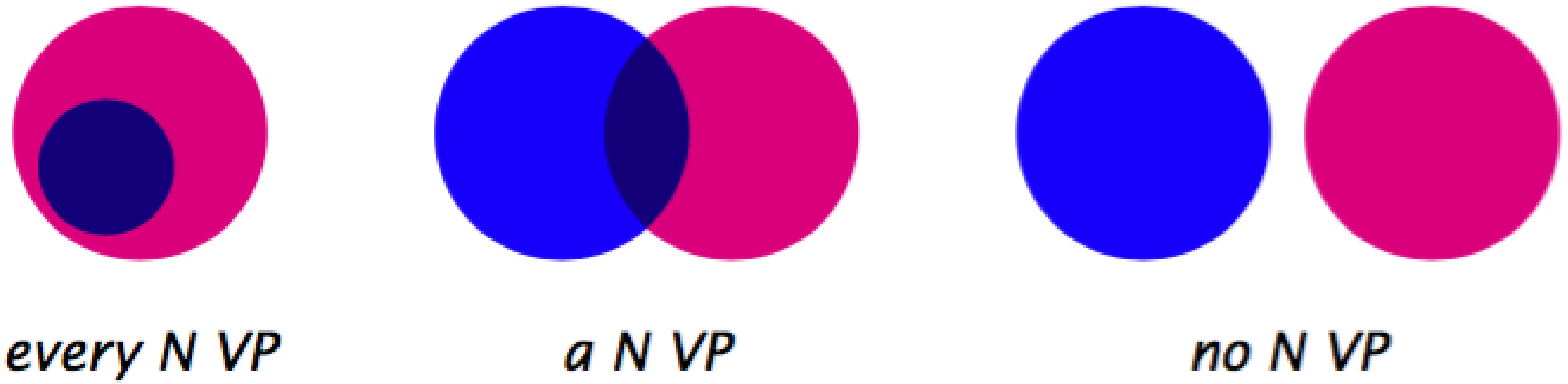
$$[\![\text{a N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] \neq \emptyset$$

$$[\![\text{no N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] = \emptyset$$

You can find more examples in Readings, ch-5, p. 381.

Pictorial representation of quantifier meanings

- The blue sets are ⟦NP⟧
- The magenta sets are ⟦VP⟧



Computation with quantifiers ‘a’ and ‘no’

$U = \{b, m, s\}$
$[\![\text{Student}]\!] = \{b, m\}$
$[\![\text{Prof.}]\!] = \{s\}$
$[\![\text{read a book}]\!] = \{b, m, s\}$

1. A student read a book.

$$[\![\text{a N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] \neq \emptyset$$
$$= [\![\text{student}]\!] \cap [\![\text{read a book}]\!] \neq \emptyset$$
$$= \{b, m\} \cap \{b, m, s\} \neq \emptyset$$
$$= \{b, m\} \neq \emptyset$$

This sentence is **True**.

2. No student read a book. ?

$$[\![\text{no N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] = \emptyset$$
$$= [\![\text{student}]\!] \cap [\![\text{read a book}]\!] = \emptyset$$
$$= \{b, m\} \cap \{b, m, s\} = \emptyset$$
$$= \{b, m\} = \emptyset$$

This sentence is **False**.

Some other quantifiers

Exactly n

- We have lots of quantifiers besides *every*, *a*, and *no*. We will not look all of them but let's see a couple of them.

Consider (1)

1. *Exactly three* students came.

- What should be the semantics of *exactly three*? What does it say about the relationship of ⟦N⟧ and ⟦VP⟧ ?

$$[\![\text{exactly three N VP}]\!] = |\,[\![\text{N}]\!] \cap [\![\text{VP}]\!]\,| = 3$$

$|A|$ means the **cardinality** of set A i.e., how many things are in A.

Exactly n

$U = \{b, m, s\}$
$[\![Student]\!] = \{b, m\}$
$[\![Prof.]\!] = \{s\}$
$[\![read\ a\ book]\!] = \{b, m, s\}$

1. Exactly three students read a book.

$$[\![\text{Exactly three N VP}]\!] = |\ [\![N]\!] \cap [\![VP]\!]\ | = 3$$
$$= |\ [\![\text{student}]\!] \cap [\![\text{read a book}]\!]\ | = 3$$
$$= |\ \{b, m\} \cap \{b, m, s\}\ | = 3$$
$$= |\ \{b, m\}\ | = 3$$
$$= 2 = 3$$

This sentence is **False**.

2. Exactly two students read a book. ?

$$[\![\text{Exactly two N VP}]\!] = |\ [\![N]\!] \cap [\![VP]\!]\ | = 2$$
$$= |\ [\![\text{student}]\!] \cap [\![\text{read a book}]\!]\ | = 2$$
$$= |\ \{b, m\} \cap \{b, m, s\}\ | = 2$$
$$= |\ \{b, m\}\ | = 2$$
$$= 2 = 2$$

This sentence is **True**.

Most

- How about sentences with *most*?
  1. *Most students* came.

- What should be the semantics of *most*? What does it say about the relationship of $[\![N]\!]$ and $[\![VP]\!]$?

$$[\![\text{most N VP}]\!] = \quad |[\![N]\!] \cap [\![VP]\!]| > \frac{1}{2} \times |[\![N]\!]|$$

- That is, the N's who VP are more than half of the N's!

