Chapter Eight
The Third Reading

In this chapter, we will see that quantificational noun phrases in the scope of a modal operator can receive a reading where their restrictive predicate is not interpreted in the worlds introduced by the modal operator (which is what happens in specific readings as well) while at the same time *their quantificational force takes scope below the modal operator (which is what happens in non-specific readings as well). This seemingly paradoxical situation might force whole-sale revisions to our architecture. We discuss the standard solution (which involves supplying predicates with world-arguments) and some alternatives.*

8.1 A Problem

Janet Dean Fodor discussed examples like (1) in her dissertation (1970).

(1) Mary wanted to buy a hat just like mine.

Fodor observes that (1) has three readings, which she labels "specific transparent," "non-specific transparent," and "non-specific opaque."

(i) On the "specific transparent" reading, the sentence says that there is a particular hat which is just like mine such that Mary has a desire to buy it. Say, I am walking along Newbury Street with Mary. Mary sees a hat in a display window and wants to buy *it*. She tells me so. I don't reveal that I have one just like it. But later I tell *you* by uttering (1).

(ii) On the "non-specific opaque" reading, the sentence says that Mary's desire was to buy some hat or other which fulfills the description that it is just like mine. She is a copycat.

(iii) On the "non-specific transparent" reading, finally, the sentence will be true, e.g., in the following situation: Mary's desire is to buy some hat or other, and the only important thing is that it be a Red Sox cap. Unbeknownst to her, my hat is one of those as well.

The existence of three different readings appears to be problematic for the scopal account of specific/non-specific ambiguities that we have been assuming. It seems that our analysis allows just two semantically distinct types of LFs: Either the DP *a hat just like mine* takes scope below *want*, as in (2), or it takes scope above *want*, as in (3).

(2) Mary wanted [[a hat-just-like-mine]$_1$ [PRO to buy t_1]]

(3) [a hat-just-like-mine]$_1$ [Mary wanted [PRO to buy t_1]]

In the system we have developed so far, (2) says that in every world w' in which Mary gets what she wants, there is something that she buys in w' that's a hat in w' and like my hat in w'. This is Fodor's "non-specific opaque" reading. (3), on the other hand, says that there is some thing x which is a hat in the actual world and like my hat in the actual world, and Mary buys x in every one of her desire worlds. That is Fodor's "specific transparent." But what about the "non-specific transparent" reading? To obtain this reading, it seems that we would have to evaluate the predicate *hat just like mine* in the actual world, so as to obtain its actual extension (in the scenario we have sketched, the set of all Red Sox caps). But the existential quantifier expressed by the indefinite article in the *hat*-DP should not take scope over the modal operator *want*, but below it, so that we can account for the fact that in different desire-worlds of Mary's, she buys possibly different hats.

There is a tension here: one aspect of the truth-conditions of this reading suggests that the DP *a hat just like mine* should be *outside* of the scope of *want*, but another aspect of these truth-conditions compels us to place it *inside* the scope of *want*. We can't have it both ways, it would seem, which is why this has been called a "scope paradox"

Another example of this sort, due to Bäuerle (1983), is (4):

(4) Georg believes that a woman from Stuttgart loves every member of the VfB team.

Bäuerle describes the following scenario: Georg has seen a group of men on the bus. This group happens to be the VfB team (Stuttgart's soccer team), but Georg does not know this. Georg also believes (Bäuerle doesn't spell out on what grounds) that there is some woman from Stuttgart who loves every one of these men. There is no particular woman of whom he believes that, so there are different such women in his different belief-worlds. Bäuerle notes that (4) can be understood as true in this scenario. But there is a problem in finding an appropriate LF that will predict its truth here. First, since there are different women in different belief-worlds of Georg's, the existential quantifier *a woman from Stuttgart* must be inside the scope of *believe*. Second, since (in each belief world) there aren't different women that love each of the men, but one that loves them all, the *a*-DP should take scope over the *every*-DP. If the *every*-DP is in the scope of the *a*-DP, and the *a*-DP is in the scope of *believe*, then it follows that the *every*-DP is in the scope of *believe*. But on the other hand, if we want to capture the fact that the men in question need not be VfB-members in Georg's belief-worlds, the predicate *member of the VfB team* needs to be outside of the scope of *believe*. Again, we have a "scope paradox".

Before we turn to possible solutions for this problem, let's have one more example:

(5) Mary hopes that a friend of mine will win the race.

This again seems to have three readings. In Fodor's terminology, the DP *a friend of mine* can be "non-specific opaque," in which case (5) is true iff in every world where Mary's hopes come true, there is somebody who is my friend and wins. It can also have a "specific transparent" reading: Mary wants John to win, she doesn't know John is my friend, but I can still report her hope as in (5). But there is a third option, the "non-specific transparent" reading. To bring out this rather exotic reading, imagine this: Mary looks at the ten contestants and says *I hope one of the three on the right wins - they are so shaggy - I like shaggy people*. She doesn't know that those are my friends. But I could still report her hope as in (5).

