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Modal Subordination: *It would eat you first!*
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1. Introduction to modal subordination: Illustrations and the general pattern

Suppose Hansel and Gretel are arguing over whether to lock the door to the forest hut where they're seeking refuge for the night. Gretel tells Hansel:

(1) A wolf might come in. It would eat you first!

What concerns Gretel in (1) is the possibility of some wolf or other coming in. Compare:

(2) A wolf might come in. I saw it prowling around outside earlier.

What Gretel says in (2) can only be understood on the assumption that she has a particular wolf in mind, so that *a wolf* takes wide scope relative to *might*. What forces this is that the only way to resolve the anaphoric presupposition triggered by *it* in the second sentence is to assume that Gretel had a specific wolf in mind in uttering *a wolf*. That was not necessarily the case in (1); we can understand (1) to be about a specific wolf, but it's not typically the first interpretation that comes to mind. The anaphoric presupposition of *it* in the second sentence may be resolved to *a wolf* in the first while still taking the indefinite to be non-specific, evoking a merely hypothetical wolf. What licenses that interpretation in (1)?

Consider this exchange before Hansel and Gretel have entered the hut:

- (3) Hansel: I'm scared to go in! There might be a wolf in the hut, or a bear!
Gretel: Don't be scared. I don't see any large mammal tracks around here, and the hut door is securely closed.
Hansel:
(3a) It got in through the window!
(3b) It might have gotten in through the window!

(3) underlines the correlation between the scope of *a wolf* relative to *might* and the possibility of serving as antecedent for a pronoun in a subsequent utterance. Since Hansel and Gretel are most naturally understood to be talking about hypothetical wild animals in the first two utterances, anaphoric *it* in (3a) seems quite odd, infelicitous, because it seems to presuppose some specific animal antecedent. But *it* in (3b) is felicitous; as in (1), it is the hypothetical wolf or bear that seems to serve as antecedent. Since the only difference between (3a) and (3b) is the presence of *would* (and the perfect required for use of that modal auxiliary), we suspect that the difference in available readings is a function of the presence or absence of the modal.

The phenomenon illustrated in (1) and (3)+(3b) was dubbed *modal subordination* by Roberts (1987,1989). This was the first detailed consideration and general account of the phenomenon, though related examples had been noticed and informally discussed earlier by Lakoff (1972), Karttunen (1974), and McCawley (1981). Roberts adopted this name because, she argued, what licenses the anaphora is a relationship subordinating the interpretation of the modal which has scope over the anaphoric trigger (*it* in (1), (3b)), to that of the modal which takes scope over the apparent antecedent (*a wolf/bear*): the interpretation of the *would* in (1), *might* in (3b) is modally subordinate to *might* in (1), (3).

But modal subordination may occur without overt modal auxiliaries. Note that Kratzer (1977, 1981) argued that indicative conditionals without overt modal auxiliaries themselves have the implicit force of necessity:

(4) If a wolf gets in, (then) Hansel and Gretel are in trouble.

(4) means that in any scenario in which a wolf gets in, the kids are in trouble, with the force of necessity. Similarly, we find:

(5) Hansel: What if a wolf gets in?
Gretel: (Then) we're in trouble!

In Gretel's reply in (5), we understand *then* to be anaphoric to the irrealis event in which a wolf gets in. Then the being in trouble is itself understood to be irrealis, a state following on the hypothetical event entertained by Hansel. Hence, Gretel's reply is modally subordinate to Hansel's hypothetical question.

Notice also that in (5), there is no overt anaphoric element in Gretel's modally subordinate utterance. However, this is only a superficial difference here: With or without *then*, there is independent reason to think that there is an anaphoric relation between the *if*-clause and the main clause in (4) and between Hansel's and Gretel's utterances in (5): In the main clause (4) and Gretel's utterance (5) the Event Time of the eventuality denoted is understood relative to a contextually given Reference Time (Reichenbach 1947; Hinrichs 1981,1986). Partee (1984) argues that the Reference Time is an anaphoric element resolved to some salient eventuality in prior discourse. Here, the Reference Time will be the time immediately following the Event Time of the wolf getting in, so that the interval in which Hansel and Gretel are in trouble is also understood to immediately follow after the wolf's getting in.

Moreover, though there is typically a modal in the first sentence of a pair of sentences related by modal subordination, the one containing the apparent antecedent, that needn't be the case. Consider the following:

(6) John doesn't have a car.
#It's in the garage.
(7) John doesn't have a car.
It would be in the garage.

(6) shows us that normally an indefinite under the scope of negation cannot serve as antecedent for a pronoun in subsequent discourse. Intuitively, *it* in (6) seems to refer to some specific entity, but *a car* under the scope of negation in the first sentence doesn't refer. But in (7) *a car* in that same first sentence, still understood as having narrow scope relative to negation, does seem to license anaphoric *it* in the second utterance. The difference is that the anaphora is facilitated by *would*, with a counterfactual sense. In this context, the sentence is understood to mean 'if John did have a car, it would be in the garage'. The subordination here is to the content under the scope of the negation in the first sentence.

Modal subordination also occurs with use of the future:

- (8) The birds will get hungry (this winter).
(9) If Edna forgets to fill the birdfeeder, she will feel very bad.
The birds will get hungry.

(8) without prior context seems like a prediction, with the force of necessity: '(come what may) the birds will get hungry'. But in (9), the prediction is restricted to those future branches in which Edna forgets to fill the birdfeeder, and the speaker is not committed to that actually happening. So the truth of (8) is not compatible with the birds failing to get hungry, while that of (9) is—so long as Edna doesn't forget.

The subordinate modality (that in the second sentence) may be triggered by some element other than a modal auxiliary:¹

- (10) John may wear a disguise.
Otherwise, the paparazzi will dog him relentlessly.

With overt *otherwise*, the second sentence has the conditional sense 'if he does not wear a disguise, the paparazzi will dog him'. But it seems that *otherwise* itself has a conditional flavor, as well as triggering anaphora; it means something like 'if not *p*', where *p* is some circumstance under discussion.

And we find a perfectly parallel phenomenon involving quantificational adverbials (QAdvs) like *always*, *sometimes*, *usually*, and their ilk:

- (11) Harvey courts a girl at every convention.
She always comes to the banquet with him.
The girl is **usually** very pretty. (Karttunen 1976)

In (11), *a girl* occurs under the scope of *every convention*, so that we understand that Harvey is a serial offender and the indefinite is non-specific. Then *always* and *usually* pick up on this non-specific scenario, so that we understand them to mean something like 'on those occasions' or 'when he does this'.

¹ The observation about *otherwise* inspired by related examples due to Corblin (1994).

In the literature on QAdv (see the line of development from Lewis 1975 through Barwise & Perry 1983, Kratzer 1989, Berman 1987, and de Swart 1991), quantificational adverbs have been analyzed as involving quantification over situations, effecting a unification with the semantics of modals and propositional attitudes. de Swart (1992) argues convincingly that QAdv are generalized quantifiers over events. Cipria & Roberts (2000) argue that events are a type of situation. If we take situations to be partial worlds, in the situation semantics of Kratzer (1989), then generalized quantifiers over events constitute a special sub-class of modal operators. Arguably, most QAdv (*always* and *usually*, but not, e.g., *normally*) are totally realistic, quantifying over only event-situations in the actual world. Then examples like (11) are straightforward cases of modal subordination. No particular girl is referred to, though the girls in question are real, not merely hypothetical. Note that in (11) we have a bare present tense across all three sentences, which here has the sense of the habitual present. (We could have used the simple past habitual, as well.) The habitual itself has a modal aspect; see again Cipria & Roberts (2000). So the choice of tense here, as with the future in (9), arguably facilitates the modal subordination.

