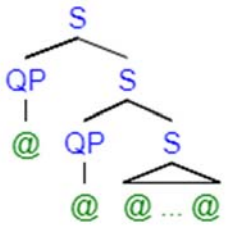
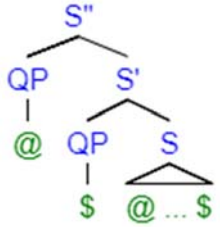
II. What looks like one QP may turn out to be two QPs that interact with other logical operators in the sentence[i_Readings]

We showed that QPs are not all alike (@), and QR is not a single omnivorous rule:



wrong

A minimal improvement, where @ and $ are not alike, and there may be different rules with different targets:

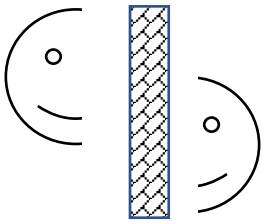


Our minimal improvement still assumes that QPs are impenetrable wholes (@, $).
The scope assignment rule grabs the QP in one chunk.
Are those assumptions always justified?

It turns out that many QPs that form a single constituent on the surface consist of two quantifiers that split up in Logical Form and can interact separately with other operators in the sentence. Three kinds of evidence:

- Ambiguities (extra readings) that the non-split interpretations do not predict, in the presence of a harmless scopal intervener.
- Missing readings that the non-split interpretations leave unexplained, in the presence of a harmful scopal intervener.
- Sometimes the same splits also occur in surface syntax.

Surface QP: 

LF: 

Some linguistic constructions that provide such evidence:

- numeral questions (*how many people, combien de voitures*)
- comparative quantifiers (*more than three people, taller than 4 feet, 5 pages longer than that*)
- relative superlatives (*the tallest mountain; the most/fewest mountains*; *ichiban/ mottomo* `most'; *aktar šey `most thing'*)
- definites (*the rabbit in the hat*)
- negative indefinites (*no deposit, at most three attempts, kein Professor, ninguna chaqueta*)

II/a. How many quantifiers in *how many* phrases?

(20) How many people do you think I **should** talk to?
(i) Good answer: Five. It doesn't matter who they are. (amount n)
(ii) Good answer: The following five: A, B, C, D, E. (individuals x)

(i) '<u>for what n</u>, you think that there **should** be <u>n-many people</u> that I talk to'
(amount reading of *how many people:* *n-many...* below *should*)

(ii) '<u>for what n</u>, <u>there are n-many people x</u> such that you think I **should** talk to x'
(individual reading of *how many people:* *n-many...* above *should*)

The **ambiguity** of (20) can be described by splitting the interpretation of the QP *how many people* into (at least) two quantifiers, with the modal *should* either (i) intervening between them or (ii) scoping below both of them. Intervention would not be possible if *how many people* were an impenetrable @.

The presence of *should* highlights the fact that the QP splits. *How many people did you talk to?* may be considered ambiguous too, but it may be difficult to convince people of the ambiguity.

(ii) is a separate reading. Proof: (i) may be unavailable but (ii) remains:

(21) How many people do you **regret** that Mary talked to?
(i) Not a good answer: Five. It doesn't matter who they are. (# amount)
(ii) Good answer: The following five: A, B, C, D, E. (individual)

The lack of ambiguity in (21) indicates that splitting is fragile. The intervention of some operators (like *should*) between the two segments is harmless, but the intervention of many others (like *regret*) causes unacceptability. -- Intervention effects will also explain missing readings in other constructions, see below.

French *combien* `how much/many' can split out either covertly or **overtly**

(22) <u>Combien de voitures</u> **doit-il** avoir conduit? (ambiguous)
how.many of cars must-he have driven

amount: `for what number n, it must be that there are n cars that he drove'
individual: `for what number n, there are n cars that he must have driven'

(23) <u>Combien</u> **doit-il** avoir conduit <u>de voitures</u>? (only amount reading)

amount: `for what number n, it must be that there are n cars that he drove'
individual: *