8.2 The Standard Solution: Overt World Variables

The scope paradoxes we have encountered can be traced back to a basic design feature of our system of intensional semantics: the relevant "evaluation world" for each predicate in a sentence is strictly determined by its LF-position. All predicates that occur in the (immediate) scope of the same modal operator must be evaluated in the same possible worlds. E.g. if the scope of *want* consists of the clause *a friend of mine (to) win*, then every desire-world w' will be required to contain an individual that wins in w' and is also my friend *in* w'. If we want to quantify over individuals that are my friends in the actual world (and not necessarily in all the subject's desire worlds), we have no choice but to place *friend of mine* outside of the scope of *want*. And if we want to accomplish this by means of QR, we must move the entire DP *a friend of mine*.

Not every kind of intensional semantics constrains our options in this way. One way to visualize what we might want is to write down an LF that looks promising:

(6) Mary wanted$_{w_0}$[$\lambda w'$[a hat-just-like-mine $_{w_0}$]λx_1[PRO to buy$_{w'}$ x_1]]

We have annotated each predicate with the world in which we wish to evaluate it. w_0 is the evaluation world for the entire sentence and it is the world in which we evaluate the predicates *want* and *hat-just-like-mine*. The embedded sentence contributes a function from worlds to truth-values and we insert an explicit λ-operator binding the world where the predicate *buy* is evaluated. The crucial aspect of (6) is that the world in which *hat-just-like-mine* is evaluated is the matrix evaluation world and not the same world in which its clause-mate predicate *buy* is evaluated. This LF thus looks like it might faithfully capture Fodor's third reading.

Logical forms with overt world variables such as (6) are in fact the standard solution to the problem presented by the third reading. Let us spell out some of the technicalities. Later, we will consider a couple of alternatives.

8.2.1 Semantic Values

In this new system, we do *not* relativize the interpretation function to a possible world. As in the old extensional system, the basic notion is just "$[\![\alpha]\!]$," i.e., "the semantic value of α". (Or "$[\![\alpha]\!]^g$," "the semantic value of α under assignment g", if α contains free variables.) However, semantic values are no longer always extensions; some of them still are, but others are intensions. Here are some representative examples of the types of semantic values for various kinds of words.

8.2.2 Lexical entries

(7) a. $[\![\text{smart}]\!] = \lambda w \in D_s.\ \lambda x \in D_e.\ x \text{ is smart in } w$
b. $[\![\text{likes}]\!] = \lambda w \in D_s.\ \lambda x \in D_e.\ \lambda y \in D_e.\ y \text{ likes } x \text{ in } w$
c. $[\![\text{teacher}]\!] = \lambda w \in D_s.\ \lambda x \in D_e.\ x \text{ is a teacher in } w$
d. $[\![\text{friend}]\!] = \lambda w \in D_s.\ \lambda x \in D_e.\ \lambda y \in D_e.\ y \text{ is } x\text{'s friend in } w$

(8) a. $[\![\text{believe}]\!] = \lambda w \in D_s.\ \lambda p \in D_{\langle s,t\rangle}.\ \lambda x \in D.$
$\forall w'\ [w' \text{ conforms to what } x \text{ believes in } w \rightarrow p(w') = 1]$
b. $[\![\text{must}]\!] = \lambda w \in D_s.\ \lambda R \in D_{\langle s,st\rangle}.\ \lambda p \in D_{\langle s,t\rangle}.$
$\forall w'\ [R(w)(w') = 1 \rightarrow p(w') = 1]$

(9) a. $[\![\text{Ann}]\!] = \text{Ann}$
b. $[\![\text{and}]\!] = \lambda u \in D_t.\ [\lambda v \in D_t.\ u = v = 1]$
c. $[\![\text{the}]\!] = \lambda f \in D_{\langle e,t\rangle}\colon\ \exists!x.\ f(x) = 1.\ \text{the } y \text{ such that } f(y) = 1.$
d. $[\![\text{every}]\!] = \lambda f \in D_{\langle e,t\rangle}.\ \lambda g \in D_{\langle e,t\rangle}.\ \forall x[f(x) = 1 \rightarrow g(x) = 1]$

The entries in (9) (for words whose extensions are constant across worlds) have stayed the same; their semantic values are still extensions. But the ones for predicates (ordinary ones and modal ones) in (7) and (8) have changed; these items now have as their semantic values what used to be their *intensions*.

8.2.3 Composition Rules

We abolish the special rule of Intensional Functional Application (IFA)[1] and go back to our old inventory of Functional Application, λ-Abstraction, and Predicate Modification[2].

