Quantifiers sometimes take scope in places different from where they appear on the surface. One such case is the inverse scope reading of (1), which we discussed in Lecture 9.

(1) Someone likes everyone.

This shows that the scope of a quantifier is not completely determined by the surface form of the sentence. However, at the same time, it is known that quantifier scope is quite constrained in natural language. In order to understand such constraints, we adopt here the hypothesis that quantifier scope is determined by the covert movement operation *Quantifier Raising (QR)*, and constraints on quantifier scope are constraints on QR. As we will see, the discussion is largely open-ended, but it is clear that there are some peculiar properties of quantifier scope in natural languages that we need to explain.

1 Locality Constraints

It is instructive to compare overt movement like *wh*-movement and QR, which is a type of covert movement. As you have learned in syntax modules, *wh*-movement is known to be subject to a number of locality constraints known as *island constraints*. Here are two examples of island constraints:

(2) *Complex NP Island*
*Which novel did somebody meet a man that has read t?

(3) *Coordinate Structure Island*
*Which novel did somebody [read t and watched TV] before going to bed?

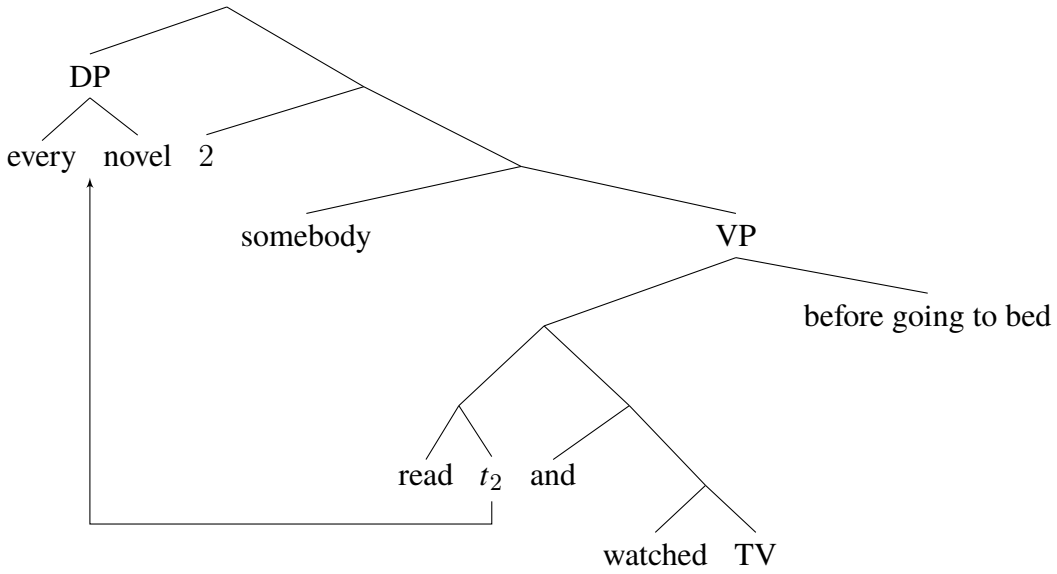
Interestingly, quantifier scope seems to be subject to these constraints as well. For example, *every novel* cannot take scope over *somebody* in the following examples.

(4) *Complex NP Island*
Somebody met a man that has read every novel.

(5) *Coordinate Structure Island*
Somebody [read every novel and watched TV] before going to bed.

This observation follows nicely under the assumption that *wh*-movement and QR are subject to the same constraints. Specifically, in order to derive the hypothetical inverse scope readings of these examples, the quantifier *every novel* would have to move out of an island, as depicted in the following diagram for (5). (**Optional exercise:** Draw an LF for the unavailable inversecope reading for (4), and compute the denotations of these sentences.)