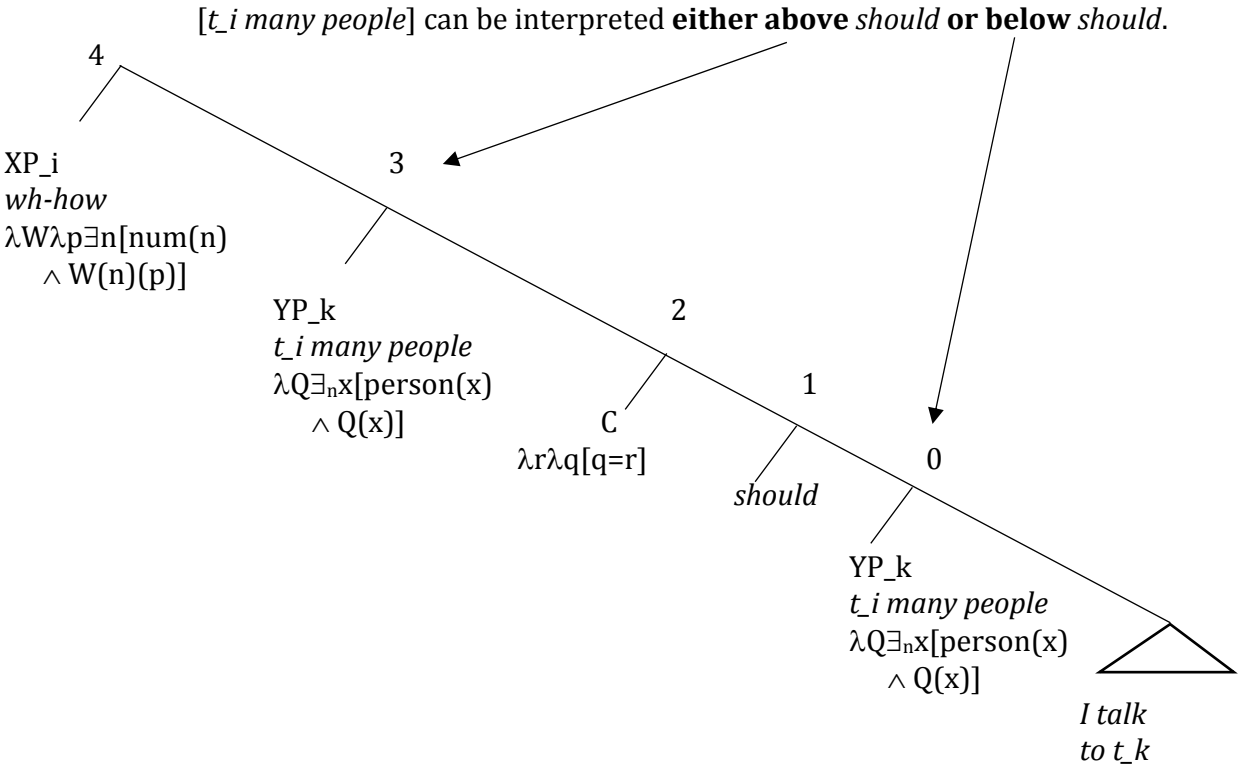
One-word `how many' exhibits the same Logical Form split: Russian *skol'ko*, Spanish *cuantos*, Hungarian *hány*.

OPTIONAL Cresti 1995 formalizes the two readings of (20) as follows.

A question denotes the set of propositions: its possible answers (Karttunen 1977).
The caret in ^ϕ forms propositions from sentences (modern notation: λw[ϕ(w)]).
$\exists_n x$ abbreviates `there are n distinct individuals': $\exists x \exists y ... [x \neq y \wedge ...]$

Amount reading:
$\lambda p \exists n[num(n) \wedge p = \hat{}should'(\hat{}\exists_n x[person'(x) \wedge talk'(I, x)])]$
`The set of possible answer-propositions p such that for any number n, the proposition that it should be the case that there are n people that I talk to is in the set'

Individual reading:
$\lambda p \exists n[num(n) \wedge p = \hat{}\exists_n x[person'(x) \wedge should'(\hat{}talk'(I, x)]]$
`The set of possible answer-propositions p such that for any number n, the proposition that there are n people such that I should talk to them is in the set'