8.2.4 Syntax

What we have at this point does not allow us to interpret even the simplest syntactic structures. For instance, we can't interpret the tree in (10).

(10) [$_{VP}$ John leave]

The verb's type is $\langle s, et\rangle$, so it's looking for a sister node which denotes a *world*. *John*, which denotes an individual, is not a suitable argument.

We get out of this problem by positing more abstract syntactic structures (at the LF level). Specifically, we assume that there is a set of covert "world pronouns" which are generated as sisters to all lexical predicates in LF-structures. Officially,

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1 We also abolish the Extensional Functional Application rule (EFA), if we had that one (see section 7.2.3 "Semantic Reconstruction").

2 Actually, PM requires a slightly revised formulation: $[\![\alpha\ \beta]\!]^g = \lambda w \in D_s.\ \lambda x \in D_e.\ [\![\alpha]\!]^g(w)(x) = [\![\beta]\!]^g(w)(x) = 1$. But we will not be concerned with the compositional interpretation of modifier-structures here, so you won't be needing this rule.

the variable would be a pair of an index and the type s. Inofficially, we will use "w" with a subscripted index, with the understanding that the "w" indicates we are dealing with a variable of type s. So, the syntax would generate something like (11):

(11) [John [leave w_{12}]]

The sentence would then obviously have an assignment-dependent extension (a truth-value), depending on what world the variable assignment assigns to the world variable with index 12. In our intensional system of Chapter 1—5, we were assuming the following principle:

(12) An utterance of a sentence (=LF) ϕ in world w is true iff $[\![\phi]\!]^w = 1$.

To achieve the same in our new system, we would have to ensure that the variable assignment assign the utterance world to the free world variable(s) in the sentence. Another possibility, which we will adopt here, is to introduce a variable binder on top of the sentence. We will assume the following kind of syntactic structure at LF:

(13) [λw_{12} [John [leave w_{12}]]]

The sentence now has as its extension what used to be its intension, a proposition. The principle of utterance truth now is this:

(14) An utterance of a sentence (=LF) ϕ in world w is true iff $[\![\phi]\!](w) = 1$.

Now, we have to look at more complex sentences. First, a simple case of embedding. The sentence is *John wants to leave*, which now as an LF like this:

(15) [λw_0[John [[wants w_0[[λw_1[PRO [leave w_1]]]]]]]]

EXERCISE 8.1: Calculate the semantic value of (15). □

Next, look at an example involving a complex subject, such as *the teacher left*.

(16) [λw_0[[the [teacher w_0]][left w_0]]]

The verb will need a world argument as before. The noun *teacher* will likewise need one, so that *the* can get the required argument of type $\langle e, t\rangle$ (not $\langle s, et\rangle$!). If we co-index the two world variables, we derive as the semantic value for (16) what its intension would have been in old system. But nothing we have said forces us to co-index the two world variables, which is what will allow us to derive the third reading for relevant examples.

Consider what happens when the sentence contains both a modal operator and a complex DP in its complement.

(17) Mary wants a friend of mine to win.

There are now three predicates that need world arguments. Furthermore, there will be two λ-operators binding world variables. We can now represent the three readings (to make the structures more readable, we'll leave off most of the bracketing and start writing the world arguments as subscripts to the predicates):

(18) a. non-specific opaque:
λw_0 Mary $\text{wants}_{w_0}[\lambda w_1$ a $\text{friend-of-mine}_{w_1}$ $\text{leave}_{w_1}]$
b. specific transparent:
λw_0 [a $\text{friend-of-mine}_{w_0}]\lambda\ x_3$Mary $\text{wants}_{w_0}[\lambda w_1\ x_3$ $\text{leave}_{w_1}]]$
c. non-specific transparent:
λw_0 Mary $\text{wants}_{w_0}[\lambda w_1$ a $\text{friend-of-mine}_{w_0}$ $\text{leave}_{w_1}]$

In this new framework, then, we have a way of resolving the apparent "scope paradoxes" and of acknowledging Fodor's point that there are two separate distinctions to be made when DPs interact with modal operators. First, there is the scopal relation between the DP and the operator; the DP may take wider scope (Fodor's "specific" reading) or narrower scope ("non-specific" reading) than the operator. Second, there is the choice of binder for the world-argument of the DP's restricting predicate; this may be cobound with the world-argument of the embedded predicate (Fodor "opaque") or with the modal operator's own world-argument ("transparent"). So the transparent/opaque distinction in the sense of Fodor is not *per se* a distinction of scope; but it has a principled connection with scope in one direction: Unless the DP is within the modal operator's scope, the opaque option (= co-binding the world-pronoun with the embedded predicate's world-argument) is in principle unavailable. (Hence "specific" implies "transparent", and "opaque" implies "non-specific".) But there is no implication in the other direction: if the DP has narrow scope w.r.t. to the modal operator, either the local or the long-distance binding option for its world-pronoun is in principle available. Hence "non-specific" readings may be either "transparent" or "opaque".

