

Quantificational DPs

Simon Charlow (simon.charlow@rutgers.edu)

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1 The semantic type of quantifiers

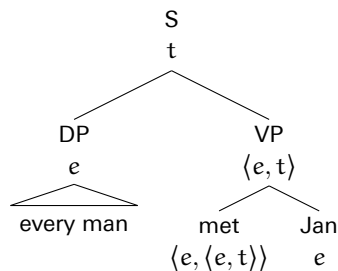
1.1 Quantifiers as individuals?

- To a first approximation, **quantificational DPs** like every man, most huskies, and a state in the NE go all the places DPs like Polly, New Jersey, and the husky Bea owns go:

- Polly met Jan / Every man met Jan
- John likes the Husky Bea owns / John likes most huskies
- New Brunswick is part of NJ / New Brunswick is part of a state in the NE

[Record scratch.] Why are we talking about indefinites like a state in the NE as if they're quantificational DPs rather than predicates? Stay tuned..

- Given the way interpretation works, these distributional facts might be construed as giving us a reason to think quantificational DPs have the same type as proper names and definite descriptions—that is, e —and that they compose with their surroundings via **FA**. For example:



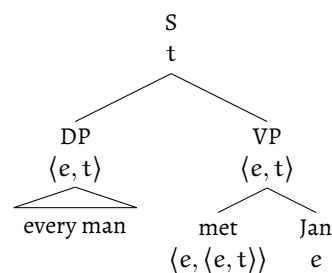
- Pros: simplicity? Cons: many.
 - Predicts bad entailments.
 - Existential commitment:
John left \Rightarrow someone left
nobody left \nRightarrow someone left
 - Adverbial modification:
John left quickly \Rightarrow John left
nobody left quickly \nRightarrow nobody left

- (c) Contradiction schema:
John left and John didn't leave $\Rightarrow \perp$
somebody left and somebody didn't leave $\not\Rightarrow \perp$
 - (d) Excluded middle schema:
John left or John didn't leave $\Rightarrow \top$
everyone left or everyone didn't leave $\not\Rightarrow \top$
 - (e) Topicalization:
the first question, everyone missed \Rightarrow everyone missed the first question
at least one question, everyone missed $\not\Rightarrow$ everyone missed at least one question
2. Moreover, quantifiers give rise to **ambiguity**, while expressions we've been analyzing as having type e do not. That is, (a) and (b) are unambiguous, but (c) is ambiguous:
- (a) Somebody likes John.
 - (b) Somebody likes the outgoing Secret Service head.
 - (c) Somebody likes everybody.
3. More generally, what semantics *could* they have on this picture?
- (a) "Negative" quantifiers like *few cats*, *less than three linguists*, and *nobody*? Which individual?
 - (b) Indefinites like *a state in the NE*? Which individual?
 - (c) *Most cats*? Modified numerals like *at least one husky*? Which individual?

We might imagine the question of "which individual" is answered by context, same as pronouns, but it's really not clear how this could extend to "negative" quantifiers.

1.2 Quantifiers as sets?

- Ok, type e really isn't gonna work. Let's climb the type ladder. Can we give a semantics for quantificational DPs in terms of sets/properties, type $\langle e, t \rangle$?



- Need a new notion of predication. Notice that this competes with PM! Composition would no longer be deterministic.

$$\llbracket \text{DP VP} \rrbracket^g := \{x : \llbracket \text{DP} \rrbracket^g x\} \subseteq \{x : \llbracket \text{VP} \rrbracket^g x\}$$

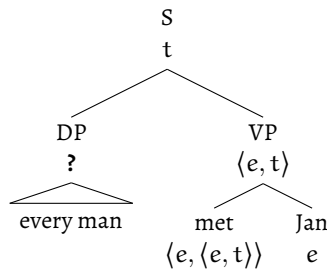
- Another possibility: upping the type of VPs from $\langle e, t \rangle$ to $\langle \langle e, t \rangle, t \rangle$:

$$\llbracket \text{met Jan} \rrbracket^g = \lambda P.P \subseteq \{x : \text{MET } J x\}$$