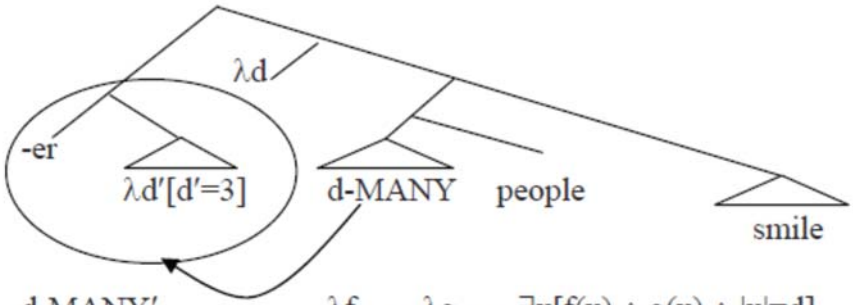
Below is the amount interpretation that we get with YP_k below *should*.
Wh-how is pre-coded using function composition, b/c a question is not of type *t*.

0: $\lambda Q \exists_n x[person(x) \wedge Q(x)] (\lambda y[I \text{ talk to } y]) =$
$\exists_n x[person(x) \wedge I \text{ talk to } x]$
1: $should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])$
2: $\lambda r \lambda q[q=r] (\hat{}should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])) =$
$\lambda q[q = \hat{}should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])]$
4: $\lambda W \lambda p \exists n[num(n) \wedge W(n)(p)](\lambda n \lambda q[q=\hat{}should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])]) =$
$\lambda p \exists n[num(n) \wedge \lambda n \lambda q[q=\hat{}should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])(n)(p)] =$
$\lambda p \exists n[num(n) \wedge p=\hat{}should(\hat{}\exists_n x[person(x) \wedge I \text{ talk to } x])]$ --- End.

- **II/b. Comparative quantifiers** (*more than three people, taller than 4 feet, 5 pages longer than that*)

Basic interpretations of comparatives (Heim 1999, Hackl 2000)

(24) More than three people smile. (MANY in caps = silent element.)



d-MANY′ $\lambda f_{\langle e,t\rangle} . \lambda g_{\langle e,t\rangle} . \exists x[f(x) \wedge g(x) \wedge |x|=d]$
-er′ $\lambda D_{\langle d,t\rangle} . \lambda D'_{\langle d,t\rangle} . \max(D) < \max(D')$
-er than 3′ $\lambda D'_{\langle d,t\rangle} . \max(\{d: d=3\}) < \max(D')$

(25) John is taller than 4 ft.

Surface, minus extraposition: John is $[_{AP}\ [_{DegP}$ -er than 4 ft] tall
LF: $[_{DegP}$ -er than 4ft$]_1$ John is $[_{AP}\ t_1$ tall]
interpretation: max{d: tall(j,d)} > 4 ft

So, *John is taller than 4 ft* is true iff the maximal degree to which John is tall exceeds 4 ft.

(26) Mary is exactly 1 inch taller than 4 ft.

(John is 4' tall.) Mary is exactly 1in taller than that.
max{d: tall(m, d)} = 4 ft 1 in

Now consider adding other operators to the sentence ("scopal interveners").

We start with modals.

(27) More than 3 people **should** smile ambiguous

(i) More than 3 is the degree D such that there **should** be D-many people who smile.
(ii) More than 3 is the degree D such that there are D-many people who **should** smile.

(28) (This draft is 10 pages.)
The paper is **required** to be exactly 5 pages longer than that. ambiguous

(28) a. (This draft is 10 pages.) The paper is required to be exactly 5 pages longer than that.
b. required [[exactly 5 pp. -er than that] the paper be t long]
$\forall w \in Acc$: $\max\{d: long_w(p,d)\} = 15pp$
c. [exactly 5 pp. -er than that] [required [the paper be t long]]
$\max\{d: \forall w \in Acc: long_w(p,d)\} = 15pp$

(28b) says that the paper is exactly 15pp long in every acceptable world. This implies that it is not allowed to be longer than 15pp.

(28c) says that the paper is exactly 15pp long in those acceptable worlds where it is shortest. This leaves open whether it might also be allowed to be longer than 15pp.

The English sentence (28a) can be understood in either one of these two ways. It is ambiguous, as we predict if DegP can move either below or above the **necessity** operator.

What about adding negation or universal quantifiers?

