Drawing out LF and QR

Simon Charlow (simon.charlow@rutgers.edu)

November 2, 2015

1 Summing up quantifiers

- Quantified DPs are **generalized quantifiers**, type $\langle\langle e, t\rangle, t\rangle$. They take properties into truth values:

$$[\![\text{between five and seven linguists}]\!]^g = \lambda P.\, 5 \leqslant |\textsc{ling} \cap P| \leqslant 7$$

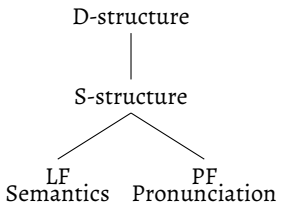
- Quantificational determiners are are type $\langle\langle e, t\rangle, \langle\langle e, t\rangle, t\rangle\rangle$. They take properties into generalized quantifiers:

$$[\![\text{between five and seven}]\!]^g = \lambda Q.\, \lambda P.\, 5 \leqslant |Q \cap P| \leqslant 7$$

- Though this basic picture is *really* well motivated We've seen numerous examples of the headaches it creates (e.g., quantifiers in internal argument positions, scope ambiguity, …).

2 LF

- Our account of quantifiers parallels closely the account of topicalization, requiring two substantial shifts in our theory:
  1. **LF** (mnemonic for "logical form", but really means something distinct from what is usually meant by that term): an abstract level of representation which serves as the input to $[\![\cdot]\!]^g$.
  2. **QR** (abbreviation for "quantifier raising"): a movement operation that may occur between surface structures and LF. An XP is *covertly* moved, leaving behind a trace and inserting an abstraction index co-indexed with the trace.
- "Y-model" of syntax (we have not talked so much about D-structure or PF):

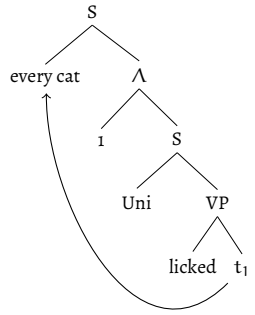


- So the relationship between overt structure and meaning is less direct than we had been assuming (hoping?). As we will see, the interpreted structure can be a good deal more abstract than what we see on the surface.
- Like topicalization, QR inserts a trace and a co-indexed, c-commanding abstraction operator. The sister of the moved quantifier will have type $\langle e, t\rangle$, the right sort of thing to combine with the quantifier by functional application.
- Our rules for interpretation do not change:

$$\text{Functional application: } [\![A_{\langle\tau,\sigma\rangle}\ B_\tau]\!]^g = [\![A]\!]^g\,[\![B]\!]^g$$
$$\text{Predicate modification: } [\![A_{\langle e,t\rangle}\ B_{\langle e,t\rangle}]\!]^g = \lambda x.\, [\![A]\!]^g\, x \wedge [\![B]\!]^g\, x$$
$$\text{Predicate abstraction: } [\![n\ A]\!]^g = \lambda x.\, [\![A]\!]^{g[n\to x]}$$

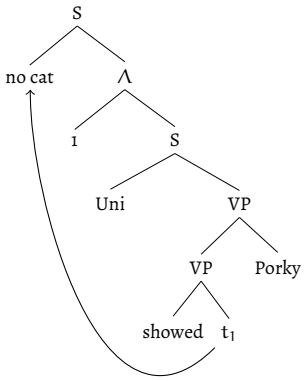
3 Examples (take notes!)

- In situ quantification:



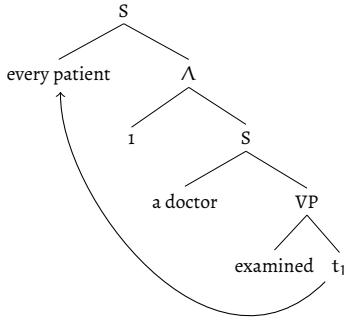
EVERY-CAT $(\lambda x.$ LICKED x U$)$

- In situ quantification with ditransitives:



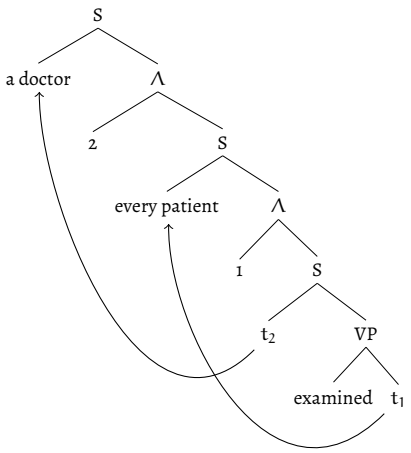
NO-CAT $(\lambda x.$ SHOWED x P U$)$

- Inverse scope:



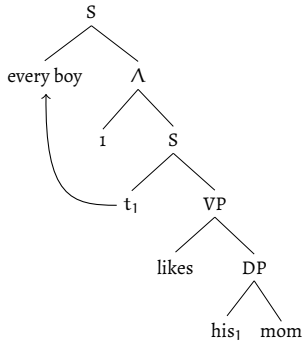
EVERY-PATIENT $(\lambda x.$ A-DOCTOR $($EXAMINED $x))$

- Restoring surface scope:



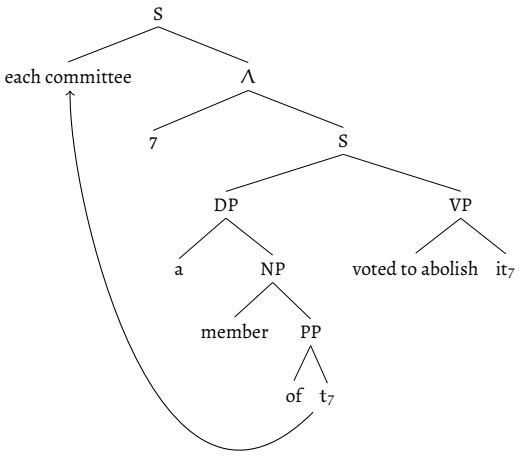
A-DOCTOR $(\lambda y.$ EVERY-PATIENT $(\lambda x.$ EXAMINED $x\ y))$

- Binding (MOM is a function from an individual x to x's mom):



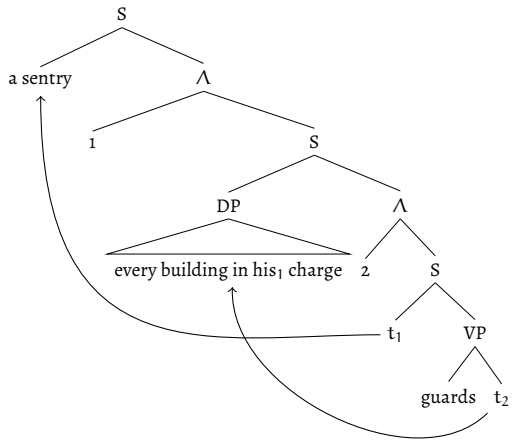
EVERY-BOY $(\lambda x.$ LIKES $($MOM $x)\ x)$

- A quantifier can only bind a pronoun if the quantifier c-commands the pronoun at LF:



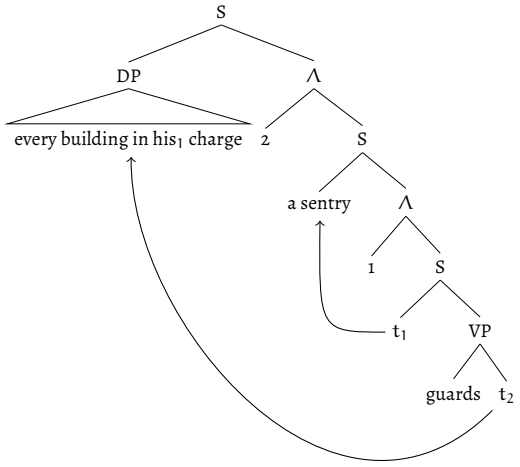
EACH-COMMITTEE $(\lambda x.\ [\![$a member of $t_7]\!]^{g[7\to x]}$ $($VOTED-TO-ABOLISH $x))$

- $\mathcal{Q}_1$ can only bind into $\mathcal{Q}_2$ if $\mathcal{Q}_1$ has scope over $\mathcal{Q}_2$, where $\mathcal{Q}_1$ has scope over $\mathcal{Q}_2$ iff $\mathcal{Q}_1$ c-commands $\mathcal{Q}_2$ at LF:



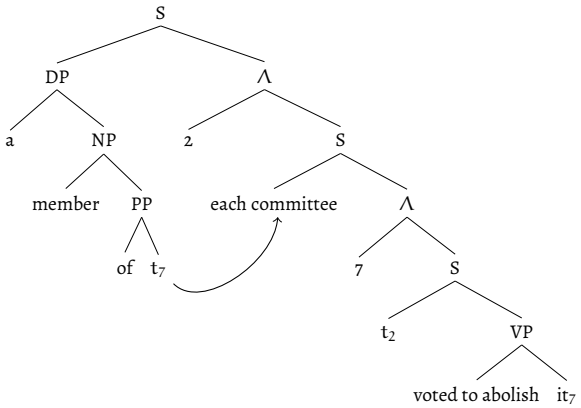
$$\textsc{a-sentry}\ (\lambda x.\ [\![\text{every building in his}_1\ \text{charge}]\!]^{g[1\to x]}\ (\lambda y.\ \textsc{guards}\ y\ x))$$

- If we try to assign the object quantifier scope over the subject, we inevitably end up unbinding the pronoun his_1:



$$[\![\text{every building in his}_1\ \text{charge}]\!]^g\ (\lambda y.\ \textsc{a-sentry}\ (\lambda x.\ \textsc{guards}\ y\ x))$$

- Over-generation concern: QR should never be able to un-bind traces. That is, the following LF shouldn't be allowed, on pain of assigning a free-pronoun-like interpretation to the trace:



$$[\![\text{a member of } t_7]\!]^g\ (\lambda x.\ \textsc{each-committee}\ (\lambda y.\ \textsc{voted-to-abolish}\ y\ x))$$

- The truth conditions derived in this case are truly bizarre. Given an assignment g, they require there to be a member of g 7 such that, for each committee x, s/he voted to abolish x.

- Obviously, this isn't a possible reading of the sentence, and so the rule that relates S-structure with LFs will have to be carefully formulated so avoid this sort of outcome.

4 Covert subjects: more targets for QR

4.1 VP-internal subjects

- Data point: VP-level negation:

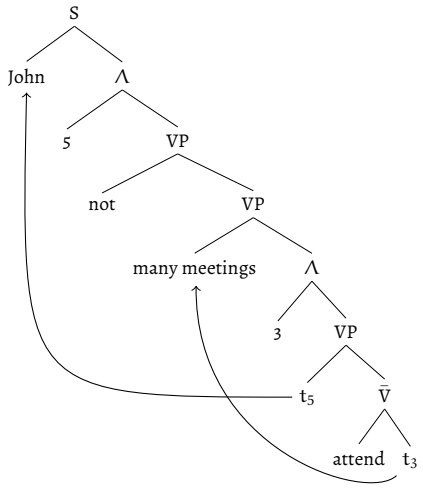
  (1) Kyle doesn't like natto.

  (2) John didn't attend many meetings.

- Before, we'd just assumed negation had sentential scope. So why not have a QR-able sentential negation? For one, it would badly over-generate:

  (3) I'm certain not to teach ≠ I'm not certain to teach

- A standard solution: VP-internal subjects allow us to quantify into VP. In other words, there is a subject position internal to VP which moves out to subject position, and VPs are thus actually of type t.[1]



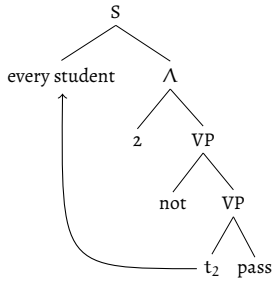
$\neg$MANY-MEETINGS $(\lambda x.$ ATTEND x J$)$

- On this analysis, VPs are—contrary to appearances—actually of type t, and negation is of type $\langle t, t\rangle$ rather than $\langle\langle e, t\rangle, \langle e, t\rangle\rangle$.
- Along similar lines, we can readily account for the wide-scope-negation reading of *I didn't introduce many people here*$_i$ *to their*$_i$ *partner.*
- An empirical wrinkle. The following is ambiguous between a reading on which every student x was such that x didn't pass, and a reading on which it's false that every student passed:

  (4) Every student didn't pass.

[1] Notice that we often write $\neg f\ x$ where we really mean $\neg(f\ x)$. This is a standard convention.