(6)



Si it seems that the constraints on overt movements like *wh*-movement and those on QR are at least partially identical. Then, it is natural to expect that the constraints on quantifier scope are syntactic constraints, and a semantic theory does not need to say anything about them. However, this issue is not so simple, because *wh*-movement and quantifier scope are subject to slightly different constraints. Below, we will discuss three such discrepancies, namely clause-boundedness, scope freezing, and nested DPs.

1.1 Clause Boundedness

It is a well-known fact that *wh*-movement can cross indefinitely many finite-clause boundaries, as illustrated by the following examples.

(7) a. Which novel did somebody say that John wrote t?
b. Which novel did you think that somebody said that John wrote t?
c. Which novel did Bill claim that you thought that somebody said that John wrote t?

Unlike *wh*-movement, quantifier scope is generally clause-bounded. Consider the following examples.

(8) Somebody said that John wrote every novel.

The inverse scope reading of (8) seems to be absent, i.e. it cannot mean: for every novel, there is somebody who said that John read it. Generally, QR cannot cross a tensed clause boundary, unlike *wh*-movement.

However, there are some interesting potential exceptions to this generalization.

(9) a. I demanded that you read not a single book. (Fox 2003:85)
b. Determine whether each number in the list is even or odd. (Szabolcsi 2010:107)
c. Somebody said that they can solve every problem that John did. (Syrett 2015)

These examples seem to have the following readings:

(10) a. No book is such that I demanded that you read it.
(The speaker is fine if you read some books)
b. For each number in the list, determine whether it is even or odd.

(Your task is not evaluate the truth of the following sentences: "Each number in the list is even" vs. "Each number in the list is odd")

c. For every problem that John said that he can solve, someone said that they can solve it as well.

But arguably, such examples are exceptions rather than the rule, and generally, quantifier scope cannot extend beyond the local tensed clause.

1.2 Scope Freezing Effects

Another difference between *wh*-movement and QR crops up in the double object construction. (11a) shows that the direct object in a double object construction can *wh*-move, but the corresponding quantification sentence in (11b) lacks an inverse scope reading (Larson 1990, Bruening 2001)

(11) a. Which doll did you give a child?
b. You gave a child each doll.

This suggests that *each doll* cannot move across *a child*. Notice that if the double object construction is not used, the indirect and direct objects can generally scopally interact, which shows that this is not a problem of meaning. Concretely, both of the sentences below are scopally ambiguous.

(12) a. You gave each doll to a child.
b. You gave a doll to each child.

Interestingly, this restriction is only about the relative scope of the indirect and direct objects in the double object construction, and the direct object can take scope over the subject, for example, as illustrated by (13).

(13) A teacher gave me every book.

This shows that the direct object (*every book* here) needs to be able to undergo QR, but for some reason, the indirect object always needs to take scope over the direct object.

These effects that the double object construction creates on scope possibilities is called *scope freezing effects*. It is likely to be a syntactic phenomenon, but whatever the correct explanation is, it does not apply to *wh*-movement.

1.3 Nested DPs

In the above two cases, quantifier scope is more constrained than *wh*-movement. There are also cases where *wh*-movement is more constrained. For instance, *wh*-movement is subject to the *Subject Island Constraint*, as shown by (14).

(14) *Which city does somebody from *t* despise London?

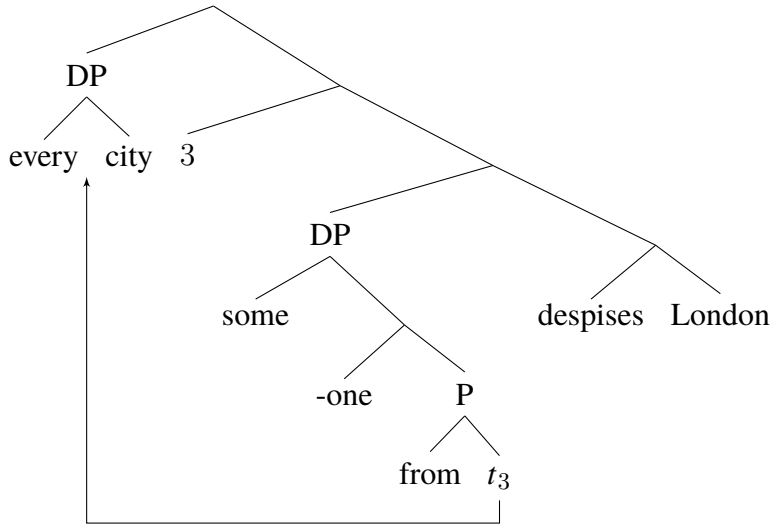
However, the inverse scope reading is possible in this configuration, as shown by (15) (May 1977, 1985, May & Bale 2006, Sauerland 2005).