Compare (12) (Roberts 1996b), where the present progressive second sentence fails to convey the habitual sense required for modal subordination to the generalization in the first sentence. Then because *it* seems to refer to a particular entity, and there is none salient in the context of utterance, the anaphora is infelicitous. But in (13), the bare present and *always* together license modal subordination, and we have felicitous anaphora.

- (12) **Usually** Fred buys a muffin every morning and eats it at the office.
#It's being baked.
- (13) **Usually** Fred buys a muffin every morning and eats it at the office.
It's always oat bran.

Finally, in the QAdv cases, modal subordination can also arise without an overt operator in second sentence, so long as the tense and aspect are compatible with that interpretation, as in (14):

- (14) **Usually** Fred buys a muffin every morning and eats it at the office.
He buys [a cup of coffee]_F, too.

In (14), the anaphoric trigger is *too*, whose felicity requires that there be some salient situation of the sort *Fred buys x, x* other than the denotation of the focused constituent *a cup of coffee* (Heim 1992). There is no specific situation of that type, but the bare present *buys* permits the habitual interpretation, so that we understand this sentence to be modally subordinate to the first: ‘whenever Fred buys a muffin to eat in the office, he buys a cup of coffee too’, so that *too* is anaphoric to the proposition that Fred bought a muffin on any particular instantiation of that typical situation.

We also find modal subordination under attitude predicates, first noticed (though not under that description) by Lakoff (1972) and McCawley (1981):

- (15) Jan **expected** to get a puppy.
It was eager to please, so she figured it wouldn’t take long to house-break.
- (16) Jan **expected** to get a new puppy.

She **intended** to keep it in her back yard until it was house-broken.

There are two interpretations of the first sentence of (15), one in which *a puppy* takes wide scope relative to *expect*, so that there's a particular puppy Jan expected to get, and one in which she expected to get some non-specific puppy or other. Taking *a puppy* as antecedent for *it* is only felicitous on the first, specific interpretation of the indefinite. But in (16), *it* in the complement of *intend* can be understood non-specifically, where we take this to mean 'Jan expected to keep in her back yard whatever puppy she got'. A Hintikka-style (1969) interpretation of attitude predicates like *expect*, *intend*, and many others takes them to have a modal as part of their lexical semantics. So we can paraphrase (16) as 'in all the worlds consistent with Jan's expectations, she gets a new puppy soon, and in all the worlds consistent with her expectations, she intends to keep it in her back yard...'. Heim (1992) develops detailed lexical semantics for a number of attitude predicates, implementing this idea to show how their modal semantics facilitates anaphora like that noted in (16). But as in (3a) or (6), in (15) there is no modal in the second sentence, hence nothing to facilitate modal subordination to a non-specific puppy.

Finally, modal subordination can occur in cases where the operator in the first sentence and that in the second are of mixed type. In (1) the two modal auxiliaries have different force. In (7), we saw negation in the first sentence, *would* in the second. We can also mix modal auxiliaries and QAdv, as in (17), with QAdv *never* in the first sentence, *would* in the second. In (18) *regret* is factive, implicating the truth of its complement.² In the context here, presumably Mary has not yet attended graduate school, but is only *considering* doing so. Nonetheless, this factive is felicitous because *would* facilitates modal subordination to the circumstances Mary is considering, those in which she *does* get her Ph.D.

- (17) I **never** eat a big breakfast.
It would make me sleepy all morning.
- (18) Mary is **considering** getting her Ph.D. in linguistics.
She **wouldn't** regret attending graduate school.

Here is a general schema for the type of logical form found in modal subordination, involving two independent sentences uttered sequentially:

[S₁ . . . OP₁ [. . . X . . .] . . .] . . . [S₂ . . . ModalOP₂ [. . . Y . . .] . . .]

where:

- S₁ and S₂ are both complete sentences, syntactically independent of each other;
- Y is a presupposition trigger under the scope of ModalOP₂, either a pronoun or other anaphoric definite, *too*, a factive presupposing its complement, or a tense presupposing a Reference Time;
- X, under the scope of OP₁ would satisfy the presupposition triggered by Y;

² Some would say that it presupposes it, but this is controversial. See Simons (2001), Simons et al. (2015). For the purposes of discussion here, I will assume that this is presupposition; it makes no difference to the ultimate analysis.

- OP₁ may be a modal (1, 3), negation (7), future tense (9,10), a QAdv (11, 13, 14, 17), or a modal operator in the lexical semantics of an attitude predicate (16,18); and
- ModalOp is some type of modal operator, e.g. a modal auxiliary (explicit: 1,3b,7,17; or implicit: 5), future tense (9), modal adverbial (10), QAdv (11,13), generic present (14), or the modal operator in the lexical content of an attitude predicate (16).

Then summarizing, the examples above illustrate three essential features of the phenomenon of modal subordination, across a sequence of uttered sentences S₁ and S₂ in the schema above:

1. In the interpretation of S₂, a presupposition trigger *Y* itself occurs under the scope of a modal operator.
2. The only content which would satisfy the presupposition triggered by *Y* occurs under the scope of OP₁ in S₁, so that the satisfying content *X* itself is non-specific (if introduced by an indefinite, as in (1)) or irrealis (if propositional, as in (18)).
3. Even though S₂ may have no *if*-clause itself,³ that part of it headed by ModalOP₂ has a conditional-like interpretation, wherein part of the hypothetical assumption from which the ModOP₂-headed constituent is understood to follow (if the force is that of necessity) or with which it must be compatible (if the force is possibility) is the denotation of *X*.

2. The theoretical problem

Modal subordination phenomena like those considered above pose problems for otherwise robust generalizations about discourse (non-bound) anaphora, and about presupposition satisfaction more generally. To understand why, we need to briefly consider some background: the usual robust assumptions about presupposition projection and satisfaction (§2.1), and the phenomenon of scope islands (§2.2). Modal subordination presents *prima facie* challenges to these otherwise well-motivated generalizations about presupposition and scope islands (§2.3).

§2.1 Presupposition projection and satisfaction

In classical accounts of presupposition projection and satisfaction, stemming from the work of Karttunen (1974) and Stalnaker (1973,1974) and epitomized by Heim (1983), a presupposition such as that triggered by an anaphoric element (e.g. a pronoun or *too*) or a factive predicate imposes a felicity constraint on the context in which it is interpreted: in order for the utterance containing the trigger to be felicitous, the context must satisfy that presupposition. Roughly, in the case of a factive, this means that the context has to entail the truth of the factive's complement; for an anaphoric element, the context has to make available a unique preferred antecedent, satisfactorily resolving the anaphora. The key to characterizing how satisfaction works across a very wide range of cases is Heim's notion of the local context of interpretation for the expression including the trigger.

³ ψ may have an *if*-clause. Consider:

(i) A wolf might come in. If I hid, it would eat you first!

Here the conditional is still understood as modally subordinate to the first clause, with the *if*-clause enriched to yield the interpretation 'if a wolf came in and I hid, it would eat you first'.

A dynamic semantic theory like that of Heim (1982,1983) and much subsequent work not only calculates the truth conditional content of an utterance, but also predicts how it will lead to the modification of the input context of utterance to yield a new context reflecting its content. Moreover, context is updated not only at the conclusion of interpretation of a given utterance, to yield an updated context of utterance for the subsequent utterance, but utterance-internally, so that parts of the sentence being interpreted may contribute in crucial ways to the interpretation of the remainder of that utterance itself. This is simple and relatively obvious for conjunctions. The first conjunct of (20) clearly influences the context for interpretation of the second conjunct in just the way that the first sentence of (19) influences the context for the second:⁴

- (19) John has a dog. He walks it in the park.
(20) John has a dog, and he walks it in the park.

But update also happens under the scope of operators, as well. In a complex utterance like the famous “donkey sentences” of Geach (1967), illustrated by (21) and (22) below, the antecedent of a conditional or the relative clause modifying a quantificational determiner contributes a temporary update to the context of utterance in such a way as to make available an antecedent for a pronoun or entails the truth of a factive.