- Yet our semantics only derives one reading:

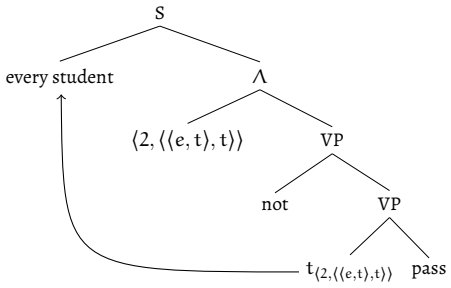


EVERY-STUDENT $(\lambda x.\ \neg \text{PASS}\ x)$

- Here is another option: we assume that the trace can be of type $\langle\langle e, t\rangle, t\rangle$, and that in such cases **PA** can introduce functions *from generalized quantifiers* into values. This requires generalizing our apparatus for pronoun/trace interpretation and abstraction:

Generalized assignment functions:
An index is a **pair** $\langle n, \tau\rangle$ of a natural number n and a type τ.
An assignment is a function g from indices to denotations such that, for any $\langle n, \tau\rangle$, $g\ \langle n, \tau\rangle$ has type τ.
Generalized interpretation rules:
For any pronoun or trace x, $[\![x_{\langle n,\tau\rangle}]\!]^g := g\ \langle n, \tau\rangle$
$[\![\langle n, \tau\rangle\ X]\!]^g := \lambda v_\tau.[\![X]\!]^{g[\langle n,\tau\rangle \to v]}$

- Then a tree that looks very much like the previous tree receives the following interpretation:



$(\lambda \mathcal{Q}.\ \neg \mathcal{Q}\ \text{PASS})$ EVERY-STUDENT = ¬EVERY-STUDENT PASS

- This highlights an important point. QR generates new interpretations because the type of the left-behind trace is "lower" than the type of the moved quantifier. When this happens (and QR targets a node of type t), a property is created and fed to the generalized quantifier as an argument. This gives the quantifier scope over whatever it c-commands at LF.
- However, if the trace of the moved quantifier is type $\langle\langle e, t\rangle, t\rangle$, the sister of the moved quantifier takes *it* as an argument. The result is just as if the quantifier had never moved!
- Related: cases of so-called A-movement, as in (5). We lack the resources to address cases like this at this point, but the eventual analysis (and choice points) would look a great deal like the case with negation.

(5) A unicorn seems to be approaching.

(6) A semanticist might be at the conference.

(7) After the review session, everyone began to get good grades.

- There's independent motivation for generalizing **PA** and assignment functions in this way—that is, allowing higher-order traces and abstraction over things other than individuals—comes from cross-categorial topicalization:

(8) On the porch, she isn't t

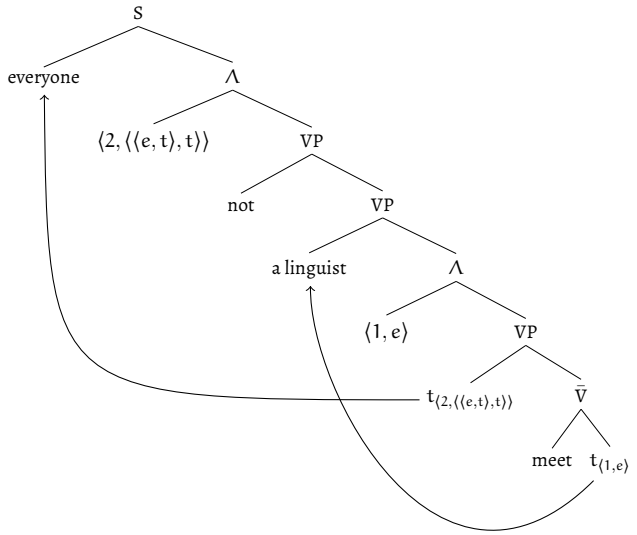
(9) Hard-working, he is t.

(10) I said I was gonna write to him, and write to him I did t.

- Worth thinking about the following construction, which has a reading roughly amounting to: it is false that everyone did some linguist-meeting. That is, the subject "reconstructs", but we still have the subject taking scope over the object.

  (11) Everyone didn't meet a linguist.

- The following LF will only generate the *not* > *a linguist* > *everyone* interpretation (do you see why?):



  How, do you suppose, might we generate the grammatical *not* > *everyone* > *a linguist* reading (there is a way)?

