Discourse anaphoric *otherwise*:
Information structure & modal subordination[*]

Josh Phillips
Yale University

Hadas Kotek
Yale University

Abstract This paper provides a formal semantic/pragmatic analysis of the interpretation and meaning contribution of the English discourse anaphor *otherwise*. *Otherwise* is modeled as a discourse move (in the sense of Roberts 2012) which encodes an instruction to consider the *complement* of a set of worlds introduced in the clause preceding *otherwise*. Following Webber et al. (2001) and other authors, we take as key the observation that the identity of this antecedent clause to *otherwise* cannot be determined by the syntax alone. Instead, we argue that we must make crucial reference to the current information structure, and in particular to the current Question under Discussion, to determine the nature of the antecedent. We propose a dynamic semantic/pragmatic account for *otherwise*, which makes crucial use of *modal subordination* in order to both model *otherwise*'s flexible distribution, as well as previously unobserved limitations on its use.

1 Introduction

The work presented here develops an analysis of the English lexical item *otherwise*, drawing on tools from the dynamic semantics and information structural literatures. Our main focus is on *otherwise*'s use as a discourse 'connective' or 'anaphor' (e.g. Webber et al. 2001, Kruijff-Korbayová & Webber 2001), so named because of its apparent interpretive reliance on foregoing elements of discourse.[1] This is demonstrated by the sentence pair (1), from Webber et al. (2001: 7). Each sentence is accompanied by a paraphrase that spells out its intended meaning.

(1)   *The discourse anaphor* 'otherwise'*:*

    a.   If the light is red, stop. *Otherwise* go straight on.

        ≈ if the light is <u>not</u> red...

---

1 For the purposes of this current paper, we restrict our attention to these "inter-clausal" adverbial uses. As we will discuss in §7, however, we anticipate that our account could be expanded to account for other uses as well.

b. If the light is red, stop. *Otherwise* you'll get a ticket.
$\approx$ if the light is red and you <u>don't</u> stop...

As example (1) makes clear, the question of *how* to determine the nature of the antecedent *p* is quite subtle. While the syntactic environment preceding *otherwise* is identical in both (1-a) and (1-b), it is clear that the proposition which is interpreted as the antecedent in each case is different. How, then, do speakers retrieve an antecedent to *otherwise*? In order to answer this, we take a view that emphasizes the *flow of information* in a discourse (see also Roberts 2012).

In a nutshell, we develop an analysis of *otherwise* which draws on existing dynamic semantic analyses of conditionals. We'll argue that *otherwise* contributes a discourse move whose content is to predicate a subsequent proposition of the *complement* set of worlds made salient by the prior discourse. This accommodated antecedent may be a conditional, as in (1), but need not be:

(2) Otherwise*'s antecedent may be a declarative, imperative, or (certain) interrogatives:*
a. She's asleep, *otherwise* she would have come.
b. Stop. *Otherwise* you'll get a ticket.
c. Do you have your car? *Otherwise* I'll give you a lift.
d. Do you want to get a beer at Three Sheets or Counterweight tonight? *Otherwise* you make a bloody suggestion.[2]

A (declarative) *otherwise* statement, then, includes two components: the *antecedent* is put on the table as accurate to the best of the speaker's knowledge.[3] *Otherwise* then introduces an instruction to consider how the world must be if the speaker is incorrect about their initial assumption, or if their instruction to add the antecedent into the Common Ground is rejected. Its *prejacent* provides a description of such a world. Pragmatically speaking, this prejacent is often taken to represent a *justification* for the antecedent assertion, providing a discourse link between these two components.

The complement set of worlds under consideration by *otherwise* cannot be contributed strictly by the syntax, as we have just seen. Instead, we claim that it requires reference to the Question under Discussion (QuD) and the current Information Structure. We will show how this proposal can model cases such as (1) and, in addition, that it correctly predicts a previously unnoted interaction of *otherwise* with possibility modals as well as other restrictions on the choice of antecedent. We

---

2 To our ears, this question can be read as either a polar question or an alternative question.
3 That is, *asserted*, cf. Stalnaker 1979.

conclude the paper by briefly discussing an expansion of our proposal to nonclausal uses of *otherwise.* Two examples are given in (3):

(3)   *Intra-sentential uses of* otherwise*:*
    a.   The income they earn from it is likely to be the only source of cash to supplement their *otherwise* subsistence economy.   (OED)
    b.   Amelia behaved well *otherwise*.   (Flament-Boistrancourt 2011[4])

Before presenting our analysis in section 4, we first discuss in a bit more detail previous analyses and additional properties of *otherwise*, which our analysis builds on. We then present several novel observations about *otherwise* in section 3.

