HANDOUT 9: QUANTIFICATION AND GRAMMAR

The problem of quantifiers in object position

We started our investigation of quantification in English by looking at quantifier phrases in subject position. There was a good reason for limiting ourselves to subject positions. Compare 1(a) to 1(b):

(1) a. **[NP every linguist] [VP offended John]**.
b. **John [VP offended [NP every linguist]]**.

1(a) is true just in case the set of linguists is included in the set of those who offended John. It was easy for us to arrive at the correct truth-conditions for sentences like 1(a) in a compositional way. The denotation of the determiner 'every' relates two sets. The first set (the restrictor set) is provided by the common noun 'linguist', the second set (the nuclear scope set) comes from the VP 'offended John'. The noun 'linguist' and the VP 'offended John' are both constituents of 1(a). But what if 'every linguist' occurs in object position as in 1(b)? We would like to continue to assume that 'every' denotes a relation between sets. But then, which two sets? The restrictor set is the set of linguists (for a given situation), and it will be provided by the common noun as before. The nuclear scope set should be the set of all those who were offended by John (for a given situation). But this last set is not denoted by any constituent in 1(b). This is, in a nutshell, the problem of quantifiers in object position. The dilemma becomes more dramatic if we consider sentences with multiple quantifier phrases:

(2) **Some publisher offended every linguist**.

(2) has two readings. On one reading, the claim is that there is at least one publisher who offended every linguist. The other reading is compatible with a situation where every linguist was offended by a possibly different publisher. Set theory lets us express the two readings as follows:

(2') a. {s: {a: a is a publisher in s} ∩ {b: {a: a is a linguist in s} ⊆ {a: b offended a in s} } ≠ ∅ }.

b. {s: {a: a is a linguist in s} ⊆ {b: {a: a is a publisher in s} ∩ {a: a offended b in s} ≠ ∅ } }.

But how can we compute such statements in a compositional way from plausible syntactic structures?

The relational theory of quantification that we have been relying on in this class from the very beginning is the oldest known theory of quantification, dating back at least to Aristotle. The problem of quantifiers in object position is almost as old. Medieval scholars tried to solve it, but failed, and so did many logicians and mathematicians in more modern times. A solution was eventually found by Frege. Frege discovered the notation of quantifiers and variables, and thereby "resolved, for the first time in the whole history of logic, the problem which had foiled the most penetrating minds that had given their attention to the subject"[1].

Modern linguistic theories fall into different camps depending on their approach to the problem of quantifiers in object position[2]. There are those who assume in the spirit of Frege that sentences are constructed in stages, and that at some stage, the argument positions of predicates might be occupied by variables that are related to displaced quantifier phrases via a syntactic binding relationship. The relationship is created by movement (Quantifier Raising, QR) in Chomsky's Extended Standard Theory and its more recent offspring like Minimalism. The movement is not visible in English, but has been claimed to be overt in other languages. Hungarian is one such language. Other semanticists are opposed to covert movement operations and therefore avoid displacement of quantifier phrases. Instead they are looking for ways to interpret all arguments of predicates *in situ* (that is, in their original position), and are willing to give up the assumption that determiners have a uniform interpretation, regardless of whether they occur as part of subjects, objects, or prepositional phrases. In what follows, I will illustrate and motivate the Quantifier Raising approach. You will get to know non-movement approaches in more advanced classes in semantics.

Quantifier Raising

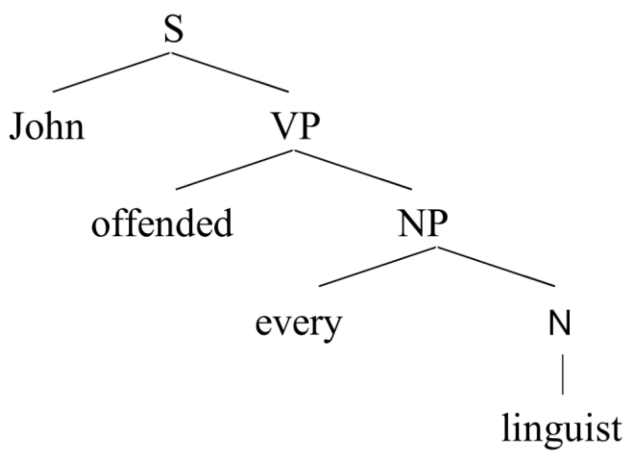
In this section, we will pursue an approach to quantifier interpretation that maintains our original assumption that the determiner is unambiguous and combines with two expressions that denote sets of individuals (with respect to a possible situation). Since the overt syntactic structure of 'John offended every linguist'

---

[1] Michael Dummett: Frege. Philosophy of Language. Second Edition. Cambridge/Mass. (Harvard University Press), 1981, p. 8. Frege's Begiffsschrift was published in 1879.

