Quantification in English

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1. Scope ambiguities in English

Recall our sentence

> Everyone loves someone.

On the one hand, this sentence seems ambiguous; and the ambiguity seems traceable to a distinction between two trees — two syntactic structures — that might be associated with that sentence. When this is the case, let’s say that a sentence is *syntactically ambiguous*. (This is to distinguish it from lexical ambiguities like ‘John went to the bank’, which are not due to the sentence being associated with distinct trees, but rather to the lexicon assigning more than one meaning to one of the expressions in the sentence.)

The problem is that at least some standard tests for syntactic ambiguities don’t confirm our view of the above sentence. Consider the sentence

> John hit a boy with a pair of binoculars.

This sentence is associated with multiple trees. On one reading, we can take the above sentence to follow from

> John hit a dog, a boy with a pair of binoculars, and a girl.

which indicates that ‘a boy with a pair of binoculars’ is of the same grammatical category as ‘a dog’ — and on the other, we can take it to be an answer to the question,

> With what did John hit a boy?

which indicates that ‘with a pair of binoculars’ modifies ‘hit.’ But it is hard to come up with tests of this sort which show that ‘Everyone loves someone’ is syntactically ambiguous.

This leaves open two possibilities: either the ambiguity in our sentence is a lexical ambiguity, or the appearance of an ambiguity is due to pragmatic effects.

We'll talk about the first possibility in a bit. The second possibility is most naturally carried out by saying that the tree associated with "Everyone loves someone" gives the universal quantifier wide scope, and that the other (stronger) reading is sometimes pragmatically conveyed. But then we need general rules to tell us which quantifiers should get wide scope in which English sentences.

You might think: the first one (leftmost one) should get wide scope. That does work for the above sentence, but does not work for others:

> There was a name tag near every plate.
> A flag hung in front of every window.
> A student guide took every visitor to a museum.

The difficulty of giving a general theory of this sort which delivers the right results is one reason for positing a syntactic ambiguity here.

2. A basic syntax for quantification in English

In the predicate calculus, our expressions for expressing quantification were just '∀' and '∃.' But in English we express ourselves using complex phrases like 'every cat' or 'some dog.' (Even 'everything' can be viewed as a composite of 'every' and 'thing.') In quantifier phrases like this, we separate out two parts: the determiner ('every') and the restrictor ('cat'). For these we need two new syntactic categories:

> Det (determiner) $\rightarrow$ a, every, the
> N_c (common noun) $\rightarrow$ book, fish, man, woman

You get a quantifier phrase by combining a Det with a N_c.

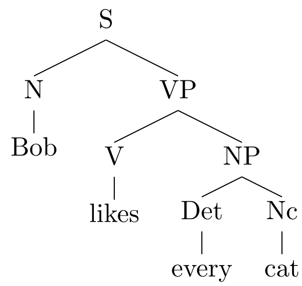
These quantifier phrases are themselves of the syntactic category NP (noun phrase). (We're leaving the category N, from our earlier language, out of this one; we'll reintroduce it later.)

Some discussion of deep structure, surface structure, logical form (LF), and movement, and the basic idea behind transformational grammars.

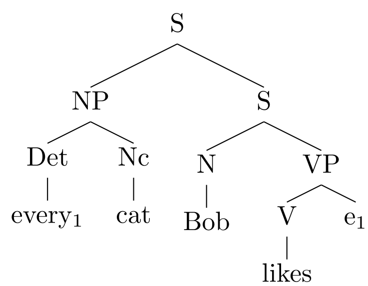
When a constituent is moved, it leaves behind a *trace* in the LF of the sentence. You can think of traces, for now, as a little bit like variables in the predicate calculus. We're intrested in particular in *quantifier movement*, or *quantifier raising*. Hence we might take a sentence like

Bob likes every cat.

to have, not the structure



but rather a structure more like

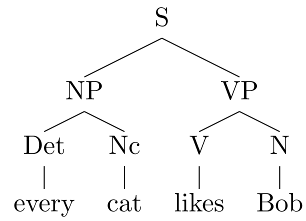


You might wonder: why do we need to posit deep structure and LF, in addition to surface structure? Why can't we simply give our syntax and semantics using the word order of the surface structure?