- (21) If a boy let a wolf_i get in, it_i bit him.
(22) Every boy who let a wolf_i get in was bitten by it_i.

The details needn't concern us here; see Kamp (1981), Heim (1982, 1983) and much subsequent work for a variety of implementations. The basic idea is simple. Neither (21) nor (22) is about a specific wolf (or boy). But neither does the underlined indefinite in either sentence c-command the coindexed pronoun; hence the anaphoric relationship between them is not one of binding. Instead, in interpreting the *if*-clause in (19), the input context of utterance is temporarily updated to reflect the fact that in the hypothetical situation offered for consideration there was a wolf who got in. This updated context then serves as the local context of interpretation for the main clause, and accordingly, the wolf in that hypothetical context can serve as antecedent for *it*. Similarly, in (20) we update the input, “global” context of utterance with the proposition that the arbitrary boy in the domain of *every* let a wolf get in, and this is the local context of utterance for the VP, making that arbitrary wolf available as antecedent for *it*. In both types of sentence, after the utterance has been fully interpreted the temporary modification of the context is dropped—we're no longer considering the arbitrary wolf; and the resulting truth conditional content is added to the input context to yield the context for the subsequent utterance. Since there was no specific wolf referred to, the new update doesn't contain information about any particular wolf, and follow-ups like (23) are therefore infelicitous:

- (23) It_i was very hungry.

⁴ Some of the kinds of update on local context found in dynamic semantic theories, like that for conjunctions and conditionals, are actually foreshadowed in the rules for presupposition projection due to Karttunen (1974), but in a less general way, and not explicitly understood as local context update under the scope of an operator.

The same kind of context-update explains how factive and other non-anaphoric presuppositions can also be merely locally satisfied, as we see in (24) and (25) with factive *regret*:

- (24) [context: Sven has a terrible disease X which is usually transmitted to the sufferer's offspring. Nothing is known about whether Sven has kids.]
If Sven is a father, he regrets that he has children.
- (25) Every X-sufferer who has children regrets that he has children.

The real key to the local update in such cases is that the logical form of the sentences in question involves a tripartite operator structure (see Heim 1982; Bach et al. 1995):

Operator [Restriction , Nuclear Scope]

All natural language operators have such a logical form. In conditionals, following Kratzer (1981), Heim (1982), we assume that there is either an overt or covert modal operator. The *if*-clause serves to make explicit part of the restriction on the modal; the main clause is the nuclear scope. In examples involving a quantificational determiner, like (25), the head NP, including relative clause, gives part of the restriction on the quantifier, the remainder of the sentence constituting the nuclear scope. Utterances with QAdv_s have the same tripartite structure; again, the restriction may be completely contextual or partly implicit; as Lewis (1975) noted, *if*- or *when*-clauses may serve to restrict QAdv_s, the main clause then serving as nuclear scope:

- (26) Usually, if a boy lets a wolf get in, it bites him.

In a dynamic semantics, contextual update in all these cases operates in the same fashion. In interpreting the tripartite logical form, we first update temporarily the global context of utterance with the content of the restriction, using the result to interpret the nuclear scope.⁵ But that temporary update expires once the nuclear scope has been interpreted. Then the resulting truth conditional content of the whole tripartite structure, as given by the semantics of the operator itself, is added to the input context to yield the output. Normally only indefinites which have a specific interpretation, escaping the scope of the operator in logical form, bring about the addition of a possible antecedent for anaphoric triggers in subsequent discourse. So in (2) from above, if *a wolf* has wider scope than *might*, it is a possible antecedent for *it* in the subsequent sentence:

- (2) A wolf might come in. I saw it prowling around outside earlier.

But as we saw in (21) and (22), non-specific, narrow scope indefinites do not result in an update which licenses anaphora in the subsequent (23).

⁵ The best real explanation of why local update works in these tripartite structures is due to Chierchia (1995). He notes that this structure is the schema of the logical forms of generalized quantifiers, and that, as observed by Barwise & Cooper (1981), generalized quantifiers are conservative. To be conservative means that for quantifier Q, restriction A and nuclear scope B, Q [A , B] is true iff Q [A , A∩B] is true as well. Thus, the local context update proposed by Heim and others is not just a stipulation, but reflects this deeper semantic principle.

The same kind of temporary update facilitates the local satisfaction of the factive presupposition triggered by *regret* in (24) and (25): the restriction of the *if*-clause restriction of the conditional and the relative clause restriction on *every* set up local contexts which entail that Sven has children, and those local contexts are available for the interpretation of the nuclear scope in the main clause or VP. Thus, in neither of these examples does the factive presupposition project—neither implies that Sven *does* have children, unlike in (27) and (28), where it does project:

- (27) If Sven suffers from X, he regrets that he has children.
- (28) Every X-sufferer regrets that he has children.

§2.2 Anaphora and scope islands

As we saw above, one of the hallmarks of modal subordination is that the interpretation of a second sentence ψ seems to be conditional on assumptions borrowed, in some sense, from the previous utterance of ϕ , even though the borrowed content is itself under the scope of some modal, quantifier (*every convention* in (11)), or negation (in (6)). One hypothesis one might entertain about simple cases of modal subordination involving modal auxiliaries in both sentences ϕ and ψ is that the modal in ϕ takes scope over the content of the entire second sentence ψ . Then the content introduced under the scope of ϕ would still be local in ψ , just as it is in the main clause of a conditional. But there are both theoretical and empirical problems with this hypothesis.

First, theoretically there is good reason to think that tensed clauses, including tensed main clauses ϕ and ψ in our examples, are scope islands, that is, that the scope of any operator in such a clause is restricted to that clause itself. Rodman (1976) pointed out that relative clauses are islands to quantifier scope, so that the quantifier can't "get off the island". He offers examples like these:

- (29) Guinevere has a bone in every corner of the room.
- (30) Guinevere has a bone that's in every corner of the room.
- (31) Guinevere met a representative from every city in Ohio. (inverse linking)

Unlike (29), (30) gives rise only to a very odd interpretation in which the same bone is in every corner of the room: *every corner of the room* cannot take wide scope out of the relative clause in which it occurs, to permit it to scope over the existential head NP, *a bone that's...* This contrasts both with the locative adjunct *every corner of the room* in (29), and the NP-internal complement *from every city in Ohio* in (31). (29) permits different bones in different corners, and (31) may be true in a case where Guinevere met different representatives from different cities. So the scope-islandhood of the relative clause in (30) is specific to that construction.

Szabolcsi (2010:18) argues that the underlying generalization is broader, and that the scope of a quantificational NP is limited to the tensed clause in which it occurs. Generally, you can bind *into* a tensed clause from a c-commanding quantificational operator, just not *out* of it. Some of her examples:

- (32) That every boy was hungry surprised his mother.
 #'for every boy, that he was hungry surprised his own mother'
- (33) Some judge saw that every contestant was cheating.
 #'every contestant was such that some judge saw that s/he was cheating'

In accord with this generalization, we see that the antecedent of a conditional is a scope island:

- (34) #If every farmer planted his fields last spring, he must now be preparing to harvest.

The quantificational DP *every farmer* cannot scope over the main clause to bind *he*.

And quite generally, matrix sentences are scope islands. Thus, the second sentence in (35) is infelicitous due to anaphora failure, since the only potential antecedent for *he* is bound by *every* in the preceding sentence, which serves as a scope island. This is despite the fact that the intended interpretation is perfectly felicitous when the content is in a relative clause that itself is under the scope of *every*, in (36):⁶

- (35) Every farmer planted his fields last spring.
 #I heard that he's now preparing to harvest.
- (36) Every farmer planted last spring the fields that he's now preparing to harvest.

Hence, theoretically it seems quite implausible to account for anaphora resolution (and presupposition satisfaction more generally) in modal subordination by taking the operator in the first sentence ϕ to take scope over the entire second sentence ψ .