Most

$U = \{b, m, s, d\}$
$[\![\text{Student}]\!] = \{b, m, d\}$
$[\![\text{Prof.}]\!] = \{s\}$
$[\![\text{read a book}]\!] = \{b, m, s\}$

1. Most students read a book.

$$[\![\text{Most N VP}]\!] = |\ [\![\text{N}]\!] \cap [\![\text{VP}]\!]\ | > \frac{1}{2} \times |\ [\![\text{N}]\!]\ |$$
$$= |\ [\![\text{student}]\!] \cap [\![\text{read a book}]\!]\ | > \frac{1}{2} \times |\ [\![\text{student}]\!]\ |$$
$$= |\ \{b, m, d\} \cap \{b, m, s\}\ | > \frac{1}{2} \times |\ [\![b, m, d]\!]\ |$$
$$= |\ \{b, m\}\ | > \frac{1}{2} \times 3$$
$$= 2 > 1.5$$

This sentence is **True**.

at least five, but fewer than ten

$$[\![\textit{at least five, but fewer than ten N VP}]\!] \;=\; 5 \leq |[\![N]\!] \cap [\![VP]\!]| < 10$$

at least five, but fewer than ten

$U = \{b, m, s, d\}$
$[\![\text{Student}]\!] = \{b, m, d\}$
$[\![\text{Prof.}]\!] = \{s\}$
$[\![\text{read a book}]\!] = \{b, m, s\}$

1. At least five but fewer than ten students read a book.

$[\![\text{At least five but fewer than ten N VP}]\!]$

$$= 5 \leq |\ [\![N]\!] \ \cap \ [\![VP]\!]\ | < 10$$
$$= 5 \leq |\ [\![\text{student}]\!] \ \cap \ [\![\text{read a book}]\!]\ | < 10$$
$$= 5 \leq |\ \{b, m, d\} \cap \{b, m, s\}\ | < 10$$
$$= 5 \leq |\ \{b, m\}\ | < 10$$
$$= 5 \leq 2 < 10$$

This sentence is **False**.

Assertion and Presupposition: Two subspecies of entailment

Presupposition

- Let's begin with a simple sentence:

  1. John regrets voting for Biden.

- What does it mean?

- Well, we haven't seen a semantic rule for sentences like (1), but it would probably shake out something like this:

  a. ⟦ John ⟧ $\in$ ⟦regrets his vote (for Biden)⟧ and
  b. ⟦ John ⟧ $\in$ ⟦voted for Biden⟧

- This meaning has two parts. The first kind is called **Assertion,** and the second kind is called **Presupposition.**
- Do they have equal status?

Unequal status

- Consider (1) (the negation of our test sentence) and then (a) and (b):

1. John **doesn't** regret voting for Biden.
    a. ⟦ John ⟧ ∈ ⟦ regrets her vote ⟧
    b. ⟦ John ⟧ ∈ ⟦ voted for Biden⟧

- What do you notice?
    - Line (a) doesn't seem to be part of the meaning anymore
    - But *line (b) still does!*

- **Assertion is cancelled by negation. Presupposition survived the negation.**

Presupposition: In terms of entailment

- A sentence S1 presupposes S2 only for the case where S1 entails S2 and the negation of S1 also entails S2.

- To represent it. We write *S1* ⇝ S2.

  - ‘*S1* ⇝ *S2*’ means that *S1* ⊨ *S2*, and ‘*not S1*’ ⊨ *S2*

An example:

1. John regrets voting for Biden.
2. John doesn’t regret voting for Biden.
3. John voted for Biden.

- (1) ⊨ (3), and (2) ⊨ (3). Therefore, (1) ⇝ (3).

Presupposition as shared knowledge and accomodation

- Presuppositions are **shared assumptions** about the way the world is (i.e., they are pre-supposed). If you (addressee) and I both take something for granted, I can use a **presupposition**.

- Often, we are happy to **accommodate** presuppositions if we don't find them to be too surprising:

  1. I'm going to pick up **my brother** from the airport.

- But if the presupposition is too surprising, we might be somewhat reluctant to accommodate it:

  2. I'm going to pick up **my tiger** from the zoo.

A natural response to (2) is something, "Wait, what? You have a tiger?"

Presupposition triggers

Definite descriptions:

1. The King of France is bald ⇝ There's a King of France

Possessives:

2. John met my pet goldfish ⇝ I have a pet goldfish

Change-of-state verbs:

3. John quit smoking ⇝ John has smoked

***It*-clefts**:

4. It was John who read the book ⇝ Somebody read the book

Implicative verbs:

5. John managed to lift the bag of flour ⇝ John tried to lift the bag

Quantifier movement

Ambiguity with quantifiers

- Do you think that (1) is ambiguous?

1. **A linguist** saw **every philosopher**.

- How about (2)?

2. **A guard** was standing in front of **every building**.

- When an indefinite quantifier NP like *a linguist* and a universal quantifier NP like *every philosopher* occur in a sentence, the result is **ambiguity**.

Ambiguity with quantifiers

- We can think of (1)'s ambiguity in terms of situations

1. **A linguist** saw **every philosopher**.