- Note: when it doesn't matter for interpretation, we will generally gloss over VP-internal subjects, even as they are an official part of the theory we're developing. In addition, when the type of an index isn't relevant, we'll omit the bracketed notation and pretend as if assingment functions just map numbers to individuals.

4.2 XP-internal subjects

- Similar data suggests we may need to posit covert subjects inside PPs, APs, and NPs:

  (12) No student [$_{PP}$ from a foreign country] knew the national anthem.

  (13) Everyone [$_{AP}$ interested in more than one country] came to the session.

  (14) No [$_{NP}$ owner of an espresso machine] drinks tea.

- A wrinkle: so-called *i*-within-*i* effects…

  (15) *Every wife$_i$ of her$_i$ childhood sweetheart came to the reunion.

  (16) Every woman$_i$ who married her$_i$ childhood sweetheart came to the reunion.

- Seems to suggest that there is a substantive difference between "true" subjects (i.e. what you find in relative clause constructions) and the covert subjects we allow ourselves to appeal to in order to derive certain interpretations.
- One of your tasks on the next homework will be to draw this out a bit.

5 ACD

- Elliptical constructions like the following are known as ACD (short for "antecedent-contained deletion")

  (17) John read everything Bill did.

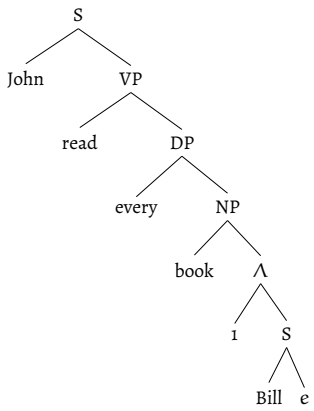
- Some background on ellipsis. It's usually taken to involve some sort of identity relation (either syntactic or semantic) between antecedent and unpronounced VPs. Reasons for this include that ambiguity is generally resolved the same way across ellipses, as are pronominal interpretations and scope ambiguities:

  (18) I went to the bank, and then you did.

  (19) I like him, but you don't.

  (20) I gave a book to every child, and Bill did too.

- One way to think about what happens here: the antecedent VP is somehow "copied into" the elided VP's position and left unpronounced.
- But where is the antecedent in ACD constructions? Copying the VP here into the silent slot *e* would create another copy of *e*! And so on, ad infinitum: we end up with an infinite regress.

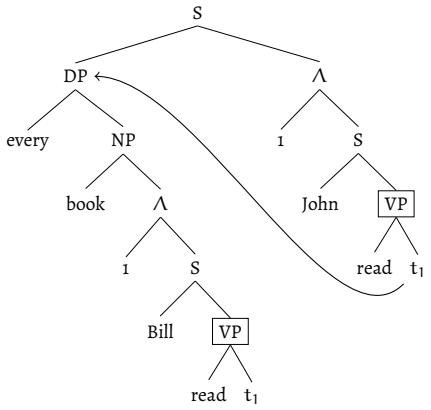


- Notice that this argument presupposes that ACD is really a species of VP ellipsis. That isn't obvious from the get-go. It could be that we're just copying the transitive verb *read* into the ellipsis site, rather than elided an entire VP.
- But there are countervailing forces that make this approach less than plausible. For one, the antecedent can be complex. For another, the antecedent can be discontinuous!

  (21) Mary wanted to read everything Billy did.

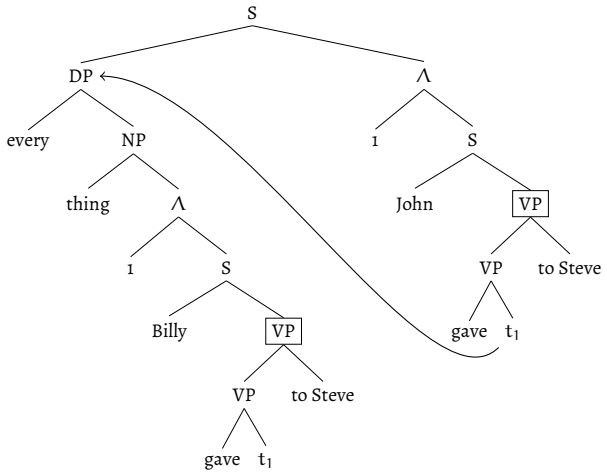
  (22) Mary gave everything Billy did to Steve.