Exercise 8.2: For DPs with extensions of type *e* (specifically, DPs headed by the definite article), there is a truth-conditionally manifest transparent/opaque distinction, but no truth-conditionally detectable specific/non-specific distinction. In other words, if we construct LFs analogous to (18a-c) above for an example with a definite DP, we can always prove that the first option (wide scope DP) and the third option (narrow scope DP with distantly bound world-pronoun) denote identical propositions. In this exercise, you are asked to show this for the example in (19).

(19) John believes that your abstract will be accepted. □

8.2.5 The Need for a Binding Theory for World Variables

One could in principle imagine some indexings of our LFs that we have not considered so far. The following LF indexes the predicate of the complement clause to the matrix λ-operator rather than to the one on top of its own clause.

(20) λw_0 John wants$_{w_0}$[λw_1 PRO leave$_{w_0}$]

Of course, the resulting semantics would be pathological: what John would be claimed to stand in the wanting relation to is a set of worlds that is either the entire set *W* of possible worlds (if the evaluation world is one in which John leaves) or the empty set (if the evaluation world is one in which John doesn't leave). Clearly, the sentence has no such meaning. Do we need to restrict our system to not generate such an LF? Perhaps not, if the meaning is so absurd that the LF would be filtered out by some overarching rules distinguishing sense from nonsense.

But the problem becomes real when we look at more complex examples. Here is one discussed by Percus in important work (Percus 2000):

(21) Mary thinks that my brother is Canadian.

Since the subject of the lower clause is a type e expression, we expect at least two readings: opaque and transparent, cf. Exercise 8.2. The two LFs are as follows:

(22) a. opaque
λw_0 Mary thinks$_{w_0}$[(that) λw_1 my brother$_{w_1}$ (is) Canadian$_{w_1}$]
b. transparent
λw_0 Mary thinks$_{w_0}$[(that) λw_1 my brother$_{w_0}$ (is) Canadian$_{w_1}$]

But as Percus points out, there is another indexing that might be generated:

(23) λw_0 Mary thinks$_{w_0}$[(that) w_1 my brother$_{w_1}$ (is) Canadian$_{w_0}$]

In (23), we have co-indexed the main predicate of the lower clause with the matrix λ-operator and co-indexed the nominal predicate *brother* with the embedded λ-operator. That is, in comparison with the transparent reading in (22b), we have just switched around the indices on the two predicates in the lower clause.

Note that this LF will not lead to a pathological reading. So, is the predicted reading one that the sentence actually has? No. For the transparent reading, we can easily convince ourselves that the sentence does have that reading. Here is Percus' scenario: "My brother's name is Allon. Suppose Mary thinks Allon is not my brother but she also thinks that Allon is Canadian." In such a scenario, our sentence can be judged as true, as predicted if it can have the LF in (22b). But when we try to find evidence that (23) is a possible LF for our sentence, we fail. Here is Percus:

> If the sentence permitted a structure with this indexing, we would take the sentence to be true whenever there is some *actual* Canadian who *Mary thinks* is my brother — even when this person is not my brother in actuality, and *even when Mary mistakenly thinks that he is not Canadian*. For instance, we would take the sentence to be true when Mary thinks that Pierre (the Canadian) is my brother and naturally concludes — since she knows that *I* am American — that Pierre too is American. But in fact we judge the sentence to be *false* on this scenario, and so there must be something that makes the indexing in (23) impossible.

Percus then proposes the following descriptive generalization:

(24) Generalization X: The situation pronoun that a verb selects for must be coindexed with the nearest λ above it.[3]

We expect that there will need to be a lot of work done to understand the deeper sources of this generalization. For fun, we offer the following implementation (devised by Irene Heim).

8.2.6 Two Kinds of World Pronouns

We distinguish two syntactic types of world-pronouns. One type, *w*-pro, behaves like relative pronouns and pro in the analysis of H&K, ch. 8.5 (pp. 226ff.): it is semantically vacuous itself, but can move and leave a trace that is a variable. The only difference between *w*-pro and pro is that the latter leaves a variable of type *e* when it moves, whereas the former leaves a variable of type s. The other type of world-pronoun, *w-pro*, is analogous to bound-variable personal pronouns, i.e., it is itself a variable (here of type s). Like a personal pronoun, it can be coindexed with the trace of an existing movement chain.