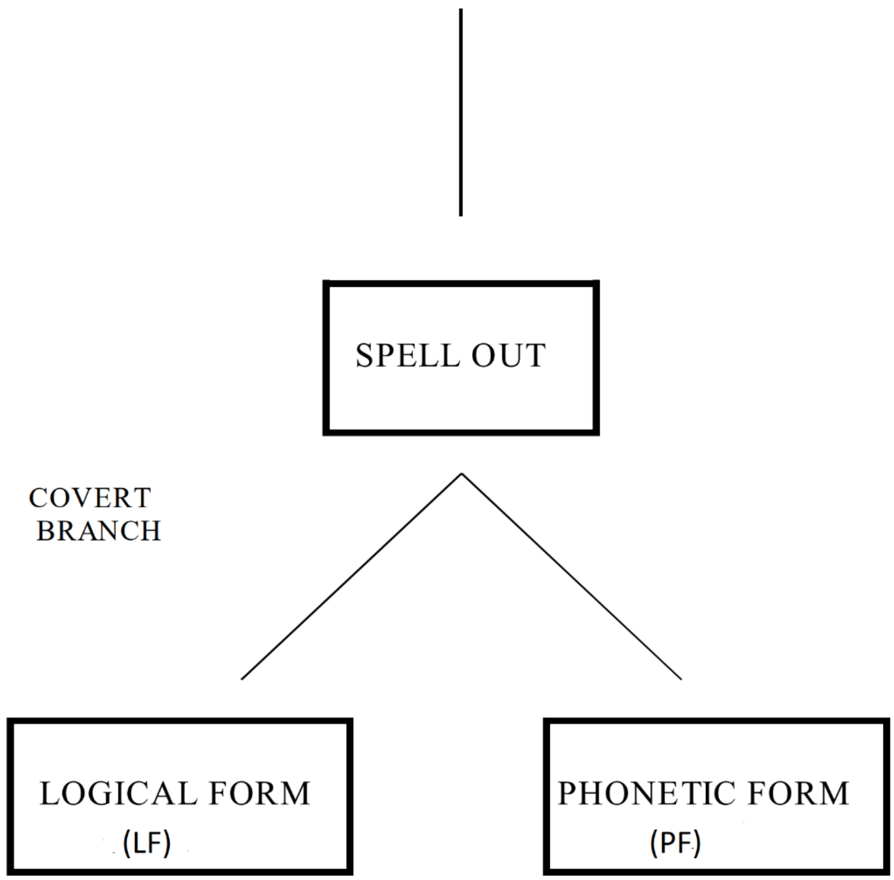
[2] Useful handbook articles are: A. v. Stechow: "Syntax and Semantics". In: A. v. Stechow and D. Wunderlich (eds.): op. cit., 90-148. J. van Eijck: "Quantification" In: A .v. Stechow and D. Wunderlich (eds.): op. cit., 459-487. P. Jacobson: "The Syntax/Semantics Interface in Categorial Grammar". In: S. Lappin (ed.), op. cit., 89-116.

(1)



does not contain two constituents of the required kind, we might conclude that surface structure is not the input to the semantic interpretation component. Rather, this sentence should have another structural description under which ‘every’ combines with two constituents each denoting a set (with respect to a possible situation). Such a structure can be created by moving the NP ‘every linguist’ from its original position in the covert part of the syntactic derivation of sentences like (1) above.

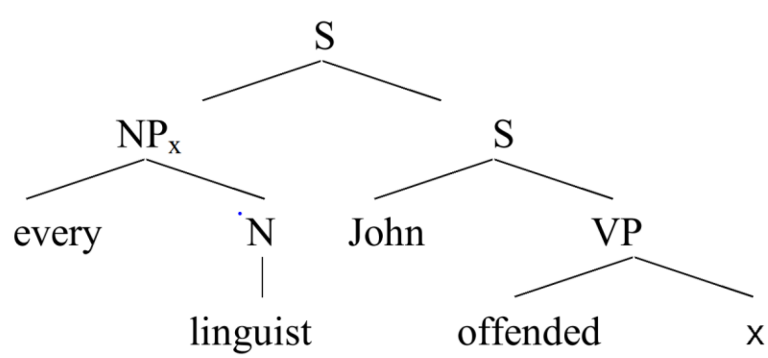
To have a concrete proposal to work with, suppose we have a model of grammar like the one of Chomsky's Minimalist Theory[3]:



[3] Consult C.-T. J. Huang: "Logical Form". In: G. Webelhuth (ed.): Government and Binding Theory and the Minimalist Program. Oxford (Basil Blackwell), 1995, 125-175. See also: N. Hornstein: Logical Form. From GB to Minimalism. Oxford (Basil Blackwell), 1995.