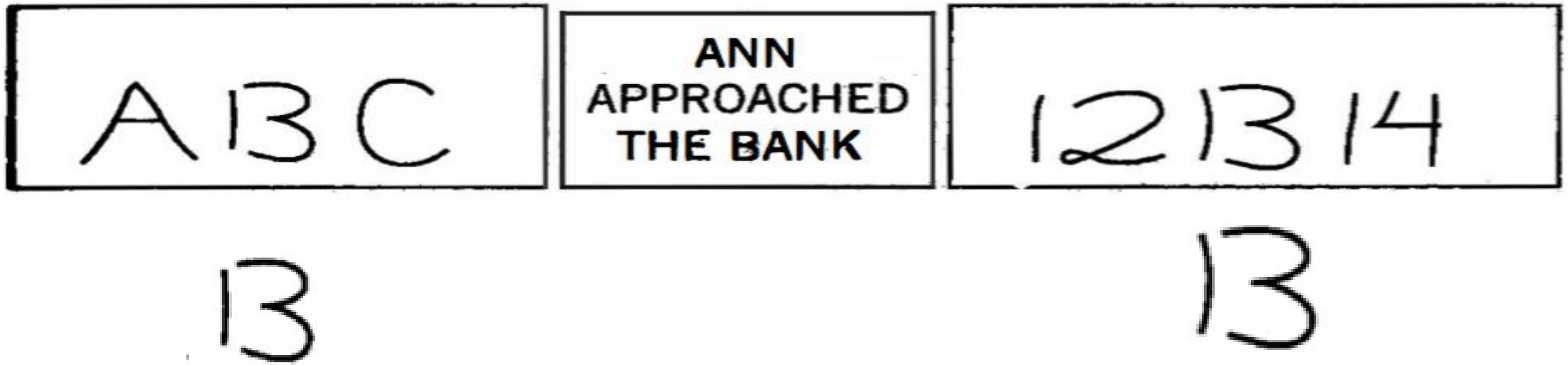
Two situations. The left dots are linguists, the right dots are philosophers, and the arrows show you who sees who.

- On the left, there's a linguist who sees every philosopher.
- On the right, every philosopher is seen by some linguist.

Ambiguity resolution

- Probably you've never noticed quantifier ambiguity before!

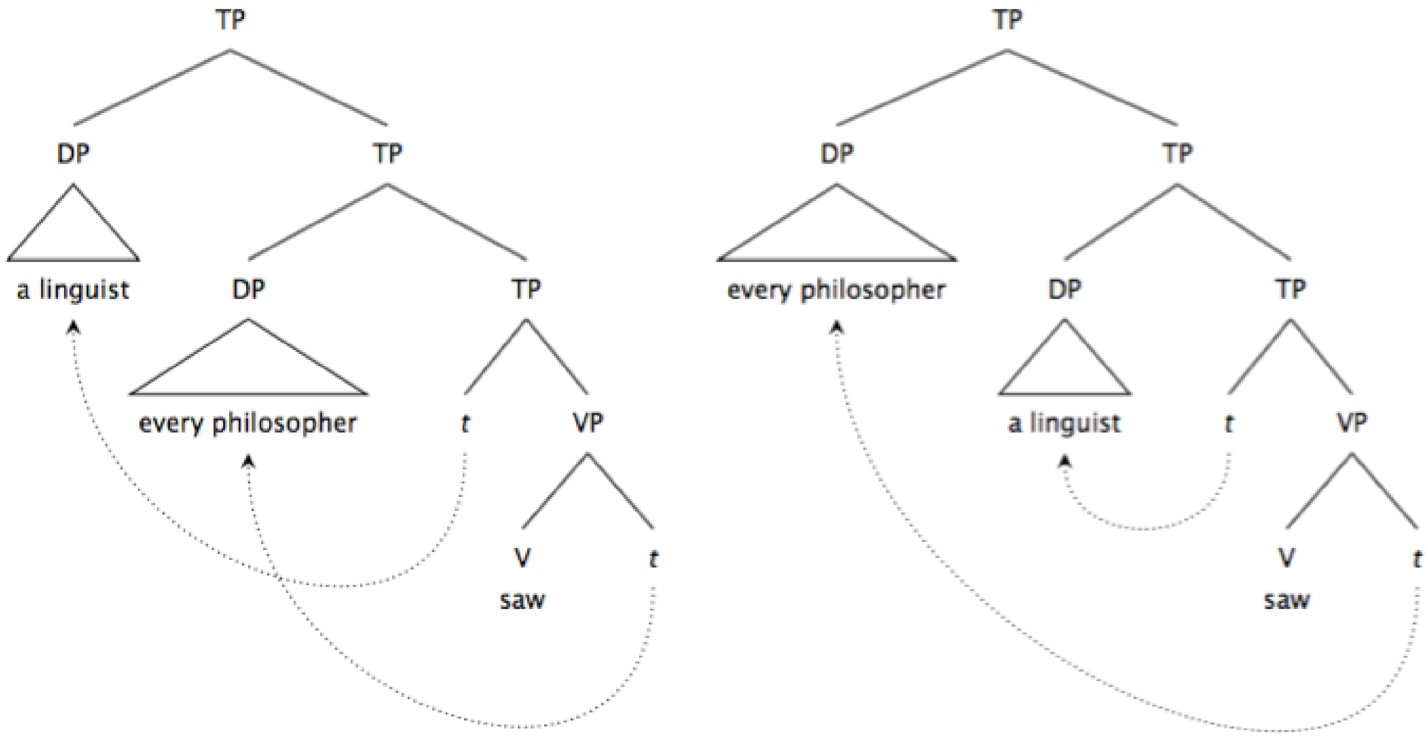
- Read the following image left to right:



- This image (from Daniel Kahneman's *Thinking, Fast and Slow*). It suggests that **context leads us to automatically** choose among ambiguous meanings, i.e., without noticing.