- The answer is in fact already given by our general framework: the antecedent to the VP exists not on the surface, but at LF! That is, QRing the object DP creates a configuration in which the antecedent and elliptical VPs are "identical enough":



- The trace in the object DP's relative clause corresponds to the trace in the VP left behind by the QR'd object. Antecedent containment is resolved, and there is no problem of an infinite regress.

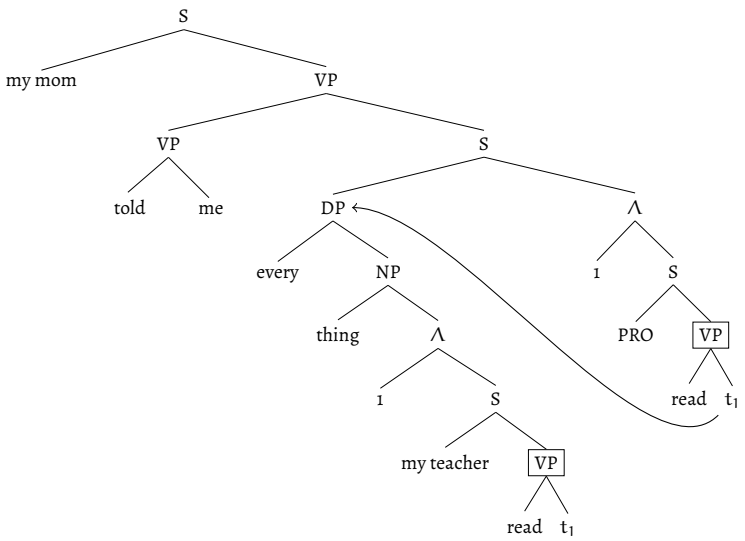
- Here, I have chosen the *same index* for both VPs. An incredibly vexed question: does this really matter? Could I have chosen one set of indices for the relative clause and another set for the sister of the QR'd DP? This would plainly yield the correct interpretation, but would ellipsis be licensed in that case?? (Recall that pronouns cannot in general vary between antecedent and elided VPs.)
- Notice that this solution also allows us to assemble complex and discontinuous predicates for ACD to target. Here is an example with a discontinuous antecedent:

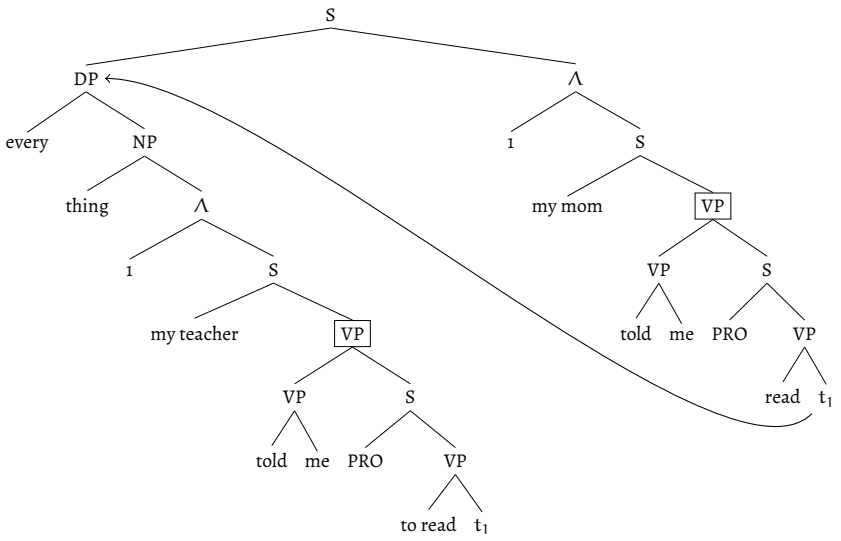


- In fact, something like this picture (i.e. where the relevant identity relation holds at LF/has access to something closer to meanings than what the surface provides) was already suggested by an earlier example, where scope relations between quantifiers in the VP had to stay constant between antecedent and elided VPs.
- Thus, our theory is *consistent with* ACD. Can we find additional evidence that our proposal for ACD is *correct*? Indeed, we can. Consider the following:

  (23) My mom told me to read everything my teacher did.