With this inventory of world-pronouns, we can capture the essence of Generalization X by stipulating that *w-pro* is only generated in the immediate scope of a determiner (i.e., as sister to the determiner's argument). Everywhere else where a world-pronoun is needed for interpretability, we must generate a *w*-pro and move it. This (with some tacit assumptions left to the reader to puzzle over) derives the result that the predicates inside nominals can be freely indexed but that the ones inside predicates are captured by the closest λ-operator.

As we said, there is plenty more to be explored in the Binding Theory for world pronouns. The reader is referred to the paper by Percus and the references he cites.

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3 Percus works with situation pronouns rather than world pronouns, an immaterial difference for our purposes here.

8.2.7 Excursus: Semantic reconstruction for non-specific raised subjects?

Let us look back at the account of non-specific readings of raised subjects that we sketched earlier in Section 7.2.3. We showed that you can derive such readings by positing a high type trace for the subject raising, a trace of type $\langle s, \langle et, t\rangle\rangle$. Before the lower predicate can combine with the trace, the semantic value of the trace has to be extensionalized by being applied to the lower evaluation world (done via the EFA composition principle). Upstairs the raised subject has to be combined with the λ-abstract (which will be of type $\langle\langle s, \langle et, t\rangle\rangle, t\rangle$) via its intension.

We then saw recently discovered data suggesting that syntactic reconstruction is actually what is going on. This, of course, raises the question of why semantic reconstruction is unavailable (otherwise we wouldn't expect the data that we observed).

Fox (2000, p. 171, fn. 41) mentions two possible explanations:

(i) "traces, like pronouns, are always interpreted as variables that range over individuals (type e)",
(ii) "the semantic type of a trace is determined to be the lowest type compatible with the syntactic environment (as suggested in Beck (1996))".

In this excursus, we will briefly consider whether our new framework has something to say about this issue. Let's figure out what we would have to do in the new framework to replicate the account in the section on semantics reconstruction.

Downstairs, we would have a trace of type $\langle s, \langle et, t\rangle\rangle$. To calculate its extension, we do not need recourse to a special composition principle, but can simply give it a world-argument (co-indexed with the abstractor resulting from the movement of the *w*-PRO in the argument position of the lower verb).

Now, what has to happen upstairs? Well, there we need the subject to be of type $\langle s, \langle et, t\rangle\rangle$, the same type as the trace, to make sure that its semantics will enter the truth-conditions downstairs. But how can we do this?

We need the DP *somebody from New York* to have as its semantic value an intension, the function from any world to the existential quantifier over individuals who are people from New York in that world. This is actually hard to do in our system. It *would* be possible if (i) the predicate(s) inside the DP received *w*-PRO as their argument, and if (ii) that *w*-PRO were allowed to moved to adjoin to the DP. If we manage to rule out at least one of the two preconditions on principled grounds, we would have derived the impossibility of semantic reconstruction as a way of getting non-specific readings of raised subjects.

(i) may be ruled out by the Binding Theory for world pronominals, when it gets developed.
(ii) may be ruled out by principled considerations as well. Perhaps, world-abstractors are only allowed at sentential boundaries.

8.3 Alternatives to Overt World Variables

We presented (a variant of) what is currently the most widely accepted solution to the scope paradoxes, which required the use of non-locally bound world-variables. There are some alternatives, one of which is to some extent a "notational variant", the others involved syntactic scoping after all.

8.3.1 Indexed Operators

It is possible to devise systems where predicates maintain the semantics we originally gave them, according to which they are sensitive to a world of evaluation parameter. The freedom needed to account for the third reading and further facts would be created by assuming more sophisticated operators that shift the evaluation world. Here is a toy example:

(25) Mary wants [a [ACTUALLY$_0$ friend-of-mine] leave]

The idea is that the ACTUALLY "temporarily" shifts the evaluation world back to what it was "before" the abstraction over worlds triggered by *want* happened.

This kind of system can be spelled out in as much detail as the world-variable analysis. Cresswell (1990) proves that the two systems are equivalent in their expressive power. The decision is therefore a syntactic one. Does natural language have a multitude of indexed world-shifters or a multitude of indexed world-variables? Cresswell suspects the former, as did Kamp (1971) who wrote:

> I of course exclude the possibility of symbolizing the sentence by means of explicit quantification over moments. Such a symbolization would certainly be possible; and it would even make the operators P and F superfluous. Such symbolizations, however, are a considerable departure from the actual form of the original sentences which they represent — which is unsatisfactory if we want to gain insight into the semantics of English. Moreover, one can object to symbolizations involving quantification over such abstract objects as moments, if these objects are not explicitly mentioned in the sentences that are to be symbolized.

There is some resistance to world-time variables because they are not phonetically realized. But in an operator-based system, we'll have non-overt operators all over the place. So, there is no a priori advantage for either system. We will stick with the more transparent LFs with world variables.

