1 More Quantificational Determiners

In class we analysed the meanings of *no, every* and *some* as follows:

(1) *Function Talk*

a. $[\![\text{every}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff for every } x \in D_e \text{ such that } g(x) = 1,\ f(x) = 1]]$

b. $[\![\text{no}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff for no } x \in D_e \text{ such that } g(x) = 1,\ f(x) = 1]]$

c. $[\![\text{some}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff for some } x \in D_e \text{ such that } g(x) = 1,\ f(x) = 1]]$

We also discussed how these meanings can be viewed as relations between two sets of individuals.

(2) *Set Talk*

a. $[\![\text{every}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } \mathsf{set}(g) \subseteq \mathsf{set}(f)]]$

b. $[\![\text{no}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } \mathsf{set}(f) \cap \mathsf{set}(g) = \varnothing]]$

c. $[\![\text{some}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } \mathsf{set}(f) \cap \mathsf{set}(g) \neq \varnothing]]$

In this exercise, you will analyse the quantificational determiners in the following sentences in similar ways.

(3) a. Between five and ten students were asleep.
b. Some but not all professors came.
c. An even number of cats purred.
d. Fewer boys than girls smiled.

Throughout this exercise we ignore the number marking on the noun, so we assume $[\![\text{linguist}]\!]^{a,M}$ = $[\![\text{linguists}]\!]^{a,M}$, for example. Also, we don't analyze the composition of complex phrases like *between five and ten* and *an even number of*, essentially treating them as single determiners.

Here are some useful set theoretic notions (see also Lecture 1):

- $A \cap B$ is the *intersection* of A and B, defined as $\{ x \mid x \in A \text{ and } x \in B \}$.
- $A \cup B$ is the *union* of A and B, defined as $\{ x \mid x \in A \text{ or } x \in B \}$.
- $A - B$ is defined as $\{ x \mid x \in A \text{ and } x \notin B \}$.
- $|A|$ is the *cardinality* of A, i.e. the number of (distinct) members of A. E.g. $|\{ z, 3, \text{John} \}| = 3$.

Question: Write the denotations of the determiners in the following sentences both in terms functions like (1) (function talk) and in terms of sets like (2) (set talk).

(a) *Between five and ten*

- Function talk: $[\![\text{between five and ten}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } ???]]$
- Set talk: $[\![\text{between five and ten}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } ???]]$

(b) *Some but not all*

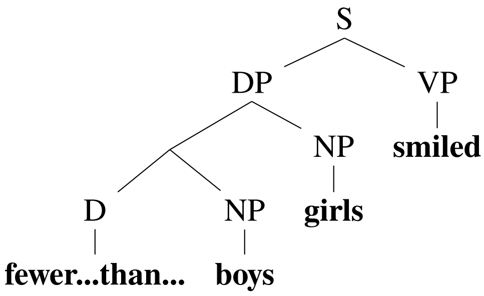
- Function talk: $[\![\text{some but not all}]\!]^{a,M} = [\lambda g \in D_{\langle e,t\rangle}.[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff } ???]]$

- Set talk: $[\![\text{some but not all}]\!]^{a,M} = [\lambda g \in D_{\langle e,t \rangle}.[\lambda f \in D_{\langle e,t \rangle}.\ 1 \text{ iff } ???]]$

(c) *An even number of*

- Function talk: $[\![\text{an even number of}]\!]^{a,M} = [\lambda g \in D_{\langle e,t \rangle}.[\lambda f \in D_{\langle e,t \rangle}.\ 1 \text{ iff } ???]]$
- Set talk: $[\![\text{an even number of}]\!]^{a,M} = [\lambda g \in D_{\langle e,t \rangle}.[\lambda f \in D_{\langle e,t \rangle}.\ 1 \text{ iff } ???]]$

(d) Assume that *fewer ... than ...* has the following structure (ignoring the word order):



Notice that there are three type $\langle e,t \rangle$ functions, namely, $[\![\text{boys}]\!]^{a,M}$, $[\![\text{girls}]\!]^{a,M}$ and $[\![\text{smiled}]\!]^{a,M}$, rather than two. So *fewer...than...* must be of type $\langle et, \langle et, \langle et, t \rangle\rangle\rangle$.

What should $[\![\text{fewer...than...}]\!]^{a,M}$ look like?

- Function talk: $[\![\text{fewer...than...}]\!]^{a,M} = [\lambda h \in D_{\langle e,t \rangle}.\ [\lambda g \in D_{\langle e,t \rangle}.[\lambda f \in D_{\langle e,t \rangle}.\ 1 \text{ iff } ???]]]$
- Set talk: $[\![\text{fewer...than...}]\!]^{a,M} = [\lambda h \in D_{\langle e,t \rangle}.\ [\lambda g \in D_{\langle e,t \rangle}.[\lambda f \in D_{\langle e,t \rangle}.\ 1 \text{ iff } ???]]]$

2 Optional: Proper Names as Generalized Quantifiers

In class, we analyzed proper names as denoting individuals (of type e) and quantificational DPs like *every linguist* and *no linguist* as denoting functions of type $\langle et, t \rangle$. This means that there are two kinds of DPs.

However, there is a way to assign a single type to all DPs. Recall that we concluded that quantificational DPs cannot be of type e, but there's nothing that prevents us from assigning proper names type-$\langle et, t \rangle$ functions as their denotations.

For the sake of this exercise, let's assume that there are two lexical entries $John_e$ and $John_{\langle et,t \rangle}$ and that $[\![\text{John}_e]\!]^{a,M}$ = John. Of course we want $[\![\text{John}_e \text{ smiled}]\!]^{a,M} = [\![\text{John}_{\langle et,t \rangle} \text{ smiled}]\!]^{a,M}$, which is 1 if John smiled in M, and 0 otherwise.

What is the type $\langle et, t \rangle$ meaning for *John*? Hint: It should map any function f of type $\langle e,t \rangle$ to 1 iff f maps John to 1.

$$[\![\text{John}_{\langle et,t \rangle}]\!]^{a,M} = [\lambda f \in D_{\langle e,t \rangle}.\ ???]$$