(17) a. Mary isn't taller than 4 feet
b. not [-er than 4'] Mary is t tall
$\neg$ max{d: tall(m,d)} > 4 ft
c. [-er than 4'] not [Mary is t tall]
max{d: $\neg$ tall(m,d)} > 4 ft

The predicted interpretation for (17)c refers to the maximum of the set of degrees to which Mary isn't tall. But that set has no maximum.[9] So if such an LF can be generated, it is a presupposition failure. Plausibly, this suffices to explain why only one reading (the one in (17)b) is attested. For all we know, (17)c may or may not be generated by the syntax; even if it is, it will be filtered out.

(21) a. (John is 4' tall.) Some girl is exactly 1" taller than that.
b. $[\text{some girl}]_1$ $[\text{exactly 1" -er than 4'}]_2$ t_1 is t_2 tall
$\exists x[girl(x) \& \max\{d: tall(x,d)\} = 4' + 1"]$
c. $[\text{exactly 1" -er than 4'}]_2$ $[\text{some girl}]_1$ t_1 is t_2 tall
$\max\{d: \exists x[girl(x) \& tall(x,d)]\} = 4' + 1"$

(22) a. (...) Every girl is exactly 1" taller than that.
b. $\forall x[girl(x) \rightarrow \max\{d: tall(x,d)\} = 4' + 1"]$
c. $\max\{d: \forall x[girl(x) \rightarrow tall(x,d)]\} = 4' + 1"$

The sentences are **unambiguous:** (21b)-(22b) represent their intuitive meanings.

What about the (c) LFs? (21c) says, in effect, that the tallest girl is exactly 4' 1", which appears not to be a possible reading. Since it is a stronger claim than (21b), though, it is a bit hard to prove that it's not an alternate reading. (Speakers may be reluctant to call something false when it's true on another reading.)

But (22c) expresses a weaker claim than (22b). So, we can construct scenarios in which (22c) is true while(22b) is false: just imagine that the shortest girl is exactly 4' 1" but some other girls are taller. If (22c) were a possible reading, then speakers should sometimes be willing to judge it true in this situation. But it clearly is false. So (22c) cannot be a grammatical LF. The DegP cannot scope over the quantificational DP.

Kennedy--Heim scopal-intervention generalization

A quantifier or negation cannot separate a DegP from the QP that it split out of.
By contrast, intensional and modal operators (e.g. *should, is required, want*) can intervene.

The data motivating the Kennedy--Heim intervention generalization in turn provide **evidence for the split.** If *how many* phrases and comparatives did not split, then neither the ambiguities, not the missing readings would arise.

Before going on, we may look back to yesterday's observation that comparative quantifiers do not take inverse scope over distributive universals:

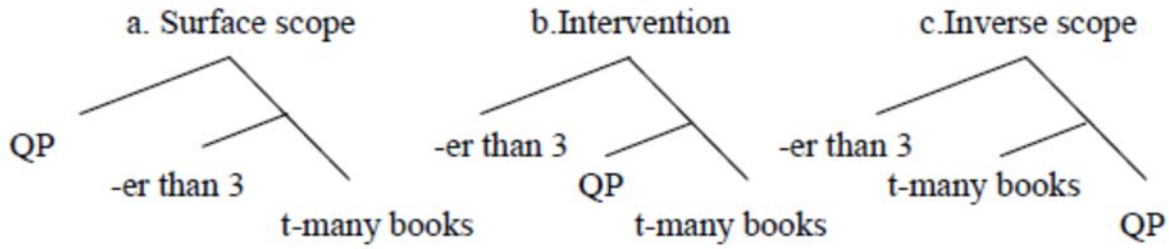
(29) Every student read more than 3 books. unambiguous, no inverse scope

We have seen that (b) with intervention is bad.

If the grammar is set up in such a way that (c) inverse scope can only be produced stepwise, so that first the intervention structure is produced, then in fact the inverse configuration cannot be produced (Takahashi 2006).

a. The decomposition of *more than* n *NP* into *-er than* n and *t-many NP* (Heim 2001; Hackl 2000).
b. Quantifier Raising forced by type mismatches, subject to Shortest Move.
c. Optional Quantifier Lowering, subject to Shortest Move.
d. Shortest Move: QR/QL targets the closest node of type t (Fox 2000).
e. Intervention constraint: A quantificational DP cannot intervene between DegreeP and its trace (Kennedy 1999, Heim 2001, and much literature on weak islands).
f. Scope Economy: Covert QR/QL cannot be semantically vacuous (Fox 2000).
g. Results regarding when scope commutativity obtains with comparative quantifiers (Heim 2001).