There are also empirical problems with attempting to account for modal subordination with scope extension. For one thing, as we saw in (1), even when ϕ and ψ both contain overt modals, those modals may have distinct force: *might* has the force of possibility in ϕ , while *would* has the force of necessity in ψ . We get the wrong truth conditions if we simply extend the scope of *might* over the entire second sentence, the too-weak 'it might be that it would eat you first'. The attested interpretation is stronger—the speaker is committed to it being necessarily the case, should the wolf come in, that it eats the addressee first.

The existence of cases involving mixed attitude predicates also argues against scope extension. For example, the second sentence of (18) cannot mean that Mary is considering that she wouldn't regret attending graduate school. Instead, it is an assertion by the speaker that Mary wouldn't regret a particular decision, if she makes it:

- (18) Mary is **considering** getting her Ph.D. in linguistics.
 She **wouldn't** regret attending graduate school.

⁶ There are *prima facie* counterexamples to this claim. For example, some speakers find the following fine:

(i) Every farmer received a federal subsidy.
 He changed his crop rotation schedule in order to qualify, and his income was significantly enhanced.

This is an example of a phenomenon Roberts (1989) dubbed *telescoping*; see her arguments that telescoping does *not* involve binding. See §4 below.

And scope extension certainly would not apply in cases involving negation in the first sentence, as in (17).

- (17) I **never** eat a big breakfast.
It would make me sleepy all morning.

That would yield the unattested interpretation ‘it’s not ever the case that there’s a big breakfast that I eat and that it necessarily makes me sleepy all morning’.

Scope extension also cannot account for cases where the interpretation of an utterance ψ clearly draws on content given in multiple previous irrealis clauses, each with its own wide-scope modal auxiliary, QAdv, or attitude predicate. Consider the following, from Roberts (1995):

- (37) If Audrey met a sorcerer, she’d be delighted.
Sorcerers **often** have leprechaun companions.
Leprechauns **sometimes** have a pot of gold.
If Audrey was really lucky, she **might** get the sorcerer to get the leprechaun to let her have some of it.

We understand the last sentence in (37) to mean ‘if Audrey was really lucky and met a sorcerer who had a leprechaun companion that had a pot of gold, she might get the sorcerer to get the leprechaun to let her have some of the leprechaun’s gold’. That is, the implicit enrichment of the overt *if*-clause restriction on *might* is taken from the restrictions (*a sorcerer*) and nuclear scopes (*leprechaun companions*, *a pot of gold*) of multiple operators in distinct preceding sentences: *would* and the mixed-force QAdv *often* and *sometimes*. None of those operators is understood to extend its scope over subsequent discourse.

Finally, extension of scope would not account for cases where the subordinate modal itself is in the complement of an evidential attitude predicate.

- (38) John wants to give the boss a piece of his mind.⁷
Alexa thinks he **would** get fired.

The second sentence is understood to mean ‘Alexa thinks that if John gave his boss a piece of his mind, John would get fired’, so that the borrowed content and conditional force have no effect on the embedding evidential *Alexa thinks*.

§2.3 The challenge of modal subordination

Now we can appreciate the problem posed by modal subordination for the classical theories of presupposition projection. Consider again the general tripartite logical form instantiated by the otherwise varied examples we have considered:

[S₁ . . . OP₁[. . . X. . .]. . .] . . . [S₂ . . . ModalOP₂[. . . Y. . .]. . .]

⁷ To give someone a piece of one’s mind is to tell them one’s harshly negative assessment of their behavior.

X occurs within the restriction or nuclear scope of OP_1 . Any contextual update local to OP_1 —making available *X* as potential antecedent, expires after the tripartite logical form headed by OP_1 has been fully interpreted, in keeping with the general context-update procedure for such logical forms. But because the tensed sentence S_1 is a scope island, OP_1 cannot take scope over S_2 . Therefore, nothing in S_2 is in the tripartite structure headed by S_1 , and in particular *X* is not available as antecedent for *Y* in S_2 .

But then, not only does the characterization of how context update bears on presupposition satisfaction sketched above provide no obvious antecedent for *Y*, but another puzzle arises. If a presupposition fails to be satisfied in the context of utterance, it is said to project. That is to say, if a presupposition is triggered by *Y* in S_2 and the context of utterance resulting from interpretation of S_1 fails to satisfy it—to entail the factive complement or provide an antecedent for the anaphoric trigger—we would expect S_2 to have an unsatisfied presupposition, which is what it means for a presupposition to “project”. So in (18), repeated below, the classical characterization of presupposition projection would predict that in the absence of prior context not given here, the second sentence will presuppose that Mary has attended or will attend graduate school.

- (18) Mary is **considering** getting her Ph.D. in linguistics.
She **wouldn't** regret attending graduate school.

Yet that is clearly not our impression. Similarly, the classical story about presuppositions incorrectly predicts that the second sentence in (1) should be infelicitous in the context given because that context fails to yield an antecedent for *it*.

- (1) A wolf **might** come in. It **would** eat you first!

Of course, Karttunen, Stalnaker and Heim all admitted of the possibility that other contextual factors might play a role in satisfying presuppositions. But in their accounts, these factors were all constrained by the kinds of scope factors considered in §§2.1 and 2.2.

Thus, we need an account of how in modal subordination, content under the scope of OP_1 apparently manages to satisfy presuppositions triggered under $ModalOP_2$.

3. The general form of an explanation of modal subordination:

Recall the summary of features of modal subordination at the end of §1, now restated in the terms introduced in §2. We have a logical form:

$$[S_1 \dots OP_1[\dots X \dots]] \dots [S_2 \dots ModalOP_2[\dots Y \dots]] \dots$$

where crucially:

1. *Y* in S_2 is a presupposition trigger; and the only content *X* which would satisfy the presupposition it triggers occurs under the scope of OP_1 in the scope island S_1 .

2. ModOP₂ in S₂ is a modal operator which has scope over Y.
3. The ModOP₂-headed constituent in S₂ has a conditional-like interpretation wherein part of its restriction consists of X.

Underlying the explanation for features 2 and 3 is the now generally accepted semantics of the tripartite structure of a modal operator-headed constituent like ModalOP₂[. . .Y. . .] in S₂. In Kratzer's (1981) semantics for modal operators, a modal operator in natural language presupposes two functions, a Modal Base *f* and Ordering Source *g*, which together give the contextually intended restriction for the interpretation of the modal. Kratzer (1977) uses *in view of* paraphrases to give the intuitive content of such restrictions, so that one and the same modal, *must* in (39) and (40), may have very different flavors—epistemic in (39), deontic in (40), as a function of the contextually given *f* and *g*:

- (39) In view of what we've just learned from the weather satellite, it must be raining in Seattle.
- (40) In view of the laws in the state of Missouri, you must signal before turning right.

Kratzer argues that when there is an overt *if*-clause modifying a modally-headed clause, the *if*-clause enriches the otherwise-contextually given Modal Base *f*; hence contextual factors are always part of the determination of the restriction. Given this independently motivated semantics, we now expect that ModalOP₂ in the schema above will itself have some restriction, which may in part be given by an overt *if*-clause but need not be overt at all. This predicts that the ModOP₂-headed constituent in S₂ will have a conditional-like interpretation, with its restriction at least partly given contextually.

Then if we can explain how the content denoted by X in S₁ can serve as part of that contextually-given restriction, despite the fact that due to X's occurrence in a scope island it is inaccessible for presupposition satisfaction after S₁, we can explain all the features of modal subordination. Put another way, if content in the scope of OP₁ can somehow serve to restrict ModOP₂, that explains how the X so "borrowed" comes to satisfy the presupposition triggered by Y, since it is assumed that in the interpretation of an operator-headed tripartite structure, the local context with respect to which the operator's scope is interpreted has been temporarily enriched with the content of its restriction.