(15) Someone from every city despises London.

The surface scope reading of this sentence would be a strange one, as it says that there is someone who is from every city. The more natural reading says that for every city, there is

someone from it who despises London. In order to derive this reading, the quantifier *every city* needs to QR out of the subject DP *someone from every city* in violation of the Subject Island Constraint, as shown in the following diagram (**Optional exercise**: Compute the meaning):

(16)



1.4 Interim Summary

The above observations suggest that overt movement like *wh*-movement and covert movement like QR are subject to slightly different sets of constraints. This of course does not mean that QR is not a syntactic operation, but it needs to be explained why overt and covert movement differ in these particular ways. In the current literature on quantifier scope, there are some theoretical attempts to explicate each of the above constraints on quantifier scope, but we still don't have a good understanding of why we have such constraints.

2 Semantic Restrictions on Quantifier Scope

Independently from the syntactic constraints like above, quantifier scope is also restricted semantically. Generally speaking, downward entailing quantifiers like *no NP* and *few NP* do not show scope ambiguity. Consider the following examples.

(17) a. A boy climbed every tree.
b. A boy climbed many trees.

(18) a. A boy climbed no tree.
b. A boy climbed few trees.

The examples in (18) do not seem to have inverse scope readings, unlike those in (17). The inverse scope readings of (18) would be the following:

(19) a. For no tree, is there a boy who climbed it. (or in other words, no boys climbed any tree)
b. For few trees, is there a boy who climbed it.

Notice that according to our theory of quantifiers, QR should apply equally to all types of quantifiers. In fact, in cases like above with a quantificational object, QR must apply, even in (18). But for some reason, the subject quantifier in (18) needs to take scope over the object quantifier. As far as I know, no one has an insightful theory of why this is so (which is very

embarrassing, considering the time that scholars have spent on studying quantifiers). But there is a particularly interesting approach suggested by an unpublished paper by Mayr & Spector (2012).

Following Fox's (2000) influential idea, Mayr & Spector (2012) propose an interesting generalization, according to which the inverse scope reading is only possible when it does not entail but is entailed by the surface scope reading.[1] This generalization nicely applies to (17a). The two readings of this example are:

(20) a. Surface scope: There is a boy who climbed every tree.
b. Inverse scope: For every tree, there is a boy who climbed it.

Here, the surface scope reading entails the inverse scope reading, and the inverse scope reading does not entail the surface scope reading, and we have an inverse scope reading.

The entailment pattern becomes different with different quantifiers. For (18a), the two readings are:

(21) a. Surface scope: There is a boy who climbed no tree.
b. Inverse scope: For no tree, is there a boy who climbed it.

The surface scope reading does not entail the inverse scope reading. Concretely, suppose that Andrew climbed no trees, but Bill climbed some trees. Then (21a) is true but (21b) is false. Therefore, there is no inverse scope reading. ((21b) entails (21a), provided that there are boys, but this is not relevant here).

This also predicts that non-monotonic quantifiers like *exactly three NP* and *between five and ten NP* should not give rise to inverse scope readings, because the two readings will be logically independent. Consider the following examples:

(22) a. Every student read exactly two books before the exam.
b. Every student read between five and ten books before the exam.