8.3.2 Scoping After All?

Suppose we didn't give up our previous framework, in which the evaluation-world for any predicate was strictly determined by its LF-position. It turns out

that there is a way (actually, two ways) to derive Fodor's non-specific transparent reading in that framework after all.

Recall again what we need. We need a way to evaluate the restrictive predicate of a DP with respect to the higher evaluation world while at the same time interpreting the quantificational force of the DP downstairs in its local clause. We saw that if we move the DP upstairs, we get the restriction evaluated upstairs but we also have removed the quantifier from where it should exert its force. And if we leave the DP downstairs where its quantificational forces is felt, its restriction is automatically evaluated down there as well. That is why Fodor's reading is paradoxical for the old framework. In fact, though there is no paradox.

Way 1 Raise the DP upstairs but leave a $\langle\langle e, t\rangle, t\rangle$ trace. This way the restriction is evaluated upstairs, then a quantifier extension is calculated, and that quantifier extension is transmitted to trace position. This is just what we needed.

Way 2 Move the NP-complement of a quantificational D independently of the containing DP.[4] Then we could generate three distinct LFs for a sentence like *Mary wants a friend of mine to win*: two familiar ones, in which the whole DP *a friend of mine* is respectively inside and outside the scope of *want*, plus a third one, in which the NP *friend of mine* is outside the scope of *want* but the remnant DP *a* $[_{NP}\ t]$ has been left behind inside it:

(26) $[\ [_{NP}$ f-o-m$]\ \lambda_1\ [$ Mary $[$ want $[\ [_{DP}$ a $t_{\langle e,t\rangle,1}\ ]$ win$]]]]$

EXERCISE 8.3: Convince yourself that this third LF represents the narrow-quantification, restrictor-transparent reading (Fodor's "non-specific transparent"). □

We have found, then, that it is in principle possible after all to account for narrow-Q transparent readings within our original framework of intensional semantics.

EXERCISE 8.4: In (26), we chose to annotate the trace of the movement of the NP with the type-label $\langle e, t\rangle$, thus treating it as a variable whose values are predicate-extensions (characteristic functions of sets of individuals). As we just saw, this choice led to an interpretable structure. But was it our only possible choice? Suppose the LF-structure were exactly as in (26), except that the trace had been assigned type $\langle s, et\rangle$ instead of $\langle e, t\rangle$. Would the tree still be interpretable? If yes, what reading of the sentence would it express? □

4 Something like this was proposed by Groenendijk & Stokhof (1982) in their treatment of questions with *which*-DPs.

Exercise 8.5: We noted in the previous section about the world-pronouns framework that there was a principled reason why restrictor-*de dicto* readings necessarily are narrow-quantification readings. (Or, in Fodor's terms, why there is no such thing as a "specific *de dicto*" reading.) In that framework, this was simply a consequence of the fact that bound variables must be in the scope of their binders. What about the alternative account that we have sketched in the present section? Does this account also imply that opaque readings are necessarily narrow-Q? □

8.4 Scope, Restrictors, and the Syntax of Movement

To conclude our discussion of the ambiguities of DPs in the complements of modal operators, let us consider some implications for the study of LF-syntax. This will be very inconclusive.

Accepting the empirical evidence for the existence of narrow-Q transparent readings which are truth-conditionally distinct from both the wide-Q transparent and the narrow-Q opaque readings, we are facing a choice between two types of theories. One theory, which we have referred to as the "standard" one, uses a combination of DP-movement and world-pronoun binding; it maintains that wide-quantification readings really do depend on (covert) syntactic movement, but transparent interpretations of the restrictor do not. The other theory, which we may dub the "scopal" account, removes the restrictor from the scope of the modal operator, either by QR (combined with an $\langle et, t\rangle$ type trace) or by movement of the NP-restrictor by itself.

In order to adjudicate between these two competing theories, we may want to inquire whether the R-*de re* — *de dicto* distinction exhibits any of the properties that current syntactic theory would take to be diagnostic of movement. This is a very complex enterprise, and the few results to have emerged so far appear to be pointing in different directions.

We have already mentioned that it is questionable whether NPs that are complements to D can be moved out of their DPs. Even if it is possible, we might expect this movement to be similar to the movement of other predicates, such as APs, VPs, and predicative NPs. Such movements exist, but — as discussed by Heycock, Fox, and the sources they cite — they typically have no effect on semantic interpretation and appear to be obligatorily reconstructed at LF. The type of NP-movement required by the purely scopal theory of transparent readings would be exceptional in this respect.

Considerations based on the locality of uncontroversial instances of QR provide another reason to doubt the plausibility of the scopal theory. May (1977) argued, on the basis of examples like (27), that quantifiers do not take scope out of embedded tensed clauses.

(27) a. Some politician will address every rally in John's district.
b. Some politician thinks that he will address every rally in John's district.