As we will briefly review in the next section, a number of particular proposals have been made regarding why and how X can be used to restrict ModOP₂. But in all of these, the essence of an explanation of modal subordination under the schema above is that X is understood to be part of the domain restriction of ModOP₂.

Cases like (12) are unacceptable because the only potential antecedents for *it* are under the scope of *usually*, and thus not part of the updated context of utterance for the interpretation of the second sentence; the temporary availability of *a muffin* to serve as antecedent in the scope of *usually* "expires" after interpretation of the tripartite LF for the first sentence. But in (13), though the same closure has occurred, we can contextually restrict the QAdv *always* in the second sentence to only range over situations in which Fred has purchased a morning muffin, so

that this restriction does make temporarily available a muffin antecedent for *it* in the operator's nuclear scope *it's oat bran*.

- (12) **Usually** Fred buys a muffin every morning and eats it at the office.
#It's being baked.
- (13) **Usually** Fred buys a muffin every morning and eats it at the office.
It's always oat bran.

Thus, feature 1 above captures the way in which the puzzle of modal subordination is one about the apparent inaccessibility of *X*, illustrated in examples like (12). The presence of the modal (feature 2) facilitates the conditional interpretation (feature 3), “borrowing” content from under the scope of some operator(s) in preceding discourse to serve as the intuitive conditional restriction. Without a modal, as in (12), we have no borrowed domain restriction to license the attested presupposition satisfaction in the modally subordinate cases like (13).

§4. Accounts of Modal Subordination:

A modal operator (including a QAdv or the modal in an attitude predicate) introduces a tripartite logical form, the restriction understood to be partly retrieved contextually. If the context of utterance makes available relevant content of the appropriate sort to restrict the modal, that content may license both presupposition satisfaction and anaphora resolution in the operator's scope. Modal subordination occurs when content which is understood to restrict the modal is not available in the global context of utterance, but only in a prior irrealis context, under the scope of an operator which normally precludes content in its scope from contributing to the global context of utterance.

Given this general characterization, an empirically and explanatorily adequate account of modal subordination needs to draw on accounts of the following phenomena:

- a) a semantics for natural language modals generally, including an account of the selectional restrictions associated with various modal auxiliaries and adverbials, QAdv, and other modal elements;
- b) a lexical semantics for attitude predicates, and their relationship to modal semantics (since these may serve to introduce the modal operator ModOP in the schema for modal subordination);
- c) discourse anaphora, including the pragmatics of indefinite NPs and referring expressions;
- d) dynamic presupposition satisfaction, with presupposition projection reflecting lack of local satisfaction, and in particular an account of how this works in a tripartite operator structure;
- e) domain restriction as a presuppositional phenomena, anaphoric in that the same kinds of constraints that come to bear on anaphora resolution (including Reference Time retrieval), come to bear here;
- f) relevance, coherence and other discourse structural factors that bear on interpretation, e.g. on presupposition satisfaction, anaphora resolution, and domain restriction; and
- g) presupposition recognition and accommodation, as these play into the way that domain restriction works: First the addressee must recognize the domain restriction implicitly

presupposed by the speaker, and then determine whether this is consistent and coherent with the explicit local context.

One can construct various formal realizations of the explanation for modal subordination sketched in §3, as partly motivated by one's other theoretical commitments; but (a) – (g) constitute the theoretical core that any such account, if it's to be non-stipulatory, must draw on. And in turn, theories of the phenomena (a) – (g) are constrained by the requirement of offering a satisfactory account of modal subordination, which is pervasive and non-problematic.

As usual, accounts of (a) – (g) ideally should be independently motivated, to ensure a fully satisfactory resulting account of modal subordination. Fortunately, these topics have themselves been the subject of intense research over the past 25 years, so that, although each is itself a complex topic and more work remains to be done, there is emerging consensus among linguistic semanticists about the broad outlines of (a) – (e), and even (f) and (g) have developed enough to support some robust generalizations.

Kratzer's general approach to modal semantics, and work over the past twenty years on the relationships between different flavors of modality in the Kratzerian account offer a strong, intuitively appealing foundation for this account (a). The tradition coming out of Hintikka (1969) that analyzes attitude predicates as involving a modal element, and the kinds of detailed work on the lexical semantics of attitude predicates found in Asher (1987), Heim (1992), allow us to extend that general conception of modality to the attitude predicates, explaining their relationship to modal auxiliaries and other modal elements (b). Add to this the work by de Swart (1992) and others on QAdvs as generalized quantifiers over events, Cipria & Roberts' characterization of events as situations in a Kratzerian modal situation semantics, and Frank's (1997) characterization of modals as generalized quantifiers over worlds, and we have reason to be confident in generalizing over the different types of operators instantiating ModOP in the schema for modal subordination: all are species of natural language modals with a tripartite structure, retrieving their restriction at least in part contextually.

Pieces (c) and (d) are well developed in the work on dynamic interpretation that has grown out of Kamp (1981, Kamp & Reyle 1993) and Heim (1992). Though a variety of theories of dynamic interpretation have been developed (e.g. recently, Barker & Shan 2014; Martin 2013, to appear; AnderBois et al. 2015), all agree that content in an operator's restriction is available to help satisfy presuppositions triggered in its nuclear scope, as we illustrated in §2.1. In general, it is understood that indefinites and referential expressions like proper names and indexicals serve to introduce (something like) discourse referents into the context of utterance, which can serve as antecedents across discourse; but unlike those for names and indexicals, the discourse referents corresponding to indefinites only persist throughout the scope of any wider scope operators that dominate them, as illustrated above. This limits the potential of indefinites to serve as antecedents for discourse anaphora.

Work on domain restriction speculates about how the domain in a tripartite operator-headed structure is understood, given that restrictions are normally at least partly implicit. Following von Stechow's (1994) work on domain restriction, it is generally understood to involve an anaphoric presupposition, contextually resolved. Roberts (1995) argues that even Partee's

(1984) Reference Time can be understood as a domain restriction on a Priorean tense operator. This is consistent with Kratzer's account of how modals are restricted, as realized dynamically in Heim (1982), with the Modal Base and Ordering Source are functions together determining the worlds in the restriction, and thus, in effect determining the contextually understood modal accessibility relation for the flavor of modality at issue (see Portner 2005 for an excellent introduction and overview).

Accounts of relevance, coherence and other discourse structural factors are generally intended to explain how pragmatic factors in interpretation are resolved in context. Those factors include presupposition and anaphora resolution generally, and domain restriction in particular. The work of Ginzburg, 1984, 2012), Roberts (1996/2012), Asher & Lascarides (2003), Kehler (2002), among many others, serve as foundations for detailed accounts of the role of relevance in prosodic focus and in domain restriction (Beaver & Clark 2008), of coherence factors in anaphora resolution (Kehler), and implicatures generation (Asher & Lascarides 2003), among many other topics. Together, these accounts of discourse pragmatics form the backdrop for extensive work over the past decade on how presuppositions are triggered, recognized and retrieved (Simon et al. 2015), as well as accommodated (Stalnaker 2008, von Stechow 2008, Roberts 2015).

All these factors interact in complex ways to predict when modal subordination is possible and felicitous. For example, Asher (1987) and Heim (1992) show how the lexical semantics of attitude predicates both facilitates and constrains modal subordination across attitude predicates. As Heim points out, though we take belief to be closed under entailment as in (41a,b), there is evidence that wanting and wishing shouldn't be closed under entailment, so that (42a) doesn't entail (42b):

- (41) a) Nicholas believes he's due a free trip on the Concorde.
 b) Nicholas believes he's due a trip on the Concorde. ✓
- (42) a) Nicholas wants a free trip on the Concorde.
 b) Nicholas wants a trip on the Concorde. X

Similarly, Roberts (1996) discusses how *require* and *permit* are directly related to *must* and *may*, resulting in parallel constraints on modal subordination: As we see in (43) and (44), *require* and *permit* cannot readily be inverted and still yield felicity, in a way intuitively parallel to the constraints on deontic *must* and *may* in (45) and (46):

- (43) You are **required** to find a bear and **permitted** to take its picture.
 (44) #You are **permitted** to find a bear and **required** to take its picture.
- (45) You **must** find a bear. [Then] you **may** take its picture.
 (46) #You **may** find a bear. [Then] you **must** take its picture.