These sentences in fact do not seem to allow inverse scope readings (I think), which would be:

(23) a. Exactly two books are such that every student read them before the exam.
b. Between five and ten books are such that every student read them before the exam.

These are logically independent from the surface scope readings, which are actually available for (22), which is to say that there is no entailment in either direction between the two readings.

However, Mayr & Spector's (2012) generalization is not without problems, and they propose some refinements in their paper. Whether their generalization turns out to be correct or wrong, it seems that a semantic constraint like that is at play in natural language.

3 Indefinites and Exceptional Wide Scope

The final thing to note about quantifier scope is the well-known behavior of *indefinites*. Indefinites are quantificational DPs like *a NP*, *some NP*, *two NP*, etc. They create a different set of issues, because they are exempt from all the constraints mentioned above. That is, they freely give rise to inverse scope readings.

For example, the following examples show that the scope of an indefinite is not limited by

[1] This is actually one analytical possibility that they mention, and they mostly consider a weaker constraint that says that the inverse scope is possible only when it does not entail the surface scope reading. however, this weaker version wrongly predicts that (18a) has an inverse scope reading.

island constraints:

(24) a. Every student had to buy a book that a professor at UCL wrote.
b. If some relative of John's dies, he'll inherit a fortune.

These sentences are ambiguous, but crucially, they have the following readings:

(25) a. There is a professor at UCL such that every student had to buy a book he she wrote.
b. There is some relative of John's such that if he or she dies, he'll inherit a fortune.

Such interpretations are not possible with other types of quantificational DPs:

(26) a. Every student had to buy a book that every professor at UCL wrote.
b. If every relative of John's dies, he'll inherit a fortune.

These cannot mean:

(27) a. Every professor at UCL is such that every student had to buy a book he/she wrote.
b. Every relative of John's is such that if he or she dies, he'll inherit a fortune.

Needless to say, *wh*-movement is not possible from these positions:

(28) a. *Which professor at UCL did every student have to buy a book that t wrote?
b. *Which relative of John's will he inherit a fortune, if t dies?

The examples in (26) already demonstrate that the scope of an indefinite can extend beyond the local tensed clause. The same point can be made with the following example, where *a student of mine* can easily take wide scope over *every colleague of mine*.

(29) Several people asked me if a student of mine was in my class today.

Similarly, indefinites are exempt from the scope freezing effects of the double object construction. For example, (30) can be understood as saying that there is a particular book about λ-calculus that John has decided to assign to every student.

(30) John has decided to assign every student a book about λ-calculus.

In order to explain such exceptional wide scope readings of indefinites, Fodor & Sag (1982) proposed that indefinites can sometimes be used as referring expressions, and are ambiguous between a type-$\langle et, t\rangle$ interpretation and a type-e interpretation. The thought is that when an indefinite is used as a type-e expression, it behaves as if it takes the widest scope in the sentence, because it just pick out a particular individual and it takes the same individual even in the scope of quantifiers. Or, in other words, just like proper names are scopeless, type-e indefinites are also scopeless.

This analysis, however, has a problem with intermediate readings like (31).

(31) Every student has to read every paper that is about a topic of his or her choice.

This sentence has a reading where *a topic of his or her choice* takes scope between the two universal quantifiers:

(32) For every student, there is a topic of topic of his or her choice such that he or she has to read every paper about it.

If *a topic of his or her choice* is a referring expression and type-*e*, there is not way that it can vary across different students. Schwarzschild (2002) proposes a more refined version of Fodor & Sag's (1982) theory that can account for such intermediate readings.

In addition, there are several other theories of indefinites that also attempt to explain wide scope readings of indefinites. Reinhart (1997), Winter (1997), Kratzer (1998), Matthewson (1998), Chierchia (2001) and Schlenker (2006), among others, make use of *choice functions* to account for wide scope readings, although this approach has certain problems, as pointed out by Schwarz (2004). Recently Charlow (2014) puts forward a completely novel approach to this issue.

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