2   Background: The meaning of *otherwise*

As we have seen, *otherwise* acts as a discourse connective or anaphor, relating an antecedent sentence with a consequent sentence. A key example which we will concentrate on in this paper is the *Red Light* example, repeated here from (1) above. This example illustrates a key property of *otherwise*: that the continuation following *otherwise* appears to be discourse-dependent, and can't be strictly calculated based on the syntactic material preceding *otherwise*. In (4), the same material appears before *otherwise*, but with different consequents. The nature of the consequent allows us to calculate what *otherwise* is operating on, as we spelled out in (1-a)–(1-b).

(4)   *The Red Light example:*   = (1)
    a.   If the light is red, stop, *otherwise* go straight on.
    b.   If the light is red, stop, *otherwise* you'll get a ticket.

A satisfactory approach to *otherwise*, then, requires a consideration of the structure and 'flow' of information in a given discourse context. Intuitively, the *otherwise* clauses in (4) have the semantics of conditionals: *Otherwise* targets a set of worlds in which some anaphoric proposition does <u>not</u> hold (i.e. converse nonimplication).

Two prior accounts of *otherwise* in Webber et al. (2001) and Kruijff-Korbayová & Webber (2001) adopt information-structural analyses of *otherwise*, which will inform our analysis below. In particular, Webber et al. (2001) argue for the existence of a "discourse adverbial" class (comprising lexical items including *then, nevertheless, otherwise*), and a distinct class of "structural connectives" (*or, and, but, because*). These authors appeal to an 'anaphorically-derived contextual (eventive) parameter' e_i and an *inferrable relation* between two event descriptions (in the ab-

---

4 Here, and throughout, examples from both Flament-Boistrancourt 2011 and Inkova-Manzotti 2002 have been translated from the original French by the authors.

sence of an explicit structural connective). An example of these notions is given in (5):

(5)   *Two types of 'inferrable relations':*
    a.   If the light is red, stop, (**but**) *otherwise* go straight on.
    b.   If the light is red, stop, (**because**) *otherwise* you'll get a ticket.

Otherwise not only retrieves different antecedents, as we have already seen in (1), but also can encode different relations between two event descriptions (*contrast* in (5-a), and *explanation* in (5-b)). For Webber et al. (2001: 17), these effects are pragmatically derived, and are crucially unavailable to "structural connectives" which are restricted in the relations they can encode and the antecedents they can retrieve.[5]

    This observation about the limited distribution of structural connectives has been independently made in the literature on conditional uses of *or* ('pseudocoordination', see Culicover & Jackendoff 1997, Klinedinst & Rothschild 2012, Biezma & Rawlins 2016, a.o.). As examples (6-a)–(6-b) show, the distribution of these uses is narrower than the equivalent use of *otherwise*. Although a conditional *otherwise*-like reading is available in (6-b), in (6-a), the conjoined imperatives 'stop or go straight on' must be interpreted as two options of what the addressee ought to do when the light is red. The *otherwise*-like reading that was available in (1-a)/(5-a) is infelicitous here.

(6)   *Conditional* or *has a more limited distribution:*
    a.   [#]If the light is red, stop, *or* go straight on.
    b.   If the light is red, stop, *or* you'll get a ticket.

    Additional evidence that an adequate account of *otherwise* requires reference to a level of discourse representation comes from intra-sentential uses of *otherwise*, in cases such as (7). For Webber et al. (2001: 7), these examples necessitate an E-type anaphor.[6] As these authors point out, this 'suggests that discourse adverbials are accessing discourse entities (in particular, eventualities) rather than signaling a structural connection between clauses.'

(7)   *Intra-sentential* otherwise*:*
    a.   Every person selling "The Big Issue" might *otherwise* be asking for spare change.   (Webber et al. 2001: 7)
    b.   These moments give emotional ballast to what would *otherwise* be an exercise in wackiness.

---

5 A similar observation is made in Corblin (1994, 2002).
6 Although see our analysis below, an in particular section 6.1; for us, this move will not be required.