- This gets a semantics off the ground for everyone (but notice that its “quantificational force” lives elsewhere, i.e. in the grammar/in the lexical semantics of the verb). But we still have issues:
 1. Need to coerce individuals into sets for this strategy to work generally.
 2. Other cases less clear. Again, most and modified numerals like at least one question. Which set? Again, context-dependence might be some help here.
 3. Still, which set is denoted by nobody? The empty set? Then how does nobody differ from no linguists? It is certainly the case that no linguists left can be true even if nobody left is false.
- And I’ll leave it to you to sort out the lexical semantics for transitive (and ditransitive) verbs on this picture, and to determine whether the predictions are good ones when there’s more than one quantifier in a sentence. Good luck.

2 Follow the types

- Let’s go back to our old setup, i.e. with FA, PM, and PA.



- FA suggests another type for the subject DP here. How about $\langle\langle e, t \rangle, t\rangle$?
- That is, **quantifiers map properties into truth values**. (It is often easier to talk loosely in terms of sets, and we will do so here.)
 1. *Every cat* maps a P to 1 iff P holds of every cat.
i.e. $\llbracket \text{every cat} \rrbracket^g = \lambda P. \text{CAT} \subseteq P$
 2. *No cat* maps a P to 1 iff P holds of no cat.
i.e. $\llbracket \text{no cat} \rrbracket^g = \lambda P. \text{CAT} \cap P = \emptyset$
 3. *At least one cat* maps a P to 1 iff P holds of at least one cat.
i.e. $\llbracket \text{at least one cat} \rrbracket^g = \lambda P. \text{CAT} \cap P \neq \emptyset$
 4. *Most cats* maps a P to 1 iff P holds of more cats than not.
i.e. $\llbracket \text{most cats} \rrbracket^g = \lambda P. |\text{CAT} \cap P| > |\text{CAT} - P|$
 5. ...
- Exercise: rewrite the semantics for $\{\text{every, no, at least one}\}$ cat in terms of FOPL.

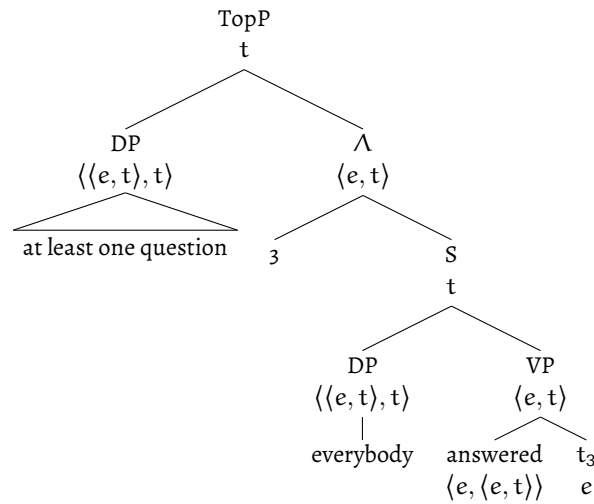
2.1 How this avoids the problematic inferences

- Existential commitment: many $\langle\langle e, t \rangle, t\rangle$ functions exist that map the empty property P_\emptyset (i.e. $\llbracket \text{left} \rrbracket^g$) to true without thereby requiring P_\emptyset to hold of anything.

- Adverbial modification: a function can map P (i.e. $\llbracket \text{left quickly} \rrbracket^g$) to true and Q (i.e. $\llbracket \text{left} \rrbracket^g$) to false even if $P \subseteq Q$.
- Contradiction schema: there is no problem in supposing a single function can map both P (i.e. $\llbracket \text{left} \rrbracket^g$) and Q (i.e. $\llbracket \text{didn't leave} \rrbracket^g$) to 1 even if $P \cap Q = \emptyset$.
- Excluded middle schema: no problem supposing a single function can map neither P (i.e. $\llbracket \text{left} \rrbracket^g$) nor Q (i.e. $\llbracket \text{didn't leave} \rrbracket^g$) to 1, even if $P \cup Q = e$.
- Topicalization is taken up in the next section.