Only the (a) surface scope can come about.



So, the splitting analysis of comparative quantifiers can be used to explain a general observation about the deficient inverse scope taking abilities of those quantifiers. (Takahashi 2006)

- **II/c. Superlatives**

Superlatives have two readings. The (a) readings have been called "**absolute** superlatives" and the (b) readings "**relative** (or comparative) superlatives".

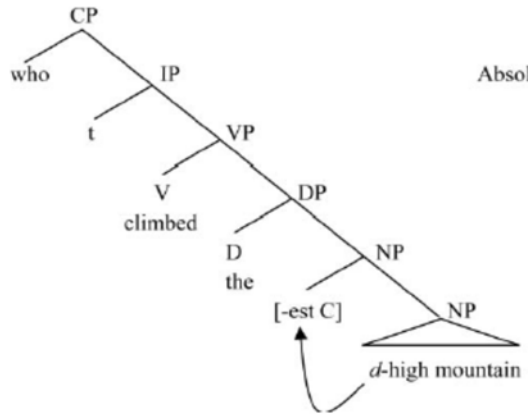
(30) Who climbed the highest mountain?
a. Who climbed the highest among the mountains, i.e. Mt. Everest?
b. Who climbed a higher mountain than how high a mountain anyone else climbed?

(31) Who wrote the largest prime number on the blackboard?
a. No one, of course! There is no largest prime number!
b. Kati wrote 11, Mari wrote 3, and Peti wrote 7, so Kati did.

The absolute readings come about with a small movement of the superlative morpheme, which is very similar to the small movement of the *more than 3* segment in comparatives.

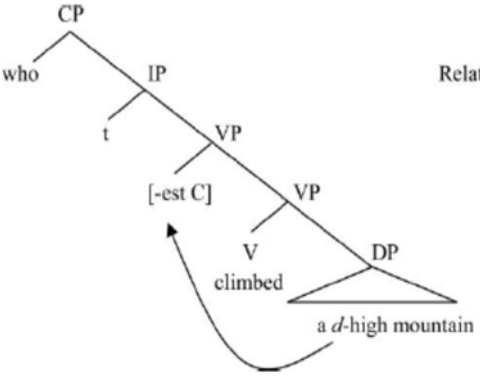
According to Szabolcsi (1986), Heim (1985, 1999), the relative readings involve a much more ambitious movement. This is clear from the fact that the comparison involves the predicate of the sentence, not only the noun in the DP.

Hackl (2009) represents the two readings adopting Heim's (1985, 1999) semantics. The variable C introduces a contextually relevant set of entities; mountains in (a), climbers in (b). *max* picks the maximal degree *d* in the set defined in {*d: . . . d . . .*}.



Absolute:

Interpretation of NP-adjunction of [-est C]:
$[[\ [\text{-est C}\ ]_i\ [d_i\text{-high mountain}]\ ]] = \lambda x.\forall y \in C\ [y \neq x \rightarrow \max\{d\text{: x is a d-high mnt}\} > \max\{d\text{: y is a d-high mnt}\}]$



Relative:

Interpretation of VP-adjunction of [-est C]:
$[[\ [\text{-est C}\ ]_i \text{ climbed } [d_i\text{-high mountain}]\ ]] = \lambda x.\forall y \in C\ [y \neq x \rightarrow \max\{d\text{: x climbed a d-high mnt}\} > \max\{d\text{: y climbed a d-high mnt}\}$

Can an operator intervene between the two parts (**-est C** and **a d-high mountain**)?

As above, a modal or an intensional verb can intervene in the relative reading:

(32) Who **must** climb the highest mountain?

a. Who **must** climb Mt. Everest? (absolute)
b. Who **must** climb a mountain that is higher than how high a mountain anyone else climbs? (relative)
b. Who **must** climb a mountain that is higher than how high a mountain anyone else **must** climb? (relative with modal intervention)

(33) Who wants to climb the highest mountain?

a. Who **wants** to climb Mt. Everest? (absolute)
b. Who **wants** to climb a mountain that is higher than how high a mountain anyone else climbs? (relative)
b. Who **wants** to climb a mountain that is higher than how high a mountain anyone else **wants** to climb? (relative with *want*-intervention)

Similar ambiguities also exist in so-called amount superlatives. In English, the absolute and the relative readings take different shapes, but in many other languages, e.g. Hungarian (*a legtöbb)* and German (*die meiste*), the two look identical.