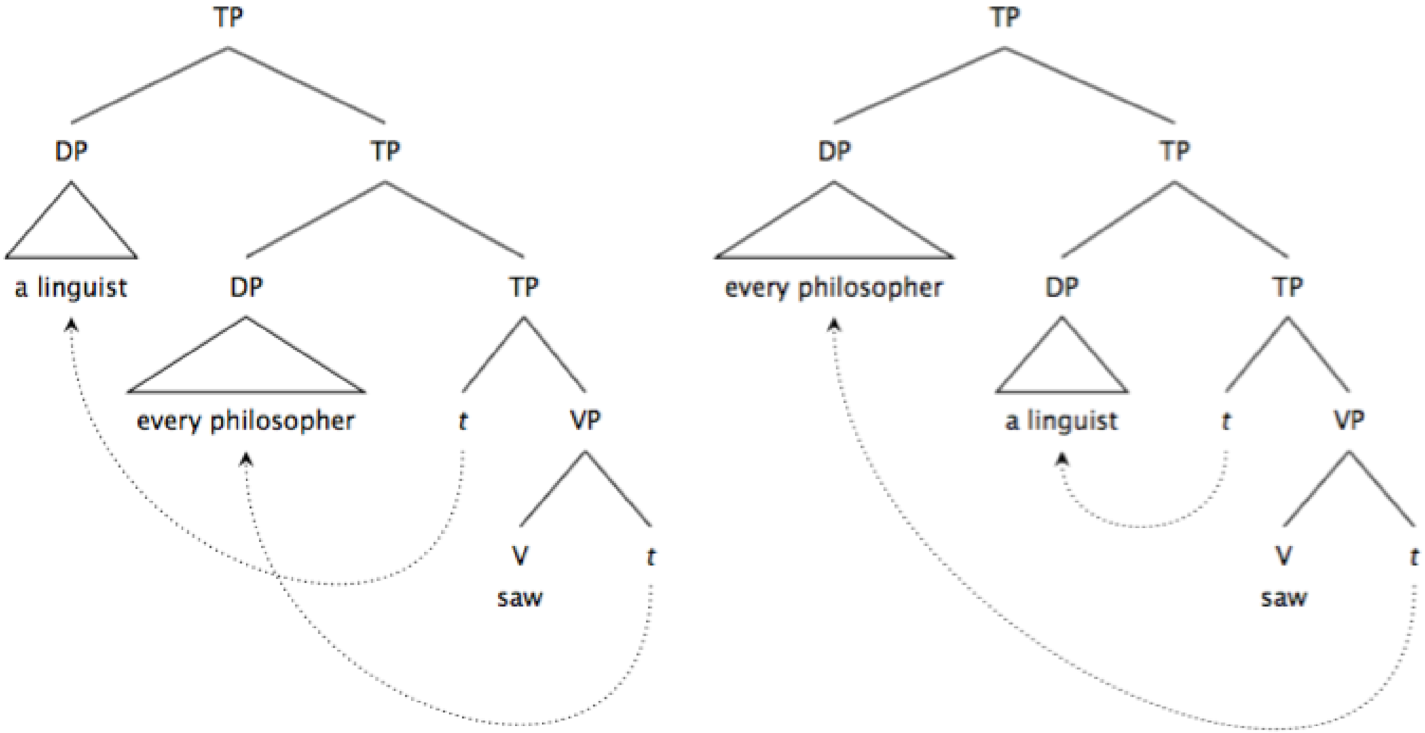
Ambiguity with quantifiers

- The standard answer: (a new kind of) structural ambiguity.
- An *unpronounced* level of syntax is called **LF** (for 'logical form').



- The tree on the left: 'There's a linguist who saw every philosopher'.
- The tree on the right: 'Every philosopher was seen by some linguist'.

Terminology



- When quantifiers in LF have the same order they have in the spoken sentence, we call that reading **surface scope**. (the left tree)

- When quantifiers in LF have the opposite order they have in the spoken sentence, we call that reading **inverse scope**. (the right tree)

What kind of ambiguity is quantifier ambiguity?

- *D*oes not seem structural (a type we have seen so far)

  (Mary *saw the elk from France*)!

- And does not seem lexical (*bank*$_1$, *bank*$_2$).

- So, what could it be?

Quantifier ambiguity as a syntactic ambiguity: Evidence for LF

Hungarian

1. a. Sok ember mindenkit felhívott.
   many man-nom everyone-acc up-called
   'Many men phoned everyone =
   There are many men who each phoned everyone.'

   b. Mindenkit sok ember felhívott.
   everyone-acc many man-nom up-called
   'Many men phoned everyone =
   For everyone, there are many men who phoned him
   (a potentially different set of callers for each case).'

