Quantification

Problem set notes

- What's the relationship between $A \cap B$ and $A \cap (A \cap B)$?

- Which are correct?

(1) All cars are red or green.

a. $\forall x[\text{Car}(x) \rightarrow [\text{Red}(x) \vee \text{Green}(x)]]$

b. $\forall x[[\text{Car}(x) \rightarrow \text{Red}(x)] \vee \text{Green}(x)]$

c. $\forall x[\text{Car}(x) \rightarrow \text{Red}(x) \vee \text{Green}(x)]$

(2) No car is blue.

a. $\forall x[\text{Car}(x) \rightarrow \neg\text{Blue}(x)]$

b. $\forall x[\text{Car}(x) \wedge \neg\text{Blue}(x)]$

c. $\neg\exists x[\text{Car}(x) \rightarrow \text{Blue}(x)]$

d. $\neg\exists x[\text{Car}(x) \wedge \text{Blue}(x)]$

- Everyone loves Marge.

Let D = {Marge, Bart, Homer}; $g = [x \mapsto \text{Marge}, y \mapsto \text{Bart}, z \mapsto \text{Homer}]$.

Recall: $[\![\forall u\ .\ \phi]\!]^{M,g} = 1$ iff for all individuals $k \in D$, $[\![\phi]\!]^{M,[u\mapsto k]\|g} = 1$ (from Handout 3)

$[\![\forall x\ .\ \text{Love}(x, \text{Marge})]\!]^{M_2,g} =$

1 Subject quantifiers

The DPs we have studied so far have generally been of type e. Let's now consider subject DPs like *everyone*, *no one*,[1] and *someone*.

(3) Everyone sleeps.

Option 1: Include "plurals" in D_e, including a symbol that refers to 'nothing,' ϵ. *Everyone* is type e, the sum of all individuals.

(4) a. $D_e = \left\{ \begin{array}{c} \epsilon, \text{John, Mary, Kara,} \\ \text{John + Mary, John + Kara, Mary + Kara,} \\ \text{John + Mary + Kara} \end{array} \right\}$

b. $[\![\text{everyone}]\!]$ = John + Mary + Kara (type e)

c. $[\![\text{everyone sleeps}]\!]$ = Sleep(John + Mary + Kara)

This sort of works for *everyone*, but it does not work for *no one* and *someone*. Why?

Option 2: *Everyone* is not type e.

(5) a. $[\![\text{everyone}]\!] = \lambda Q_{\langle e,t\rangle} \,.\, \forall x\, [\text{Animate}(x) \rightarrow Q(x)]$

b. $[\![\text{everyone sleeps}]\!] = \forall x\, [\text{Animate}(x) \rightarrow \text{Sleep}(x)]$

Quantificational DPs are type $\langle\langle e,t\rangle, t\rangle$. In other words, they take the VP as their argument.

Exercise

(6) **Every** dog sleeps.

[1] Although we spell this as two words, "no one," we will treat it as one word, just like *nothing*.

Recall from Handout 2 that we wrote meanings for quantificational determiners as relations between sets:

(7) **Quantificational determiners as set-relations, from Handout 2:**

a. *every/all*$(A)(B) = 1$ iff $A \subseteq B$

b. *a/some*$(A)(B) = 1$ iff $A \cap B \neq \emptyset$

c. *no*$(A)(B) = 1$ iff $A \cap B = \emptyset$

d. *two*$(A)(B) = 1$ iff $|\ A \cap B\ | \geq 2$

e. *more-than-two*$(A)(B) = 1$ iff $|\ A \cap B\ | > 2$

f. *most*$(A)(B) = 1$ iff $|\ A \cap B\ | > |\ A - B\ |$

Because we normally work with truth conditions and functions, not sets, we have to translate (7a) into non-set terms:

(8) $[\![\text{every dog sleeps}]\!] = 1 \text{ iff } \{x : \text{Dog}(x)\} \subseteq \{y : \text{Sleep}(y)\}$

$$\Leftrightarrow \forall z_e \in \{x : \text{Dog}(x)\} \left[z \in \{y : \text{Sleep}(y)\}\right]$$

$$\Leftrightarrow \forall z_e \; [\underbrace{\text{Dog}(z)}_{\textit{every}\text{'s first argument}} \rightarrow \underbrace{\text{Sleep}(z)}_{\textit{every}\text{'s second argument}}]$$

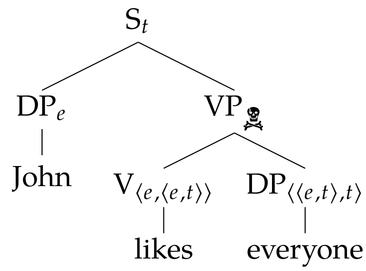
(9) $[\![\text{every}]\!] = \lambda P_{\langle e,t \rangle} \ . \ \lambda Q_{\langle e,t \rangle} \ . \ \forall z_e \left[P(z) \rightarrow Q(z)\right]$

Exercise

Rewrite the quantificational determiners in (7) as λ functions of type $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$.

2 Quantifiers in object position

(10) John likes everyone.



In order to avoid this problem, we're going to use a slight trick: to *move* the object:

(11) **The interpretation of movement:**

Pick an arbitrary variable, such as x.

a. The base position of movement is replaced with a *trace*; $[\![t]\!] = x$, type e.

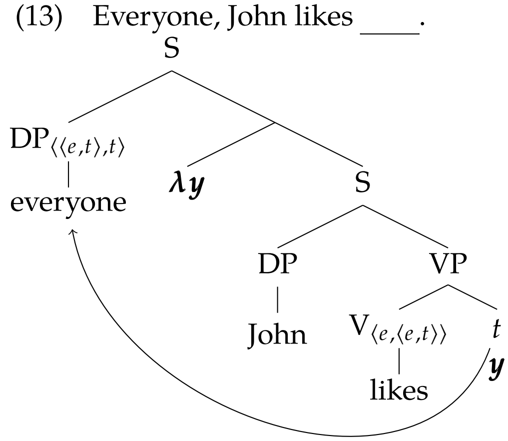
b. A λ*-binder* λx is adjoined right under the target position of the movement chain.

(12) **How to interpret $\boldsymbol{\lambda}$s in trees:** (to be revisited later)

$$\left[\!\!\left[\;[\; \lambda x \quad \ldots\, x \,\ldots \;]\; \right]\!\!\right] = \lambda x \,.\, \ldots x \ldots$$

Now notice that objects of type $\langle\langle e, t\rangle, t\rangle$ can be interpreted easily if they are moved:

(13) Everyone, John likes ____.



Exercise: Make sure this works.

A solution to the problem of quantifiers in object position, like (10) above, is to *pretend this movement happened anyway*. The arrow is dashed because it's a *covert* movement, not reflected in pronunciation.

(14) <u>LF for (10):</u> everyone, John likes ____.

We call this movement *Quantifier Raising* (QR) (May, 1977). QR is required for quantifiers that are not in subject position, in order to avoid the type problem in (10).

References

May, Robert Carlen. 1977. The grammar of quantification. Doctoral Dissertation, Massachusetts Institute of Technology.