On the basis of data similar to the red light example (*i.e. otherwise* sentences with complex-clause antecedents), Kruijff-Korbayová & Webber (2001) model *otherwise* as a discourse connective that is sensitive to information structure in its retrieval of an antecedent. They assume that Logical Forms are partitioned into theme (θ_{is}) and rheme (ρ_{is}) "phases", which have the effect of updating a given discourse context. Following Steedman (2000), Kruijff-Korbayová & Webber (2001) assume that both θ_{is} and ρ_{is} presuppose an alternative set (cf. Rooth 1985). *Otherwise* then updates the context with the complement of (a subpart of) either ρ_{is} or θ_{is} with respect to the relevant alternative set.

Along similar lines, Inkova-Manzotti (2002) and Flament-Boistrancourt (2011) provide descriptions of the broad range of uses of French *autrement* 'otherwise.' Like English *otherwise*,[7] the French particle requires use of context and pragmatics. Some examples are provided below.

(8)   *On peut se   voir mardi.   Autrement vendredi.*
        one can REFL see Tuesday otherwise Friday
        We'll see each other Tuesday. Otherwise Friday.

                                                (Inkova-Manzotti 2002: 114)

(9)   *Je pourrais faire une tarte. Je n'ai   pas de   farine.* Autrement
        I could   make a   quiche I NEG.have NEG PART flour *otherwise*

        j'ai   tout ce   qu'il faut
        I.have all   DEM REL.it necessary
        'I could make a quiche. I'm out of flour. Otherwise I've got everything needed.'   (Inkova-Manzotti 2002: 122)

In the analysis proposed below, we likewise acknowledge the importance of context and pragmatic computation in the use of *otherwise*. The existing analyses surveyed here suffer from the limitation that there are no constraints on the 'range of things that can serve as antecedents' (see Kruijff-Korbayová & Webber (2001) for an explicit discussion of this issue). Likewise, Webber et al. (2001), must make reference to complex event structures, and to yet another complex mechanism of E-type anaphora for examples such as (7). We will show in section 6.1 that these examples are naturally unified under our analysis, so that no additional assumptions must be made for intra-sentential cases as compared to inter-sentential cases.

---

7 Flament-Boistrancourt (2011) explicitly deals with distributional differences of French *sinon* and *autrement* (both are frequently translated as 'otherwise.') Francis Corblin (2002: 252; pers. comm) points out that *sinon* (lit. 'if NEG') admits of a compositional analysis and an identical distribution/use to *si ce(la) n'est pas le cas...* 'if it is not the case that *X*...'

In the section that follows, we introduce several new observations regarding the distribution and use of *otherwise*, before spelling out a proposal which aims to capture these facts in in section 4.

3   Other key properties of *otherwise*

We begin by laying out the key properties of *otherwise* that we set out to capture with our account. As we have seen in section 2, *otherwise* has a connective-like use. As example (2) showed, the antecedent of an *otherwise* sentence may be a declarative, an imperative, or an interrogative. Here we will concentrate on sentential cases, where *otherwise* connects two sentences, as in our Red Light example in (1). See section 6.1 for a brief discussion of intra-sentential cases such as (7).

We have also established that the content of the continuation which follows *otherwise* is discourse-sensitive, and cannot be computed solely based on the syntactic content of the antecedent. This has been an important guiding observation in prior work on *otherwise*, and one that we take up in our analysis as well. We highlight here several additional properties of *otherwise* that will become important for our analysis below.

3.1   *Otherwise* is an intensional operator

First, we argue that the notion of modality is crucial to the analysis of *otherwise*. Recall that Kruijff-Korbayová & Webber (2001) notice that the two components related by *otherwise* rely on an 'inferrable relation'. We claim this relation follows from a view of *otherwise* as a modalized operator, admitting of different modal bases. We illustrate this in (10):

(10)   *Observation:* otherwise *admits different 'modal flavors':*
     a.   Jan is home, *otherwise* I don't know where she could be.
     b.   Jan is home, *otherwise* she's breaking curfew.
     c.   Jan does her homework, *otherwise* she won't learn.
     d.   Jan does her homework, *otherwise* she'd fail the class.