English

2. **Many volunteers** called up **everyone**.

Quantifier ambiguity as a syntactic ambiguity: Evidence for LF

Hungarian

2. a. Hatnál több ember hívott fel mindenkit.
six-than more man-nom called up everyone-acc
'More than six men phoned everyone =
There are more than six men who each called everyone.'

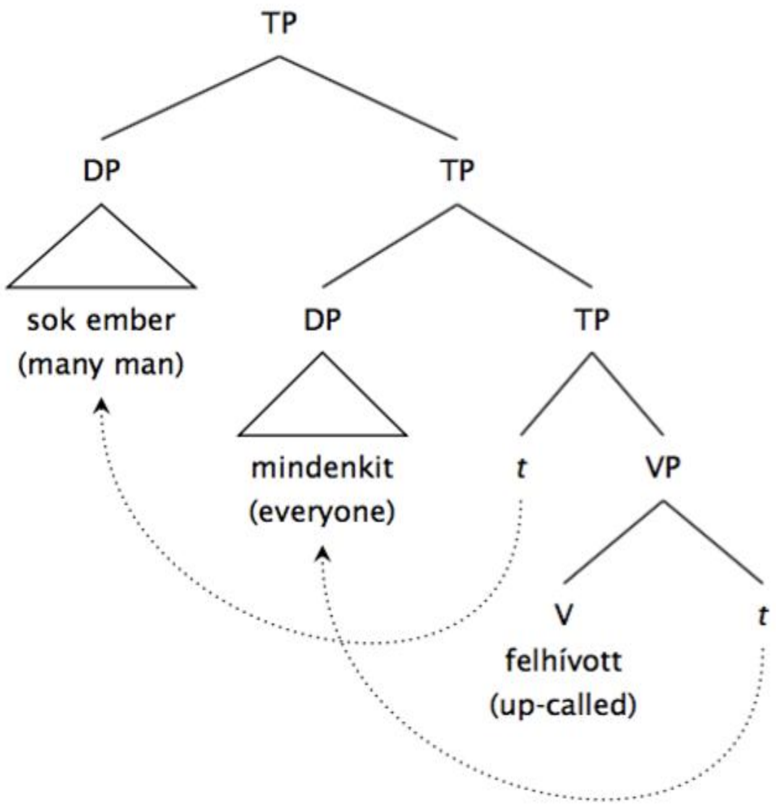
b. Mindenkit hatnál több ember hívott fel.
everyone-acc six-than more man-nom called up
'More than six men phoned everyone =
For everyone, there are more than six men who called him
(a potentially different set of caller for each case).'

English

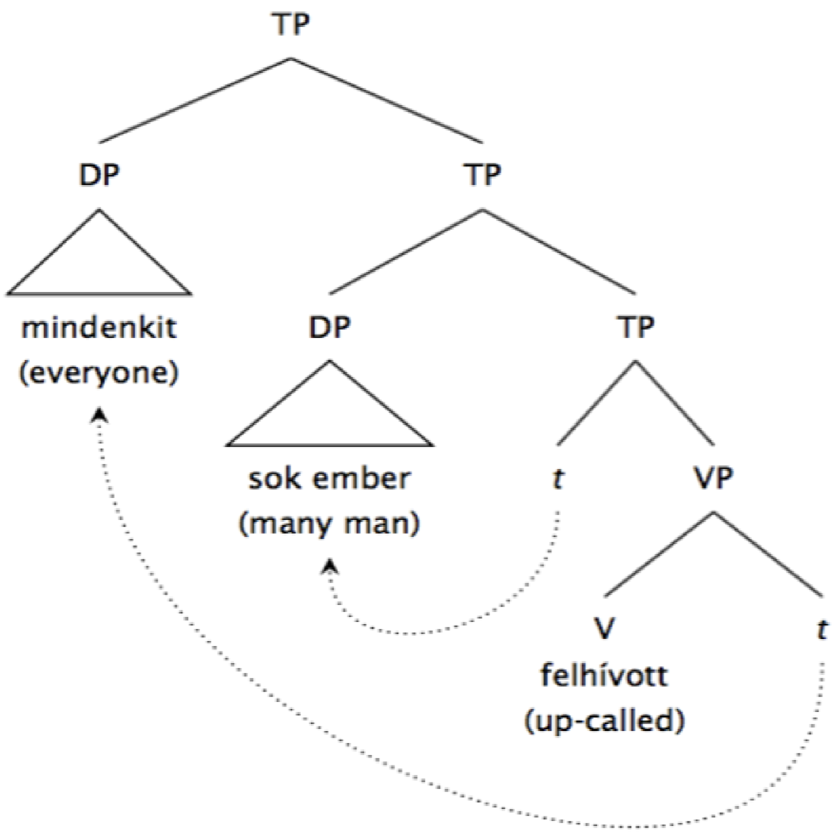
2. **More than six volunteers** called up **everyone**.