(34) Who climbed **most of the** mountains?
`Who climbed a majority of the mountains?' (absolute)

(35) Who climbed **the most** mountains?
`Who climbed more mountains than how many mountains anyone else climbed?' (relative)

Relative superlatives show several interesting things.

Not only a smaller phrase can split out of a larger phrase (*more than three--many books*) but also part of a word, an inflectional affix can (*-est -- tall-mountain*).

The *-est* part of the superlative can even scope into a higher clause (see *wants to*).

The assumption that these readings involve split is supported by the fact that in Japanese (Aihara 2009) and Syrian Arabic (Hallman 2016), the superlative parts (*ichiban, mottomo* `most' and *aktar šey `most thing'*) can split away from the nominal part even in surface syntax:

(36) a. John$_i$-ga [PRO$_i$ **ichiban** takai yama-ni nobor] -itaga-tteiru.
John-NOM most high mountain-to climb -want-be

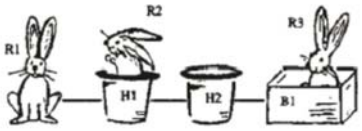
b. **Ichiban**$_k$ John$_i$-ga [PRO$_i$ t$_k$ takai yama-ni nobor] -itaga-tteiru.
most John-NOM high mountain-to climb -want-be

'John wants to climb the highest mountain. Its only meaning:
John's desire for the minimum height of mountains is higher than others'

- **II/d. Definites: the rabbit in the hat**

a. 

(no other rabbits or hats)

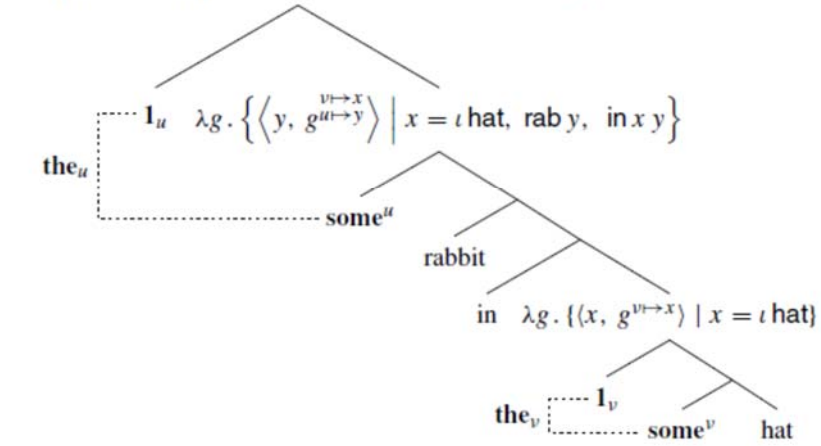
b. 

Bumford 2017 assimilates these to the absolute and relative readings of superlatives.

(17) the rabbit in the hat

a. Absolute reading: exactly one hat, with exactly one rabbit in it

$$\lambda g.\left\{\left\langle y,\ g^{v\mapsto x}_{u\mapsto y}\right\rangle \mid x = \iota\,\mathsf{hat},\quad y = \iota y.\,\mathsf{rab}\,y \wedge \mathsf{in}\,x\,y\right\}$$