While in (27a) the universal quantifier can take scope over the existential quantifier in subject position, this seems impossible in (27b), where the universal quantifier would have to scope out of its finite clause. Therefore, May suggested, we should not attribute the *de re* reading in an example like our (28) to the operation of QR.

(28) John believes that your abstract will be accepted.

As we saw above, the standard theory which appeals to non-locally bound world-pronouns does have a way of capturing the *de re* reading of (28) without any movement, so it is consistent with May's suggestion. The purely scopal theory would have to say something more complicated in order to reconcile the facts about (27) and (28). Namely, it might have to posit that DP-movement is finite-clause bound, but NP-movement is not. Or, in the other version, it would have to say that QR can escape finite clauses but only if it leaves a $\langle et, t \rangle$ type trace.

Both theories, by the way, have a problem with the fact that May's finite-clause-boundedness does not appear to hold for all quantificational DPs alike. If we look at the behavior of *every*, *no*, and *most*, we indeed can maintain that there is no DP-movement out of tensed complements. For example, (29) could mean that Mary hopes that there won't be any friends of mine that win. Or it could mean (with suitable help from the context) that she hopes that there is nobody who will win among those shaggy people over there (whom I describe as my friends). But it cannot mean merely that there isn't any friend of mine who she hopes will win.

(29) Mary hopes that no friend of mine will win.

So (30) has opaque and transparent readings for *no friend of mine*, but no wide-quantification reading where the negative existential determiner *no* takes matrix scope. Compare this with the minimally different infinitival complement structure, which does permit all three kinds of readings.

(30) Mary expects no friend of mine to win.

However, indefinite DPs like *a friend of mine*, *two friends of mine* are notoriously much freeer in the scope options for the existential quantifiaction they express. For instance, even the finite clause in (31) seems to be no impediment to a reading that is not only transparent but also wide-quantificational (i.e., it has the existential quantifier over individuals outscoping the universal world-quantifier).

(31) Mary hopes that a friend of mine will win.

The peculiar scope-taking behavior of indefinites (as opposed to universal, proportional, and negative quantifiers) has recently been addressed by a number of authors (Abusch 1994, Reinhart 1997, Winter 1997, Matthewson 1999, Kratzer 1998), and there are good prospects for a successful theory that generates even the *wide-Q* transparent readings of indefinites without any recourse to non-local DP-movement. You are encouraged to read these works, but for our current purposes here, all we want to point out is that, with respect to the behavior of indefinites, neither of the two theories we are trying to compare seems to have a special advantage over the other. This is because wide-Q readings result from DP-movement according to *both* theories.

As we mentioned in the previous chapter, a number of recent papers have been probing the connection between *de dicto* readings and the effects of Binding Condition C applying at LF. These authors have converged on the conclusion that DPs which are read as *de dicto* behave w.r.t. Binding Theory as if they are located below the relevant modal predicate at LF, and DPs that are read as *de re* (i.e., wide-Q, transparent) behave as if they are located above. It is natural to inquire whether the same kind of evidence could also be exploited to determine the LF-location of the NP-part of a DP which is read as narrow-quantificational but restrictor-transparent. If this acted for Condition C purposes as if it were below the attitude verb, it would confirm the standard theory (non-locally bound world-pronouns), whereas if it acted as if it was scoped out, we'd have evidence for the scopal account. Sharvit (1998) constructs some of the relevant examples and reports judgments that actually favor the scopal theory.[5] For example, she observes that (32a) does allow the narrow-Q, transparent-reading indicated in (32b).

(32) a. How many students who like John$_1$ does he$_1$ think every professor talked to?
b. For which n does John think that every professor talked to n people in the set of students who actually like John?

More research is required to corroborate this finding.

As a final piece of potentially relevant data, consider a contrast in Marathi recently discussed by Bhatt (1999).

(33) [ji bai kican madhe ahe]$_i$ Ram-la watte ki [[t$_i$ [ti
REL woman kitchen in is Ram thinks that that woman
bai]$_i$] kican madhe nahi]
kitchen in not is
'Ram thinks that the woman who is in the kitchen is not in the kitchen'

5 Sharvit's own conclusion, however, is not that her data supports the purely scopal theory.

(34) Ram-la watte ki [[ji bai kican madhe ahe]$_i$ [[t$_i$ [ti bai]$_i$] kican madhe nahi]]
Ram thinks that REL woman kitchen in is that woman kitchen in not is
'Ram thinks that the woman who is in the kitchen is not in the kitchen'