Hungarian

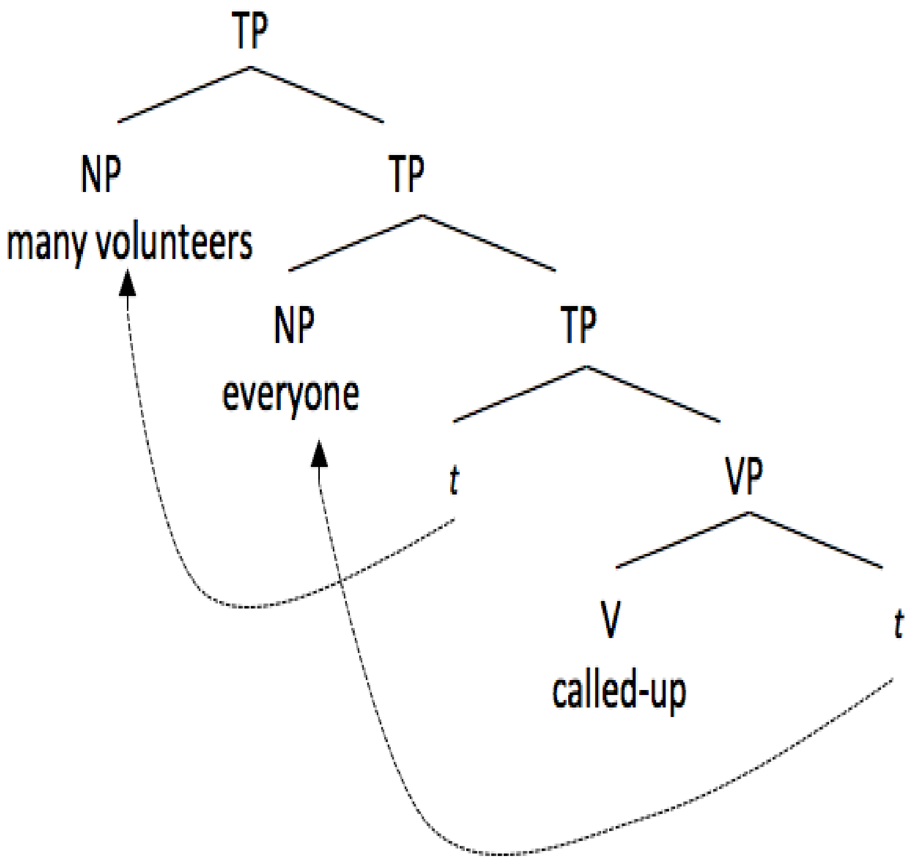
1a.



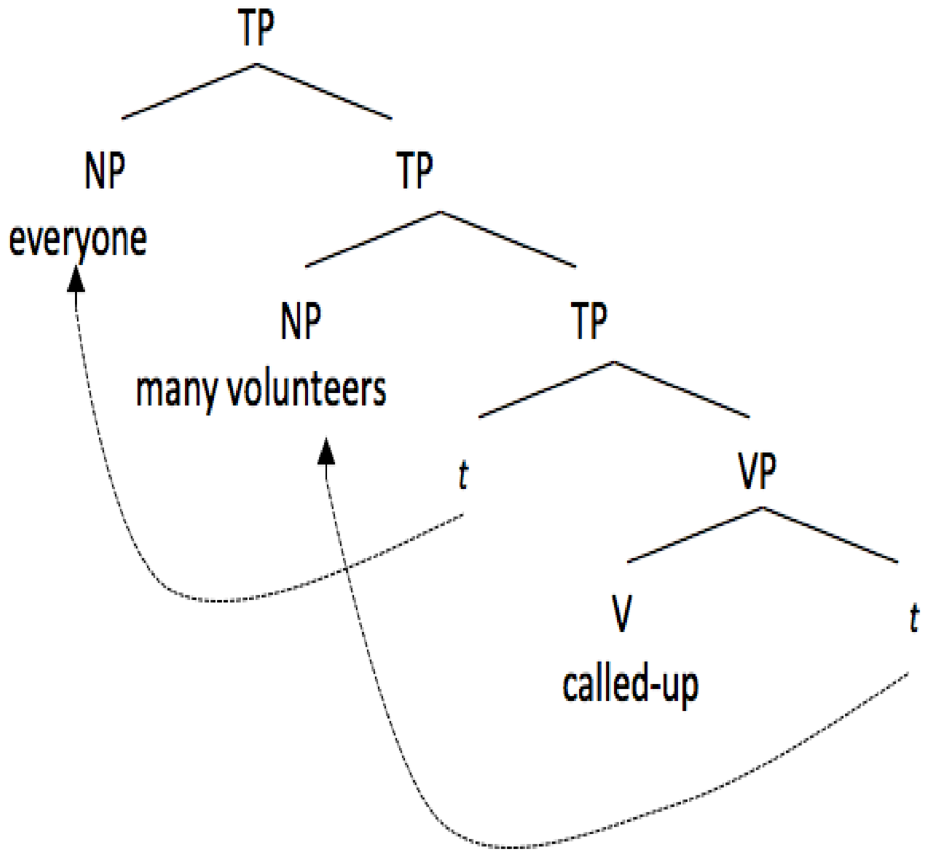
1b.