According to this model, the syntactic derivation of a sentence splits into two parts at a point called ‘Spell-Out’. One of the branches produces LF representations that are the input to the semantic interpretation component. The other branch produces PF-representations that are submitted to the pronunciation component. Movement that happens in the LF-branch is covert, but has an impact on interpretation. Movement that happens in the PF-branch is overt, but has no impact on semantic interpretation. The guiding idea behind Minimalism is that human grammars are optimal solutions to the problem of reconciling the demands made on syntactic derivations by the LF and PF interfaces. LF demands come from semantic interpretability, PF demands come from our systems of articulation and perception. Suppose that some such model of grammar is correct. The input structures for semantic interpretation are then Logical Form (LF) representations that might be derived in the covert branch of a syntactic derivation in some languages. The NP ‘every linguist’ in (1), for example, will now move out of its VP and adjoin to S on the way to LF. This movement operation, then, feeds semantic interpretation but not necessarily phonetic realization, and might therefore be invisible. Like all movement operations, Quantifier Raising is expected to obey general conditions on syntactic movement operations, and one of those conditions is that it leaves a trace. If we take the traces left by Quantifier Raising to be variables, and assume moreover that moved quantifier phrases are indexed with a copy of the traces they leave behind, we end up with interpretable structures like (2). (I left out all unnecessary category labels).

(2)



In bracket notation, the tree representation in (2) corresponds to (3), again leaving out inessential brackets and category labels:

(3) [**every** [**linguist**]$_N$]$_x$ [**John offended x**]$_S$.

In turn, (3) falls under the schema (4):

(4) **[every]**$_u$, where α is a noun, u is a variable, and β is a sentence.

As for (4) and related schemata, we know already how to interpret them.

Separating out the purely semantic part of our old semantic interpretation rules, we have for every variable assignment g:

S4 If α is an N, β is an S, and u is a variable, then

$$[\,[\textbf{every}\ \alpha]_u\ \beta\ ]]^g = \{s: [[\ \alpha\ ]]^g(s) \subseteq \{c: s \in [[\ \beta\ ]]^{g\ u \rightarrow c}\}\,\}.$$

Our new S4 is a bit simpler than our old S4 since we are now assuming that the syntactic component creates suitable LF-representations following its own syntactic principles.

Some standard arguments for Quantifier Raising

Apart from arguments relating to the desirability of having a uniform interpretation for all occurrences of quantifiers, what kind of additional evidence is there for a covert syntactic operation of Quantifier Raising? If all quantifiers were interpreted in their surface positions, then a given surface structure with two or more quantifiers in it would receive only one reading, unless we admit ever more complicated semantic interpretation rules on top of multiple ambiguities. Take sentence (1) below:

(1) **Some woman saw every movie**.

Sentence (1) has two readings, and not just one. It can mean that there is some woman who saw every movie. Or else it can mean that for every movie there is some woman who saw it. If quantifier phrases can move out of their original positions and adjoin to their S, it is straightforward to derive two distinct and truth-conditionally non-equivalent LFs for (1), as we have seen in class.

May (1977)[4] argued that the case for quantifier movement is even stronger when we consider examples like (2).

(1) **One apple in every basket is rotten**.

May's point about example (2) is that its most natural reading (perhaps even its only reading) cannot (naturally) be generated by an *in situ* approach but is straightforwardly predicted if there is such a thing as Quantifier Raising. Another argument for Quantifier Raising comes from pronouns that are anaphorically related to quantifier phrases. Consider the following sentences:

(2) **Mary blamed herself**.

(3) **No woman blamed herself**.

(4) **Every woman blamed herself**.