It is controversial that we need *both* deep structure and LF. But one reason for thinking that we need something else comes from the wish to have a type driven semantics. Consider the sentence

Every cat likes Bob.

and suppose that it's structure were (as it presumably would be without positing movement of some sort)



Now think informally about what the meaning of ‘every’ could be. It seems to be, roughly, a function from a pair of sets to a truth-value. In this case, the sets are the set of cats and the set of things that like Bob, and the sentence will be true if every element of the first set is also a member of the second.

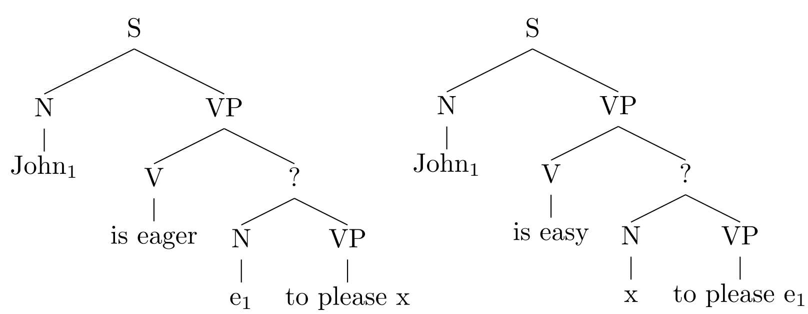
Presumably ‘every’ should mean the same thing in the case of our first sentence, ‘Bob likes every cat.’ But what should the two sets be in that case? Presumably, the set of cats, and the set of things Bob likes. But look at the above tree. What node will have as its semantic value the set of things Bob likes?

(Note: you could get around this problem by positing a lexical ambiguity in ‘every’, and try to use this to interpret quantifiers ‘in situ’ rather than via quantifier movement. The extra reading for today gives some arguments in favor of quantifier movement.)

Further evidence that we need something beyond SS is given by pairs of sentences like

> Bob is easy to please.
> Bob is eager to please.

Despite the similarity of the surface form of each sentence, they have very different structures. One might explain this by taking them to be transformations, respectively, of trees in the ballpark of



It won’t matter for our purposes whether we think of the trees related to surface structures by movement are thought of as part of deep structure or LF or both — what will matter is just that we need something other than SS, and some rules connecting this something to SS. I’ll talk in terms of LF.

The rule for quantifier raising is a transformation — a rule which tells you what trees might be associated with what surface structures. It is stated as:

$$(57)\ [_S \text{ X NP Y}] \Rightarrow [_S \text{ NP}_i\ [_S \text{ X } e_i \text{ Y}]\ ]$$

This is enough of the syntax of F_2 to give its semantics, which will be broadly similar to the semantics for quantification in the predicate calculus.

3. Semantics for 'a', 'every', and 'the'

Just as in the predicate calculus our quantifier phrases typically combined with sentences containing one or more variables which they would then bind, so in F_2 our NPs will typically combine with sentences containing one or more traces which they will then bind. Just as in the predicate calculus we utilize the notion of an assignment of values to variables, so here we utilize the notion of an assignment of values to traces. And in just the same way, we will now relativize semantic values to a pair of a model and assignment, where, as before, models are pairs of a domain and a valuation function.

The main additions to our semantic theory for F_1 are the following assignments of semantic values to 'every', 'a', and 'the':

$$[\![[\text{every } \beta]_i \text{ S}]\!]^{M,g} = 1 \text{ iff for all } u \in U, \text{ if } u \in [\![\beta]\!]^{M,g}, \text{ then } [\![S]\!]^{M,\, g[u/e1]} = 1$$

$$[\![[\text{some } \beta]_i \text{ S}]\!]^{M,g} = 1 \text{ iff for some } u \in U,\ u \in [\![\beta]\!]^{M,g} \text{ and } [\![S]\!]^{M,\, g[u/e1]} = 1$$

$$[\![[\text{the } \beta]_i \text{ S}]\!]^{M,g} = 1 \text{ iff for some } u \in U,\ [\![\beta]\!]^{M,g} = \{u\} \text{ and } [\![S]\!]^{M,\, g[u/e1]} = 1$$

The first two parallel our treatments of '∀' and '∃' in the predicate calculus. What does the clause for 'the' say?

Not all quantifier phrases are as simple as "some cat." In particular, some quantifier phrases contain others, as in "every cat next to a dog." Do our semantic rules tell us how to handle quantifier phrases of this sort? What would happen if you tried to apply the first rule above to this phrase?