English

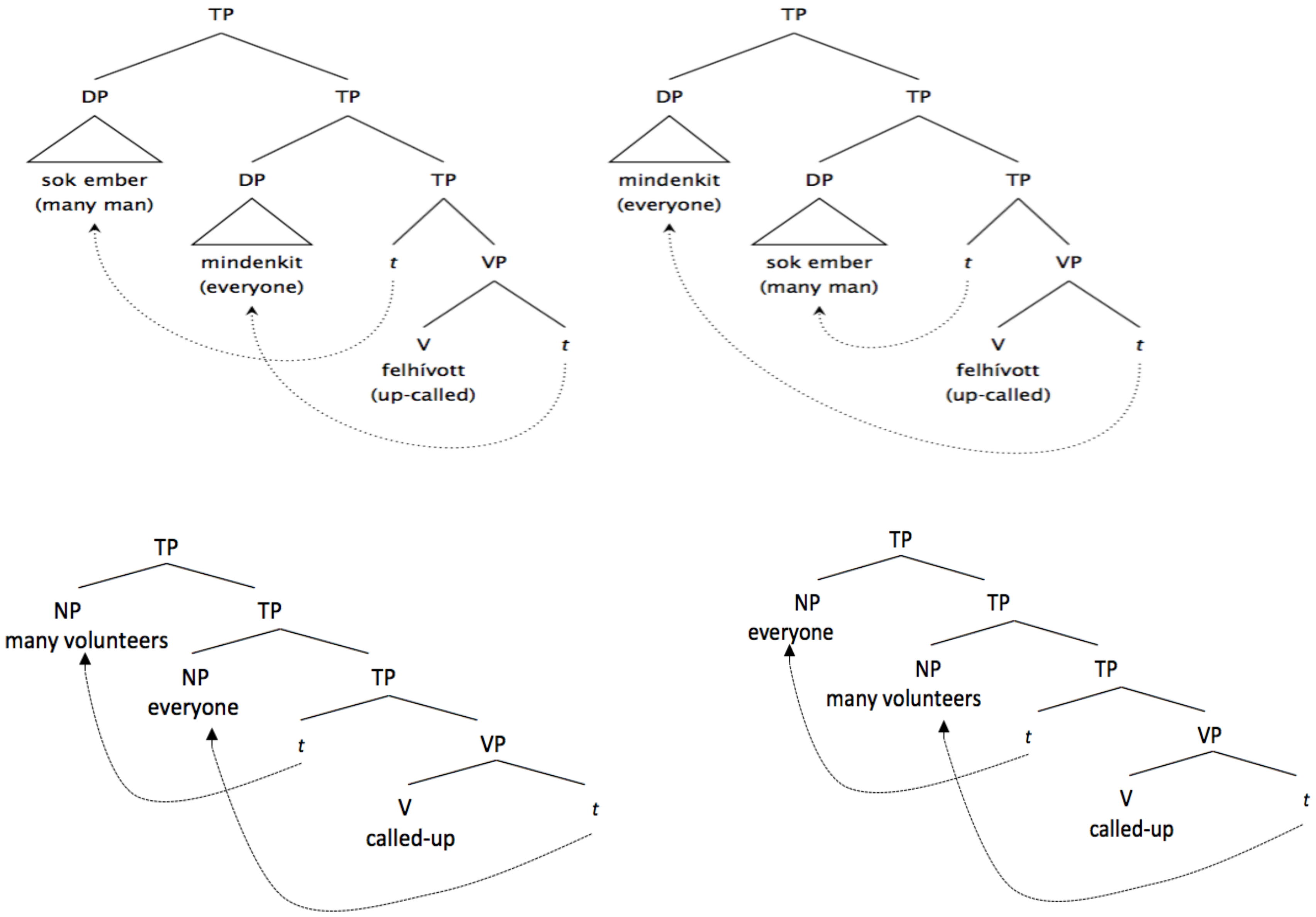


Surface scope



Inverse scope

English vs. Hungarian: Covert and overt movement



In both English and Hungarian, quantifiers move around, but they do so **overtly** – i.e., in a way you can hear! in Hungarian and **covertly** i.e. you can't hear in English!

Coming back to structural ambiguity: The influence of syntax

- Does (1) seem ambiguous?

1. I saw **a guard** who was standing in front of **every building**.

No!

- But (2) is

2. **A guard** was standing in front of **every building**.

- Generalization:
  - We do not always get an ambiguity when we have two quantifiers in a sentence. The structure of the sentence matters.

The influence of syntax

- We treat quantifier ambiguity in terms of movement.
- We already know that movement is not always possible.

1. Who do you think that John will question ___t_ first?
2. Who do you think John will question _t___ first?
3. Who do you think ___t_ will question John first?
4. *Who do you think that ___t_ will question John first?

The influence of syntax

- (1) is not ambiguous but (2) is
  1. I saw **a guard** who was standing in front of **every building**.
  2. **A guard** was standing in front of **every building**.

- You can't move a wh in (1), as shown in (3), but you can in (2), as shown in (4).

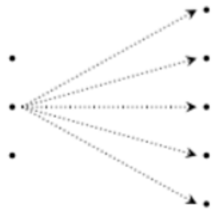
  3. *What did you see a guard who was standing in front of _?
  4. What was a guard standing in front of _?

Quantifier movement cross-linguistically

- Not all languages allow quantifiers to quietly move around!

- In Mandarin Chinese, only surface-scope readings are possible:

1. You yitiao shayu gongji-le meige haidao.
   Have one shark attacked every pirate
   'A shark attacked every pirate.'



Ambiguity with quantifiers and negation

- Is the following sentence ambiguous?