Sentences (3) to (5) contain instances of reflexive pronouns. Reflexive pronouns are necessarily anaphoric. If a pronoun is used anaphorically, its value is determined by its antecedent. If the antecedent is a proper name, then a pronoun that is anaphorically related to it might simply inherit the proper name's referent asits semantic value, or, alternatively, it might be replaced by its antecedent at LF. But what if the antecedent is a quantifier phrase? (4) is not synonymous with (4'), and (5) is not synonymous with (5'). Hence we don't seem to be able to claim that reflexives always inherit the denotation of their antecedent, or that, for the purposes of semantic interpretation, a reflexive can be replaced by its antecedent. (4') **No woman blamed no woman**.

[4] R. May: The Grammar of Quantification. MIT Ph.D. dissertation, 1977.

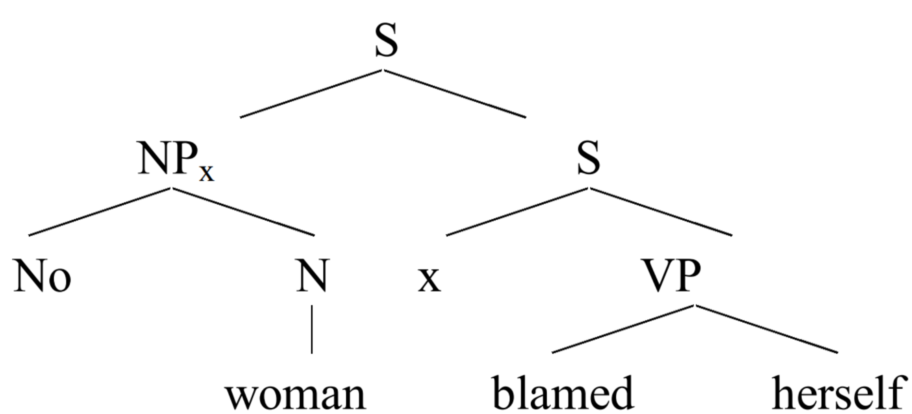
(5') **Every woman blamed every woman**.

Reflexives are not the only pronouns that can be anaphorically related to quantifier phrases. Pronouns like **he**, **she**, **it** have such uses as well. This is shown by the following examples.

(5) **<u>No man</u> noticed the snake next to <u>him</u>**.
(6) **We showed <u>every woman</u> a newspaper article with a picture of <u>her</u>**.

Again, it would not do to say that these pronouns simply inherit the denotations of their antecedents. (6) does not mean the same as 'No man noticed the snake next to no man.' So how <u>should</u> we interpret these reflexives and pronouns? It seems they behave as bound variables. On the Quantifier Raising approach, the matter is relatively straightforward. Two syntactic operations will derive structures that are interpretable, given semantic interpretation rules of the kind we developed earlier in this class:

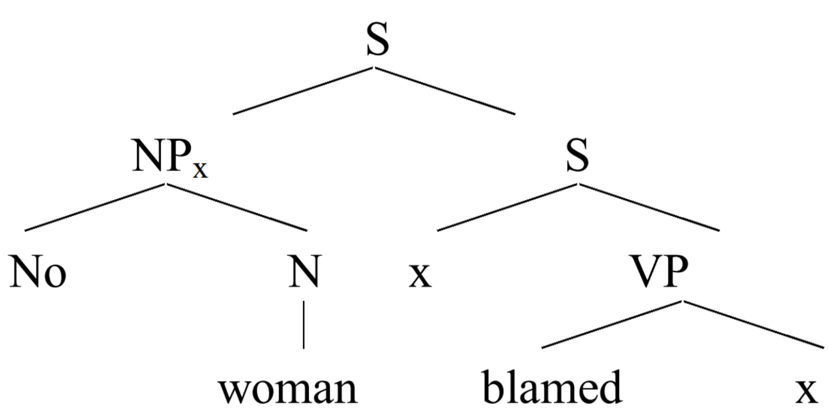
Step 1: The NP 'no woman' undergoes Quantifier Raising:



Step 2: The anaphoric pronoun is replaced with a copy of its antecedent. The result is again a structure that we know how to interpret, using our semantic interpretation rules. We have for all variable assignments g:

S3 If α is an N, β is an S, and u is a variable, then

$[[\ [\textbf{no}\ \alpha]_u\ \beta]]^g = \{s: [[\ \alpha\ ]]^g(s) \cap \{c: s \in [[\ \beta\ ]]^{g\ u \rightarrow c}\} = \varnothing\ \}.$



Another important argument for quantifier raising stems from that fact that overt movement operations in English are known to obey certain locality constraints. The covert movement of QR is argued to obey the same constraints. Unfortunately, we will not be able to explore these arguments in this class.