If we take the agent granting permissions and imposing requirements to be the same across the two conjuncts in (43) and (44), and similarly for the deontic modals in (45) and (46), we can understand the difference in acceptability: It is quite odd to require someone to do something

which has as a precondition action δ (here, finding a bear) but merely *permit* δ , permission conversationally implicating that one has the option *not* to undertake δ . I.e., no bear, no picture; the picture is required, ergo so is the bear. This yields a pragmatic contradiction, explaining infelicity.

(47) and (48) (Roberts 1996b) illustrate another lexically-based contrast in felicity, involving belief-based attitudes:

(47) Alice **fears** there's a squirrel in her kitchen cabinets.
She **hopes** to trap it alive and turn it loose outside.

(48) Alice **doubts** that a squirrel is in her kitchen cabinets.
#She **hopes** to trap it alive and turn it loose outside.

We understand that one's hopes are based on what one takes to be plausible; i.e. the modal base for *hope* yields the set of propositions whose truth the agent takes to be plausible. In (47), the first sentence tells us that Alice suspects that there's a squirrel in the cabinets; hence, assuming that one takes one's suspicions to be plausible, the second sentence can draw on that suspicion to provide an antecedent for *it*. But in (48), *doubt* tells us that Alice does *not* find it plausible that there's a squirrel; hence, there's no salient plausible existent appropriate as antecedent for *it* under the scope of subsequent *hope*.

(40)-(48) show how what Dowty (1979) called *lexical subentailments* are crucial to understanding felicitous domain restriction of the relevant predicates and deontic modals. But Heim (1992) recognizes that we cannot reduce the possibility of modal subordination in such examples to what is licensed by the lexical entailments and presuppositions of the relevant attitude predicates:

(49) John believes that Mary is here, and he believes that Susan is here too.

(50) John doubts that Mary is here and/but believes that Susan is here too.

In (49), if we assume that the interlocutors track what they know about John's belief state, then the first conjunct adds the information that he takes the proposition 'Mary is here' to be true; hence that belief will be entailed to be true in his belief state, restricting *believes* in the second conjunct. About (50), one could just say that the presuppositions of the attitude predicates *doubt* and *believe* are also entailments, in which case the contents of the two clauses are contradictory—if *doubts* entails that John does *not* believe that Mary is here, then this would be inconsistent with the domain restriction for *believes* entailing that she is, so there is no salient proposition of the right form to satisfy the presupposition of *too* that someone other than Susan is here. But this explanation doesn't work for (51), where the subjunctive *if*-clause would license accommodation of the counterfactual (in John's belief state) proposition that Mary is here:

(51) John doubts that Mary is here. He believes that if Susan were here too, there would be dancing.

Hence, pragmatics apparently comes to bear on what interlocutors take to be a reasonable domain restriction in a particular context.

Differences between the proposed accounts of modal subordination to date largely hinge on details of how to model domain restriction and capture constraints on its felicity, as well as on different formal realizations of dynamic context update.

Roberts (1987,1989s) focuses on cases of modal subordination involving modal auxiliaries and QAdv_s, and how Kratzer's semantics and the tripartite structure of the modal logical forms offers an avenue of explanation. Asher (1987) and Heim (1992) focus on cases involving pairs of attitude predicates, and the ways in which their lexical semantics constrain the possibility of modal subordination. Kibble (1995), Geurts (1995, 1998), Frank (1997), and Frank & Kamp (1997) criticize Roberts' account as too unconstrained, and offer variants of an anaphoric approach that takes the antecedent for the implicit domain restriction to be the content of a previous clause, typically as represented in a discourse representation structure. For example, Kibble and Geurts introduce propositional discourse referents to refer to such contents.

Stone (1997,1999), Bittner (2001,2007), and Schlenker (2004,2013) offer another type of anaphoric account, modeled after Partee's (1984) account of anaphora to Reference Times, in which modal subordination involves anaphora to a particular salient irrealis world or situation. Note that these accounts do not adhere to the general characterization of modal subordination as domain restriction, since they yield not a set of alternatives—as in the usual accounts of domain restriction—but only a single world or situation.

Roberts (1995, 1996b) and von Rooij (2005) emphasize the unacceptability of representational accounts of modal subordination that rely too closely on either sentential logical form or the discourse representation of a given clause, in the absence of the consideration of broader pragmatic factors and of the general structure of the discourse in which these utterances occur ((f) and (g) above). And Asher & McCready (2007) argue against anaphoric accounts, offering a range of cases where otherwise unconstrained anaphora to preceding clause(s) over-generates possible interpretations; they argue for the crucial importance of discourse structural constraints on anaphoric accessibility (for both modal subordination and Reference Time retrieval), appealing to the Segmented Discourse Representation Theory of Asher & Lascarides (2003).

Other kinds of differences between accounts of modal subordination are motivated by differences in the formal realization of the idea of dynamic interpretation in discourse, each approach argued to offer empirical advantages in accounting for the full range of relevant phenomena (Roberts 1989, Frank & Kamp 1997, Asher & McCready 2007, Brasoveanu 2007,2010).

Space precludes a critical comparison of the various proposals and their differences. But here are a few points to keep in mind in assessing their relative merits:

First, most authors tend to focus on a relatively limited range of types of examples. Any adequate account of modal subordination should address the full range of cases considered in §1 above, and the general schema offered at the end of that section. Not everyone would agree with

this assessment. For example, Frank & Kamp (1997) argue that (37), which would be problematic for their account, should not be taken to involve modal subordination, but some other related phenomenon:

- (37) If Audrey met a sorcerer, she'd be delighted.
Sorcerers **often** have leprechaun companions.
Leprechauns **sometimes** have a pot of gold.
If Audrey was really lucky, she **might** get the sorcerer to get the leprechaun to let her have some of it.

In (37), the domain restriction for *might* in the last sentence is constructed from content introduced under several preceding operators, themselves heterogeneous in type and force. Roberts (1995) argues that this type of example precludes an explanation of modal subordination as anaphora to the irrealis proposition denoted by a given preceding clause (like the prejacent of a modal). Such a proposition need not have already been under consideration prior to the restriction of the modal which licenses modal subordination.

One might argue that we also “construct” an appropriate irrealis scenario, as opposed to referring to one already available, in cases involving negation:

- (7) John doesn't have a car.
It would be in the garage.

In the first sentence in (7), there is no explicit modality whereby the speaker directs us to entertain a scenario in which John has a car. Instead, the non-indicative modal *would* and the assumption of relevance to the preceding sentence lead us to entertain the counterfactual scenario in which the prejacent of negation in the first sentence, ‘John has a car’, is true.

Examples involving disjunction, like Partee’s (52) (p.c. to Heim 1982; see Roberts 1987,1987; Groenendijk & Stokhof 1990; Dekker 1993; van der Sandt 1992; and Beaver (1992)), can also be understood to involve such scenario construction: see Heim (1982),):

- (52) Either there’s no bathroom in this house or it’s in a funny place.

A disjunction may be understood to offer alternative answers to some question under discussion. One is first led to entertain one possible answer and then, in the second disjunct, a second answer which may be true *in case the first disjunct is not*. Hence, pragmatically, it is natural to interpret the second disjunct as an indicative conditional whose restriction includes the negation of the first: ‘if there is a bathroom in this house, it’s in a funny place’.