1. I **didn't** read **a book by Premchand**.
   - ➤ It can mean I didn't read any books by Premchand.
   - ➤ Or it can mean there's a book by Premchand I didn't read.

situation-1 situation-2

- Two situations. The left dot is me, and the right dots are the books by Premchand (of course, he wrote more than 5!). The arrows tell you what I read.
   - ➤ On the left, I didn't read any Premchand books.
   - ➤ On the right, there's a Premchand book I didn't read. (for example, *Gaban*)

Tutorial/Practice

Review: Interpretation of sentences with quantifiers

- Quantified statements express some kind of **relationship that holds between two sets**, namely N and VP.

$$[\![\text{every N VP}]\!] = [\![\text{N}]\!] \subseteq [\![\text{VP}]\!]$$

$$[\![\text{a N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] \neq \emptyset$$

$$[\![\text{no N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] = \emptyset$$

$$[\![\text{exactly three N VP}]\!] = |\, [\![\text{N}]\!] \cap [\![\text{VP}]\!] \,| = 3$$

$$[\![\text{most N VP}]\!] = |[\![\text{N}]\!] \cap [\![\text{VP}]\!]| > \frac{1}{2} \times |[\![\text{N}]\!]|$$

$$[\![\textit{at least five, but fewer than ten N VP}]\!] = 5 \leq |[\![\text{N}]\!] \cap [\![\text{VP}]\!]| < 10$$

Practice: A small scenario

$U = \{a, b, c, d, j\}$

$[\![\text{Human}]\!] = \{a, b, c, d, j\}$

$[\![\text{student}]\!] = \{a, b, c, j\}$

$[\![\text{male student}]\!] = \{a, j\}$

$[\![\text{female student}]\!] = \{b, c\}$

$[\![\text{passed the test}]\!] = \{a, b, c\}$

1. Every student passed the test.
2. A student passed the test.
3. No student passed the test.
4. Exactly three students passed the test.
5. Most students passed the test.
6. At least five but fewer than ten students passed the test.

Solution

1. Every student passed the test.

$[\![$Every student passed the test$]\!]$

$= [\![\text{ student }]\!] \subseteq [\![\text{passed the test }]\!]$ $\quad [\![\text{ every N VP }]\!] = [\![\text{ N }]\!] \subseteq [\![\text{ VP }]\!]$

$= \{a, b, c, j\} \subseteq \{a, b, c\}$

This sentence is **False**.

Solution

2. A student passed the test.

$[\![\text{student passed the test}]\!]$

$= [\![\text{student}]\!] \cap [\![\text{passed the test}]\!] \neq \emptyset$ $\quad [\![\text{a N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] \neq \emptyset$

$= \{a, b, c, j\} \cap \{a, b, c\} \neq \emptyset$

$= \{a, b, c\} \neq \emptyset$

This sentence is **True**.

3. No student passed the test.

$[\![\text{No student passed the test}]\!]$

$= [\![\text{student}]\!] \cap [\![\text{passed the test}]\!] = \emptyset$ $\quad [\![\text{no N VP}]\!] = [\![\text{N}]\!] \cap [\![\text{VP}]\!] = \emptyset$

$= \{a, b, c, j\} \cap \{a, b, c\} = \emptyset$

$= \{a, b, c\} = \emptyset$

This sentence is **False**.

Solution

2. Exactly three students passed the test.

$$\llbracket \text{Exactly three students passed the test} \rrbracket$$
$$= | \llbracket \text{student} \rrbracket \cap \llbracket \text{passed the test} \rrbracket | \neq \emptyset$$
$$= | \{a, b, c, j\} \cap \{a, b, c\} | \neq \emptyset$$
$$= | \{a, b, c\} | \neq \emptyset$$
$$= 3 \neq \emptyset$$

This sentence is **True**.

$$| \llbracket N \rrbracket \cap \llbracket VP \rrbracket | = 3$$

3. Most students passed the test.

$$\llbracket \text{Most students passed the test} \rrbracket$$
$$= | \llbracket \text{student} \rrbracket \cap \llbracket \text{passed the test} \rrbracket | > \frac{1}{2} | \llbracket \text{student} \rrbracket |$$
$$= | \{a, b, c, j\} \cap \{a, b, c\} | > \frac{1}{2} | \llbracket \text{student} \rrbracket |$$
$$= | \{a, b, c\} | > \frac{1}{2} | \llbracket a, b, c, j \rrbracket |$$
$$= 3 > \frac{1}{2} 4 = 3 > 2$$

This sentence is **true**.

$$| \llbracket N \rrbracket \cap \llbracket VP \rrbracket | > \frac{1}{2} \times | \llbracket N \rrbracket |$$

Solution

6. At least five but fewer than ten students passed the test.

$[\![$At least five but fewer than ten students passed the test$]\!]$

$= 5 \leq | \; [\![\text{student}]\!] \; \cap \; [\![\text{passed the test}]\!] \; | < 10$ $\quad 5 \leq |[\![N]\!] \cap [\![VP]\!]| < 10$

$= 5 \leq |\{a, b, c, j\} \cap \{a, b, c\}| < 10$

$= 5 \leq |\{a, b, c\}| < 10$

$= 5 \leq 3 < 10$

This sentence is **False**.