- This construction is ambiguous. It can mean that my mom told me "read everything your teacher read". Call this a "low" reading. Alternatively, it can mean that the things my mom and teacher told me to read were the same. Call this the "high" reading.
- We are interested in the high reading, which doesn't implicate the teacher in the mom's thoughts. In other words, on the low reading, my mom might have told me something that has to do with my teacher. However, the high reading can make no such claim. The teacher cannot be implicated in what my mom told me (or at least, what's claimed about what my mom told me).
- Consider in this light the following two structures:





- We do not have the tools we need to give a semantics for verbs like *told*, but these trees still make the point. On the low ACD reading, it's possible for the QR'd DP to be within the scope of *told*. On the high ACD reading, it's impossible for the QR'd DP to be within the scope of *told*: to resolve antecedent containment on the high reading, we have to QR the DP over *told*.
- Thus, the QR theory of ACD predicts that the high reading is incompatible with *my teacher* being within the scope of *told*! This fits the data perfectly.
- Generalized versions of ACD, extends to adverbial modifiers(!):

  (24) Room 1 wants to have dinner before Room 2 does.

- As with the previous case, this sentence is ambiguous. On the "low" reading, Room 1's desire can be of the form "to have dinner before Room 2 has dinner". As before, however, on the high reading, Room 1's desire may be of the form "to have dinner at 6PM" (and Room 2's desire may be of the form "to have dinner at 7PM"); on this reading, Room 1's desire does not implicate Room 2 in any way.

6 Scope islands and constraining movement

6.1 Wh-islands and scope islands

- Relative clauses are islands for wh-movement (and extraction more generally):

  (25) *Who did you meet someone who ⟨likes t⟩?

- They are *also scope islands*. The following lacks an interpretation where *every linguist* scopes outside of its relative clause, let alone an interpretation where it scopes over the subject DP.

  (26) Someone read a book ⟨written by every linguist⟩.

- Nice, can we have a general theory of movement, where something can QR to a position iff a wh-word in the same position can move overtly to that position? Alas, no.
- Wrinkle one: adjuncts are wh-islands, not scope islands. Though wh-movement out of an adjunct PP is illicit, a quantificational DP inside an adjunct PP can acquire scope over a quantificational subject:

  (27) *Where did someone go to dinner ⟨in t⟩?

  (28) Someone went to dinner in every neighborhood.

- Wrinkle two: tensed clauses. Wh-movement out of a tensed clause is fairly impeccable, but QR out of an embedded tensed clause seems to be quite marginal. Thus, tensed clauses are scope islands, but not wh-islands.

  (29) Who does John think Bill likes?

  (30) Someone thinks that everybody left.

- Notice that these two wrinkles pull in opposite directions. One suggests QR is less constrained than wh-movement. The other suggests QR is more constrained than wh-movement. Oh, brother!
- Wrinkle three: indefinites can scope out of scope islands, even though other quantifiers cannot.

  (31) If a relative of mine/two relatives of mine die(s), I'll inherit a fortune.

  (32) If every relative of mine dies, I'll inherit a fortune.

- Wrinkle four: saying ACD is parasitic on QR predicts that ACD should be ungrammatical in cases where the requisite movement requires scope out of a (scope) island.

  (33) My mom said I need to read everything my teacher did.

  (34) Mary said Woody jumped over over frog Bill did.

- In fact, claims in both the theoretical and psycholinguistic literature claim that these interpretations are available.

6.2 Quantifying into DP

- Island facts seem to suggest QR out of DP might not be ok:

  (35) *Which city$_i$ does somebody from t_i like it$_i$?

  (36) Somebody from every city$_i$ likes it$_i$.

- We can find additional evidence for this:

  (37) A student met many people from every country.

  (38) A student read many books in every country.

- Arguments for the necessity of the adjunction position:

  (39) Max needs a lock of mane from every unicorn in an enchanted forest.

  (40) I read neither a book by every semanticist nor an article by every syntactician.

- But now: a problem for binding.

  (41) A member of each committee$_i$ voted to abolish it$_i$.