Such examples might lead one to entertain the possibility that modal subordination actually just involves anaphora to salient propositions, whether realis or not—the prejacent of negation and the first disjunct being such salient propositions. But this would predict that the prejacent of negation or of a modal would generally be available for propositional anaphora. But one would do well to keep in mind (53) – (55), also from Roberts (1985):

- (53) a) An earthquake might hit San Francisco.
 b) That would upset me. It would be frightening.
- (54) a) An earthquake hit San Francisco in 1989.
 b) That upset me. It was frightening.
- (55) a) An earthquake might hit San Francisco.
 b) That upsets me. It is frightening.

In (53), the restriction of *would* to the irrealis scenario described in the first sentence permits us to take *it* to be the irrealis earthquake; *that* can be understood to refer to the proposition that an earthquake hit San Francisco, the prejacent of *might*. This is parallel to the non-modal indicative pair in (54). (55b) is the same non-modal indicative as (54b), and it is also felicitous. But because there is no modal to facilitate modal subordination, *it* cannot refer to the irrealis earthquake—we can only take what is frightening to be the *possibility* of an earthquake described in (55a). And *that* can only refer to the same possibility, not to the proposition ‘an earthquake hit San Francisco’. This demonstrates that the mere salience of a proposition—here the irrealis ‘an earthquake hit San Francisco’—does not suffice to make it and its content available for anaphora resolution.

Finally, in proposing an account of modal subordination, one should not confuse it with another, closely related phenomenon, dubbed *telescoping* by Roberts (1987,1989):

- (56) **Every** frog that saw an insect ate it.
 #It was a fly.
- (57) **Every** frog that saw an insect ate it.
It disappeared forever.

As predicted by dynamic accounts of discourse anaphora, because the only antecedent of the right sort is not available in (56)—*an insect* is under the scope of *every frog*, and so the corresponding discourse referent “expires” with the closure of the scope of *every* in the first sentence—the second sentence is infelicitous in the context of utterance. But in (57), the anaphora *is* felicitous. One might be tempted to take the second sentence in (57) to involve an implicit QAdv, perhaps ‘always’ or ‘typically’. But if such an implicit operator is available in (57), why not in (56), since addition of one of these QAdv to (56) makes it acceptable?

Roberts (1987,1989) and Poesio & Zucchi (1992) show that the telescoping in (57) is much more tightly constrained than modal subordination with an overt QAdv. One of the main constraints is that all information predicated of a singular pronoun in such examples must be entirely generic, not specific to a particular instance or even pertaining to a particular event. To get the flavor of this constraint, consider (58), due to Partee (p.c. to Roberts 1987):

- (58) a. Each degree candidate walked to the stage.
 b. He took his diploma from the Dean and returned to his seat.

Here, the continuation in (58b) is felicitous, and we understand it to be a continued description of what happened in each case. But the follow-up in (58c) is infelicitous:

- c. #He had overcome serious personal challenges to complete the degree.
- d. They had overcome serious personal challenges to complete their degrees.

Roberts speculated that follow-ups like (c) are unacceptable because they do not sound like a plausible continued description of the scenario first sketched in (a). Note that the propositional content of (58c) itself is not problematic—one *could* imagine a class in which all the graduates had overcome such challenges—it just doesn't sound suitably generic or describe the unfolding scenario, and the same proposition is expressed and felicitous in (58d). See Roberts (2005) for discussion of how this bears on so-called “number-neutral” theories of pronominal anaphora in discourse: the difference in acceptability between (c) and (d) argues that pronominal number does matter for anaphora resolution.

I still know of no adequate account of telescoping, which is reminiscent of universal instantiation in the predicate calculus. The point here is to caution that we should not conflate this phenomenon with modal subordination.

§5. Conclusions and open questions

Discourse anaphora is fairly simple. Its resolution requires only that there be exactly one discourse referent (of the right type) which (i) is logically accessible (given scope constraints), (ii) satisfies the anaphoric trigger's descriptive content, and (iii) is more salient at the time of utterance than any other discourse referent satisfying the first two conditions. But discourse itself is quite complicated, its structure generally at least in part implicit, and the shared information which bears on interpretation itself both dynamic and rich. Nothing demonstrates the complexity of discourse better than the attested constraints on anaphora in discourse, and no anaphora is more subtly licensed and constrained than that displayed in the phenomenon of modal subordination.

Hence, modal subordination, wherein a pronoun or other presupposition trigger under the scope of a modal operator seems to take as antecedent a constituent which itself has narrow scope under a modal or other intensional operator in a previous clause (a scope island), serves as a very useful probe for the structure of discourse, for the investigation of domain restriction, and for theories of presupposition satisfaction and projection.

References:

- AnderBois, Scott, Adrian Brasoveanu & Robert Henderson (2015) At-issue proposals and appositive impositions in discourse. *Journal of Semantics* 32:93-138.
Doi:10.1093/jos/fft014.
- Asher, N. (1987) A typology of attitude verbs and their anaphoric properties. *Linguistics and Philosophy* 10: 127-189.
- Asher, Nicholas & Alex Lascarides (2003) *Logics of Conversation*. Cambridge University Press.
- Asher, N. & E. McCready (2007) *Were, would, might* and a compositional account of counterfactuals. *Journal of Semantics* 24:93-129.

- Bach, Emmon, Eloise Jelinek, Angelika Kratzer, and Barbara H. Partee (1995) Introduction. In Back, Jelinek, Kratzer & Partee (eds.) *Quantification in Natural Languages*, Kluwer, Dordrecht.
- Barwise, Jon & Cooper, Robin (1981) Generalized Quantifiers and Natural Language. *Linguistics and Philosophy* 4:159-219.
- Beaver, David & Brady Clark (2008) *Sense and Sensitivity: How Focus Determines Meaning*. Oxford: Wiley-Blackwell.
- Bittner, M. (2001) Topical referents for individuals and possibilities. In R. Hastings, B. Jackson and Z. Zvolenszky (eds.), Proceedings of SALT XI. Hastings, CLC. Cornell University. Ithaca. 36–55.
- Bittner, M. (2007) Online update: Temporal, modal and de de anaphora in polysynthetic discourse. In C. Barker and P. Jacobson (eds.) *Direct Compositionality*. Oxford University Press. Oxford. 363–404.
- Brasoveanu, Adrian (2007) *Structured Nominal and Modal Reference*. Ph.D. thesis. Rutgers University.
- Brasoveanu, Adrian (2010) Decomposing modal quantification. *Journal of Semantics* 27:437-527.
- Chierchia, Gennaro (1995) *Dynamics of Meaning: Anaphora, presupposition, and the meaning of grammar*. University of Chicago Press.
- Cipria, Alicia & Craige Roberts (2000) Spanish *imperfecto* and *preterito*: Truth conditions and aktionsart effects in a situation semantics. *Natural Language Semantics* 8.4:297-347.
- Corblin, François (1994) L'anaphore en subordination modale. *Actes du colloque d'Anvers: Relations anaphoriques et (in)coherence*. CNRS, Rennes.
- de Swart, Henriette (1992) *Adverbs of Quantification: A Generalized Quantifier Approach*. PhD dissertation, University of Groningen.
- Dowty, David (1979) *Word Meaning and Montague Grammar*. Reidel, Dordrecht.
- von Stechow, Kai (2008) What is presupposition accommodation again? *Philosophical Perspectives: Philosophy of Language* 22(1):137–170.
- Frank, Anette (1997) *Context Dependence in Modal Constructions*. Ph.D. dissertation, University of Stuttgart.
- Frank, Anette & Hans Kamp (1997) On context dependence in modal constructions. *Proceedings of SALT VII*, Cornell University, Ithaca, NY, 151-168.
- Geach, P. T. (1967) Intentional identity. *Journal of Philosophy* 64:627-632.
- Geurts, Bart (1995) *Presupposing*. Ph.D. dissertation, University of Stuttgart.
- Geurts, B. (1998) Presuppositions and anaphors in attitude contexts. *Linguistics and Philosophy* 21: 545-601.
- Ginzburg, Jonathan (1994) An update semantics for dialogue. In H. Bunt, R. Muskens, and G. Rentier (eds.) *Proceedings of the 1st International Workshop on Computational Semantics*. Tilburg: ITK, Tilburg University.
- Ginzburg, Jonathan (2012). *The interactive stance*. Oxford University Press.
- Heim, Irene (1982) *The Semantics of Definite and Indefinite Noun Phrases*. Ph.D. thesis, University of Massachusetts, Amherst.
- Heim, Irene (1983) On the projection problem for presuppositions. *Proceedings of WCCFL 2*, Stanford University, 114-126
- Heim, Irene (1992) Presupposition projection and the semantics of attitude verbs. *Journal of Semantics*, 9:183-221.