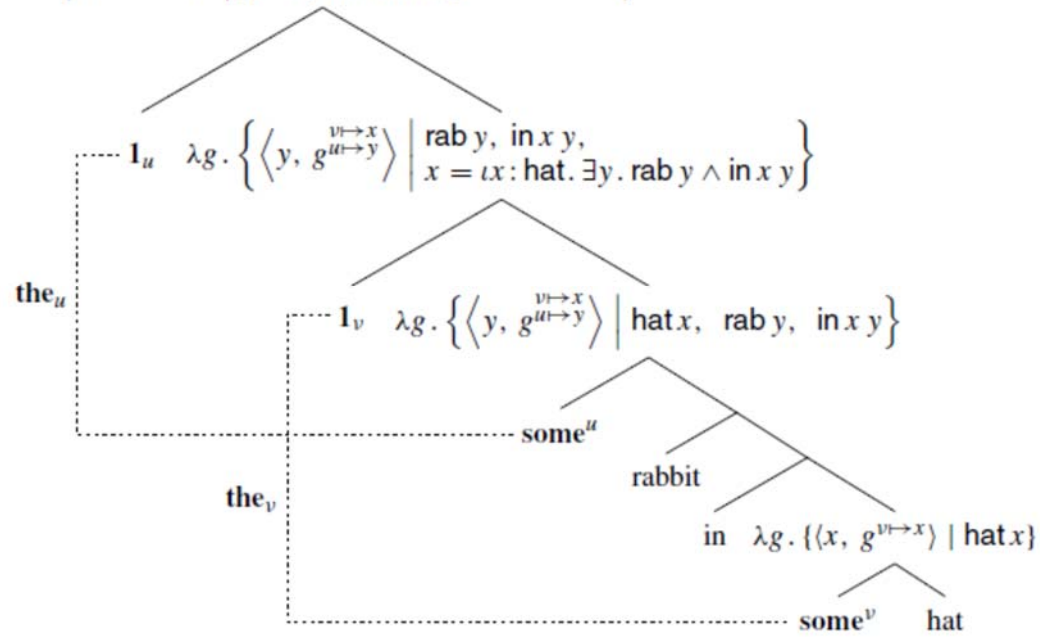


Recall Russell's **the**: existence plus unicity

$\exists x[\text{rabbit}(x) \wedge \forall y[\text{rabbit}(y) \rightarrow x{=}y] \wedge \text{in-the-hat}(x)]$

b. Relative reading: exactly one rabbit–hat pair[a]

$$\lambda g.\left\{\left\langle y,\ g^{v\mapsto x}_{u\mapsto y}\right\rangle \mid \begin{array}{l} x = \iota x\colon \mathsf{hat}.\,\exists y.\,\mathsf{rab}\,y \wedge \mathsf{in}\,x\,y,\\ y = \iota y\colon \mathsf{rab}.\,\mathsf{in}\,x\,y\end{array}\right\}$$



In the same spirit, but the two definites are inter-leaved in interpretation: there is a hat, and there is a rabbit, and there is a unique hat with a rabbit in it, and there is a unique rabbit in a hat.

- **II/e. Negative indefinites**

(37) You need no husband ¬ > must > ∃
`It is not the case that you must have a husband'

These are a somewhat different kind of split scope (Penka 2011).

In contrast to Negative Concord (NC) languages, in non-NC languages, each negative indefinite (NI) contributes a negation to the semantics. It seems simplest to assume that NIs in non-NC languages are negative quantifiers, as it is often done (e.g. Zeijlstra 2004). There is, however, evidence indicating that in non-NC languages, too, NIs are associated with sentential negation.

The salient reading of sentence (10) is the one paraphrased as (10a).

(10) Bei der Prüfung muss **kein Professor** anwesend sein. (German)
at the exam must n-DET professor present be
a. 'It is not required that there be a professor present.' ¬ > must > ∃
b. 'There is no professor who is required to be present.' ¬ > ∃ > must
c. ?? 'It is required that there be no professor present.' ?? must > ¬ > ∃

Split readings also arise when NIs serve as objects of transitive intensional Vs, as in (11).

(11) Der Verletzte braucht keinen Arzt. (German)
the injured need n-DET doctor
a. `The injured doesn't need a doctor.' ¬ > need > ∃
b. `There is no doctor that the injured needs' ¬ > ∃ > need
c. * `What the injured needs is not to have a doctor.' * need > ¬ > ∃

With transitive intensional verbs, the only readings possible are where negation takes wide scope over the modal, that is, the split reading (11a) and the *de re* reading (11b). The reading (11c) where both negation and the indefinite are interpreted below the modal is excluded.

(24) No hace falta que te pongas ninguna chaqueta. (Spanish)
NEG makes need COMP you wear.SBJ n-DET jacket
a. `You dont need to wear a jacket.' ¬ > need > ∃
b. `There is no particular jacket that you need to wear' ¬ > ∃ > need

[i] **Readings for Tuesday:**

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Ch 5.6 Comparative and superlative... pp. 77-80;
Ch 9.3--9.4 Cardinal vs. individual..., pp. 151-160.

Takahashi, Shoichi 2006. More than two quantifiers. *Natural Language Semantics* 17: 57–101.