The English translation of both examples has two readings: a (plausible) transparent reading, on which Ram thinks of the woman who is actually in the kitchen that she isn't, and an (implausible) *de dicto* reading, on which Ram has the contradictory belief that he would express by saying: "the woman in the kitchen is not in the kitchen". The Marathi sentence (33) also allows these two readings, but (34) unambiguously expresses the implausible *de dicto* reading. Bhatt's explanation invokes the assumption that covert movement in Hindi cannot cross a finite clause boundary. In (33), where the correlative clause has moved overtly, it can stay high or else reconstruct at LF, thus yielding either reading. But in (34), where it has failed to move up overtly, it must also stay low at LF, and therefore can only be *de dicto*. What is interesting about this account is that it crucially relies on a scopal account of the transparent-opaque distinction. (Recall that with type-e DPs like definite descriptions, there *is* no additional wide/narrow-Q ambiguity.) If the standard theory with its non-locally bindable world-pronouns were correct, we would not expect the constraint that blocks covert movement in (34) to affect the possibility of a transparent reading.

In sum, then, the evidence appears to be mixed. Some observations appear to favor the currently standard account, whereas others look like they might confirm the purely scopal account after all. Much more work is needed.

8.5 A Recurring Theme: Historical Overview

To recap, the main shape of the phenomenon discussed in this chapter is that the intensional parameter (time, world) with respect to which the predicate restricting a quantifier is interpreted can be distinct from the one that is introduced by the intensional operator that immediately scopes over the quantifier. The crucial cases have the character of a "scope paradox". This discovery is one that has been made repeatedly in the history of semantics. It has been made both in the domain of temporal dependencies and in the domain of modality. Here are some of the highlights of that history.[6].

1. The *now*-operator

   A. Prior (1968) noticed a semantic problem with the adverb *now*. The main early researchers that addressed the problem were Kamp (1971) and Vlach (1973). A good survey was prepared by van Benthem (1977). Another early

6 Some of this history can be found in comments throughout Cresswell's book (Cresswell 1990), which also contains additional references

reference is Saarinen (1979). The simplest scope paradox examples looked like this:

(35) One day all persons now alive will be dead.

While for this example one could say that *now* is special in always having access to the utterance time, other examples show that an unbounded number of times need to be tracked. It became clear in this work that whether one uses a multitude of indexed *now* and *then*-operators or allows variables over times is a syntactic and not a deep semantic question.

2. The *actually*-operator

   The modal equivalent of the Prior-Kamp scope paradox sentence is:

   (36) It might have been that everyone actually rich was poor.

   Crossley & Humberstone (1977) discuss such examples. Double-indexed systems of modal logic were studied by Segerberg (1973) and Åqvist (1973). See also work by Lewis (1970), van Inwagen (1980), and Hazen (1979). Indexed *actually*-operators are discussed by A. N. Prior & Fine (1977), Peacocke (1978), and Forbes (1983, 1985, 1989).

3. The time of nominal predicates

   There is quite a bit of work that argues that freedom in the time-dependency of nominals even occurs when there is no apparent space for temporal operators. Early work includes Enç (1981, 1986). But see also Ejerhed (1980). More recently Musan's dissertation (Musan 1995) is relevant.

   (37) Every fugitive is back in custody.

4. Tense in Nominals

   There is some syntactic work on tense in nominals, see for example Wiltschko (2003).

5. The Fodor-Reading

   Examples similar to the ones from Fodor and Bäuerle that we used at the beginning of this chapter are discussed in many places (Ioup 1977, Hellan 1978, Abusch 1994, Bonomi 1995, Farkas 1997). The point that all these authors have made is that the NP-predicate restricting a quantifier may be evaluated in the actual world, even when that quantifier clearly takes scope below a modal predicate.

   Heim (Heim 1991) gives an example like this:

   (38) Every time it could have been the case that the player on the left was on the right instead.

Here, *the player on the left* must be evaluated with respect to the actual world. But it is inside a tensed clause, which — as we saw earlier — is usually considered a scope island for quantifiers.

6. Explicit World Variables

   Systems with explicit world/time variables were introduced by Tichy (1971) and Gallin (1975). A system (Ty2) with overt world-variables is used by Groenendijk & Stokhof in their dissertation on the semantics of questions. See also Zimmermann (1989) on the expressive power of that system.

7. Movement

   The idea of getting the third reading via some kind of syntactic scoping has not been pursued much. But there is an intriguing idea in a paper by Bricker (1989), cited by Cresswell (1990, p. 76). Bricker formalizes a sentence like *Everyone actually rich might have been poor* as follows:

   (39) $\exists X(\forall y(Xy \equiv \text{rich } y) \& \Diamond \forall y(Xy \rightarrow \text{poor } y))$

   This is apparently meant to be interpreted as 'there is a plurality X all of whose members are rich and it might have been the case that all of the members of X are poor'. This certainly looks like somehow a syntactic scoping of the restrictive material inside the universal quantifier out of the scope of the modal operator has occurred.

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