3 Semantics for topicalization

- What we assume is that the relationship between a topicalized expression and an extraction gap is much the same as the relationship between a relative pronoun like *who* and an extraction gap:



$$\begin{aligned}
 \llbracket \text{TopP} \rrbracket^g &= \llbracket \text{at least one question} \rrbracket^g \llbracket \wedge \rrbracket^g && \text{FA} \\
 &= \text{ALOO} \llbracket \wedge \rrbracket^g && \text{Lexicon} \\
 &= \text{ALOO} (\lambda x. \llbracket S \rrbracket^{g[3 \rightarrow x]}) && \text{PA} \\
 &= \text{ALOO} (\lambda x. \llbracket \text{everybody} \rrbracket^{g[3 \rightarrow x]} \llbracket \text{VP} \rrbracket^{g[3 \rightarrow x]}) && \text{FA} \\
 &= \text{ALOO} (\lambda x. \text{EB} (\llbracket \text{VP} \rrbracket^{g[3 \rightarrow x]})) && \text{Lexicon} \\
 &= \text{ALOO} (\lambda x. \text{EB} (\llbracket \text{answered} \rrbracket^{g[3 \rightarrow x]} \llbracket t_3 \rrbracket^{g[3 \rightarrow x]})) && \text{FA} \\
 &= \text{ALOO} (\lambda x. \text{EB} (\text{ANSWERED} \llbracket t_3 \rrbracket^{g[3 \rightarrow x]})) && \text{Lexicon} \\
 &= \text{ALOO} (\lambda x. \text{EB} (\text{ANSWERED } x)) && \text{Pronoun rule}
 \end{aligned}$$

Figure 1: *at least one question, everybody answered*

- Notice that this structure is unambiguously associated with the interpretation on which the set of ques-

tions and the set of things everybody answered have a nonempty intersection:

$$\begin{aligned}
 \text{ALoQ}(\lambda x. \text{EB}(\text{ANSWERED } x)) &= \text{ALoQ}(\lambda x. (\lambda P. \text{PERSON} \subseteq P)(\text{ANSWERED } x)) \\
 &= \text{ALoQ}(\lambda x. \text{PERSON} \subseteq \{y : \text{ANSWERED } x y\}) \\
 &= (\lambda P. \text{QUESTION} \cap P \neq \emptyset)(\lambda x. \text{PERSON} \subseteq \{y : \text{ANSWERED } x y\}) \\
 &= \text{QUESTION} \cap \{x : \text{PERSON} \subseteq \{y : \text{ANSWERED } x y\}\} \neq \emptyset
 \end{aligned}$$

- Scope ambiguity is yet to come (and will require perhaps the final major revision in our basic architectural assumptions), but the way we analyze it will turn out to look extremely similar to this..

4 To come..

4.1 Generalized coordination

- Quantifiers coordinate with each other..
 - (4) Many huskies and few dachshunds like to skijor.
 - (5) Every semanticist or every phonologist got an A.
- With names..
 - (6) Polly and every phonologist bought a new iPad.
 - (7) Kolya and most huskies like to skijor.
- And don't forget that names coordinate with each other too!
 - (8) New York and Los Angeles are large.
 - (9) Uni and Puffy licked Fluffy.
- This looks mysterious. But now we have the tools to solve it.
- Hint: notice that in addition to quantificational DPs, we can characterize the semantics of names as type $\langle\langle e, t \rangle, t\rangle$. The following function maps a property P to true iff P holds of John.

$$\lambda P. P J$$

- Exercise: define a rule for coordination (i.e., *and* and *or*) that allows you to coordinate any mixture of proper names and quantifiers.

4.2 Remaining questions (for next class)

- Semantics for determiners?
- Quantifiers in object positions? (Harkens back to our discussion of indefinites last week.)
- Scope ambiguity?