- Hinrichs, Erhard W. (1981) Temporale Anaphora im Englischen. Unpublished Zulassungarbeit, University of Tiibingen.
- Hinrichs, Erhard W. (1986) Temporal Anaphora in Discourses of English. *Linguistics and Philosophy* 9:63–82.
- Hintikka, Jaako (1969) *Models for Modalities*. Dordrecht: Reidel.
- Kamp, Hans (1981) A Theory of Truth and Semantic Representation. In Jeroen Groenendijk, Theo M. V. Janssen and Martin Stokhof (eds.) *Formal Methods in the Study of Language, Vol. I*, Mathematische Centrum, Amsterdam. Reprinted in Groenendijk, Janssen and Stokhof (eds.), 1984, *Truth, Interpretation and Information*, Foris, Dordrecht.
- Kamp, Hans, & Uwe Reyle (1993). From discourse to logic: Introduction to model theoretic semantics of natural language, formal logic and discourse representation theory. Dordrecht: Kluwer.
- Karttunen, Lauri (1974) Presupposition and linguistic context. *Theoretical Linguistics*, 1:181-94.
- Kehler, Andrew (2002) *Coherence, Reference, and the Theory of Grammar*. CSLI Publications, Stanford, CA.
- Kibble, R. (1995) Modal subordination, focus and complement anaphora. In *Proceedings of the Tbilisi Symposium on Language, Logic and Computation*. [Cited in Brasoveanu:]
- Kratzer, Angelika (1977) What ‘must’ and ‘can’ must and can mean. *Linguistics and Philosophy* 1:337-355.
- Kratzer, Angelika (1981) The notional category of modality. In H. J. Eikmeyer & H. Rieser (eds.), *Words, Worlds and Contexts* (pp. 38--74). Berlin: de Gruyter.
- Kratzer, Angelika (1989) An Investigation of the Lumps of Thought. *Linguistics and Philosophy* 12:607–653.
- Lakoff, George (1972) Linguistics and natural logic. In Donald Davidson & Gilbert Harman (eds.), *Semantics of Natural Language* (pp. 545--665). Dordrecht: Reidel.
- Lewis, David (1975) Adverbs of quantification. In E. L. Keenan (ed.), *Formal Semantics of Natural Language*. Cambridge University Press.
- Martin, Scott (2013) *The Dynamics of Sense and Implicature*. Ph.D. dissertation, The Ohio State University.
- Martin, Scott (to appear) Supplemental update. To appear in *Semantics and Pragmatics*. Ms., Nuance Communications.
- McCawley, James D. (1981) *Everything that Linguists have Always Wanted to Know about Logic*. Chicago: University of Chicago Press.
- Partee, Barbara H. (1984) Nominal and temporal anaphora. *Linguistics and Philosophy* 7:243-286.
- Poesio, Massimo, & Alessandro Zucchi (1992) On Telescoping. In Chris Barker & David Dowty (ed.), *The Proceedings of SALT II*, (pp. 347--366). The Ohio State University Department of Linguistics.
- Portner, Paul (2005) *Modality*. Oxford University Press.
- Reichenbach, Hans (1947) *Elements of Symbolic Logic*. New York: Macmillan.
- Roberts, Craige (1987) *Modal Subordination, Anaphora, and Distributivity*. Ph.D. dissertation, University of Massachusetts at Amherst. Revised and published as *Modal Subordination, Anaphora, and Distributivity*. Garland Press, Outstanding Dissertations in Linguistics Series, New York, 1991.

- Roberts, Craige (1989) Modal Subordination and Pronominal Anaphora in Discourse. *Linguistics and Philosophy* 12.6:683-721. Reprinted in Javier Gutierrez-Rexach (ed.) *Semantics: Critical concepts in linguistics*, Routledge, 2003.
- Roberts, Craige (1995) Domain Selection in Dynamic Semantics. In Emmon Bach, Eloise Jelinek, Angelika Kratzer, and Barbara H. Partee (eds.) *Quantification in Natural Languages*, Kluwer, Dordrecht.
- Roberts, Craige (1996/2012) Information Structure in Discourse: Towards an Integrated Formal Theory of Pragmatics. In Jae Hak Yoon and Andreas Kathol (eds.) *Ohio State University Working Papers in Linguistics* Volume 49. Reprinted in the 1998 version with a new Afterword in *Semantics and Pragmatics*, Volume 5, 2012.
- Roberts, Craige (1996b) Anaphora in intensional contexts. In Shalom Lappin (ed.) *The Handbook of Contemporary Semantic Theory*, Basil Blackwell, pp.215-246.
- Roberts, Craige (2005) Pronouns as definites. In M. Reimer & A. Bezuidenhout (eds.) *Descriptions and Beyond*. Oxford University Press, 503-543.
- Rodman, Robert (1976) Scope phenomena, 'movement transformation, and relative clauses. In B.H. Partee (ed.) *Montague Grammar*. New York: Academic Press.
- van Rooij, Robert (1998) Modal subordination in questions. In J. Hulstijn & A. Nijholt. *Proceedings of Twendial*. University of Twente, Enschede. 1998:237-48.
- van Rooij, Robert (2001) Anaphoric relations across attitude contexts. In K. von Stechow and U. Egli (eds.), *Reference and Anaphoric Relations*. Kluwer. Dordrecht. 157-81.
- van Rooij, Robert (2005) A modal analysis of presupposition and modal subordination. *Journal of Semantics* 22.3:281-305.
- Schlenker, P. (2004) Conditionals as Definite Descriptions (A Referential Analysis). *Research on Language and Computation* 2:417-62.
- Schlenker, P. (2006), Ontological Symmetry in Language: A Brief Manifesto. *Mind and Language* 21:504-539.
- Schlenker, Philippe (2013) Temporal and modal anaphora in Sign Language (ASL). *Natural Language and Linguistic Theory* 31:207-234.
- Simons, Mandy (2001). On the conversational basis of some presuppositions. In *Proceedings of Semantics and Linguistics Theory (SALT) XI*, pages 431-448. Ithaca, NY: CLC Publications.
- Simons, Mandy, David Beaver, Craige Roberts & Judith Tonhauser (to appear) The Best Question: Explaining the projection behavior of factives. For a special edition of *Discourse Processes on the Question In Discussion*.
- Stalnaker, Robert (1973) Presuppositions. *Journal of Philosophical Logic* 2: 447-457.
- Stalnaker, Robert (1974) Pragmatic presuppositions. In Milton Munitz & Peter Unger (eds.) *Semantics and Philosophy*. NYU Press, 197-213.
- Stalnaker, Roberts (2008) A response to Abbott on presupposition and common ground. *Linguistics and Philosophy* 31:539-544.
- Stone, Matthew (1997) *The anaphoric parallel between modality and tense*. IRCS TR 97-06. University of Pennsylvania.
- Stone, Matthew (1999) *Reference to Possible Worlds*. RuCCS Report 59. Rutgers University.
- Szabolcsi, Anna (2000) The syntax of scope. In Mark Baltin & Chris Collins (eds.) *Handbook of Contemporary Syntactic Theory*. Oxford: Blackwell, pp.607-634.