7 Flexible types

- There exist other ways to interpret object quantifiers in situ. For example, we might imagine that there is a silent morpheme that either applies to transitive verbs or quantifiers and allows them to compose directly:

$$[\![\text{sat}_\varnothing]\!]^g = \lambda R_{\langle e,\langle e,t\rangle\rangle}.\, \lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}.\, \lambda x_e.\, \mathcal{Q}\,(\lambda y.\, R\, y\, x)$$

$$[\![\text{sat}_\varnothing]\!]^g = \lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}.\, \lambda R_{\langle e,\langle e,t\rangle\rangle}.\, \lambda x_e.\, \mathcal{Q}\,(\lambda y.R\, y\, x)$$

- Alternatively, it could be that everything is type $\langle\langle e, t\rangle, t\rangle$ and transitive verbs are born with a higher type:

$$[\![\text{John}]\!]^g = \lambda P_{\langle e,t\rangle}.\, P\, J \qquad [\![\text{met}]\!]^g = \lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}.\, \lambda x.\, \mathcal{Q}\,(\lambda y.\textsc{met}\, y\, x)$$

- Yet another possibility is that some expressions are born as type e but shift into type-$\langle\langle e, t\rangle, t\rangle$ expressions via the following silent morpheme:

$$[\![\text{lift}_{\varnothing}]\!]^g = \lambda x_e.\, \lambda P_{\langle e,t\rangle}.\, P\, x$$

- And we haven't even come close to exploring the entire logical space of possibilities. For example, it might be the case that functional application is not the sole saturative mode of combination(!).

7.1 Problems with flexible types?

- These flexible types solutions all allow a transitive verb to combine with a quantificational object in situ. But they struggle to account for other phenomena that QR seems to handle with aplomb:
    1. Ditransitives: it seems that, given the flexible types strategy, we'll need separate type-shifters to handle cases like *Uni showed no cat Porky*. The ones mooted above only work for combining quantificational DPs with mono-transitive verbs.
    2. Scope ambiguity: the type-shifters mooted so far only allow for *surface-scope* readings. Thus, it seems we'll need separate type-shifters that allow for the possibility of scopal ambiguity, and that these, as well, will have to allow for both transitive and distransitive verbs. While we mooted a solution in the last homework, this solution won't extend to ditransitives, or to cases like *I hoped to see a famous linguist at the conference* (do you see why?).
    3. Scope islands: it's easy enough to imagine making a representational stipulation that rules out LFs where something has covertly moved out of a finite clause. Assuming we found a way to give DPs scope out of clausal nodes, it's much less clear how we would restrict its application to tensed clauses (but allow it for, say, infinitival clauses).
    4. Inverse linking: we only generate one reading for constructions like *a member of every committee* (do you see why?), though this does allow us to avoid positing covert subjects in "surface-linking" constructions like *nobody from a foreign country*.
    5. Binding: it isn't obvious on the flexible types approach how a quantifier can bind a pronoun. Our current treatment relies on a QR'd quantifier's trace being co-indexed with the pronoun to be bound. This issue multiplies in inverse linking constructions.
    6. ACD: there is no obvious story to tell. Is ACD VP ellipsis? If so, how is antecedent containment dealt with? If not, how do we handle complex/discontinuous antecedents for ACD? How about the scope facts that QR handled so elegantly?
- We could imagine adding other type-shifters/silent lexical items to fix some of these issues. For example, here is a "type-shifter" that can apply to transitive verbs to generate inverse-scope interpretations:

$$[\![\text{inv}_{\varnothing}]\!]^g = \lambda R.\, \lambda \mathcal{Q}.\, \lambda \mathcal{P}.\, \mathcal{Q}\,(\lambda x.\, \mathcal{P}\,(\lambda y.\, R\, x\, y))$$

- Yet it isn't obvious (given what we've seen so far, anyway) how to go about finding a *general* solution to these issues. Ideally, we would like to find a small set of type-shifters that allow us to generate all the scopes we need and do binding.
- In sum, while flexible types can help us interpret quantified objects in situ, and perhaps even extend into a competitive account of inverse scope, the generality of the solution—i.e. how well it can account for the set of data that QR accounts for—is at this point very much in doubt. The flexible types approach appears too flat-footed to handle the data in a satisfying way.
- That's not the end of the story. Techniques have been developed that handle all of these data seamlessly—and in some instances, the predictions are better than those of the QR account. Depending on people's inclinations and comfort level, we have see a bit of this later in the course.