Example (10-a) requires an epistemic modal base for its interpretation, whereas the minimally different (10-b) is interpreted under a deontic modal base. Examples (10-c) and (10-d) are interpreted with a teleological and a bouletic modal base, respectively. Our account below will account for this flexibility of *otherwise*, unlike prior accounts.

In section 4.1 we additionally defend the claim that *otherwise* makes crucial use of *modal subordination* (Roberts 1989 et seq): a flexibility in the choice of

antecedents which will explain the two possible choices of antecedents in examples such as (11)—here, including or excluding the modal:

(11)   Students are required attend the lecture, *otherwise*...

　　a.　≈ If ¬ (they ATTEND)...　　　　　　...they'll fail the class.
　　b.　≈ If ¬□ (they ATTEND)...　　　　　　...it'll be empty.

3.2   Non-emptiness

As our paraphrases above illustrate, *otherwise* asks us to consider what would be the case in the *complement* set of worlds to those introduced in its antecedent. That is, *otherwise* induces a partition over worlds into those that satisfy the conditions in the antecedent, and those that don't. A crucial requirement on this partition is that both cells are non-empty.

To illustrate this, consider the contrast in (12):

(12)   a.   I must go to school, *otherwise* I'll get in trouble.
　　　　　$\alpha = \{w \in f_{\text{deontic}} \mid \text{I go to school in } w\}$
　　　　　$\overline{\alpha} = \{w \in f_{\text{deontic}} \mid \text{I don't go to school in } w\}$
　　　b.   #I can/am allowed go to school, *otherwise* I'll get in trouble.

This judgment contrast emerges because the necessity modal *must* in (12-a) eliminates a set of worlds α from the context set (*viz.* those in which I don't go to school $\overline{\alpha}$); *otherwise* is thus able to make a claim β about those worlds (namely, in all of them, I get into trouble: $\overline{\alpha} \subset \beta$).[8]

Conversely, the circumstantial possibility modal *can* asserts the existence of an accessible world in which I go to school, but fails to exclude any worlds from consideration in (12-b). As a consequence, *otherwise* has no complement set available to operate on, and we correctly predict that an *otherwise* sentence is infelicitous in this case.

Compare this with the minimally different (13), which speakers judge as acceptable:

(13)   I can go to school, *otherwise* I wouldn't be able to get an education.
　　　　　$\alpha = \{w \in f_{\text{circ}} \mid \text{I am able to go to school in } w\}$
　　　　　$\overline{\alpha} = \{w \in f_{\text{circ}} \mid \text{I am unable to go to school in } w\}$

---

8 Notice that, like in (11), an alternative pragmatic reasoning could have led us to choose as prejacent the set of worlds in which I *must* go to school. A felicitous *otherwise* statement in such a case might be: "...*otherwise* (≈ if I didn't have to go to school), I'd skip class and go to the park."

Here *otherwise* is anaphoric on the entire modal claim. The resulting assertion is that — in all those worlds where it is not the case that I *can* go to school — I don't receive an education. As a consequence, there is a non-empty complement set of worlds in which to evaluate the *otherwise* sentence (namely, all of those in which I <u>can't</u> go to school). In (13), despite the presence of a possibility modal, we are still universally quantifying into the antecedent proposition.

Our account below will elegantly explain the felicitous use of *otherwise* in such sentences. We return to this non-emptiness zconstraint on the distribution of *otherwise* and its consequences in section 5.

3.3 An *otherwise* sentence is non-commutative

Another observation that will inform our analysis below is that *otherwise* is not a symmetric operator: *p otherwise q* is different from *q otherwise p*, even in cases where the two propositions related by *otherwise* are logically independent of one another — so that an 'inferrable relation' is difficult to establish.

(14)   *Word order is important in an* otherwise *sentence:*
     a.   She's in the living room. *Otherwise*, she's in the bathroom.
     b.   She's in the bathroom. *Otherwise*, she's in the living room.

(15)   a.   She's sick. *Otherwise*, she'd be here.
     b.   #She'd be here. *Otherwise*, she's sick.

Example (14) shows that even in such a case, speakers perceive a difference in the felicity conditions and contexts in which the two variants of the *otherwise* sentence will be appropriate. Roughly: my first guess is that she's in the {living room/kitchen}; if it turns out that she's not there, then she'll be in the {bathroom, living room}.[9] Predictably, example (15) shows that when an 'inferrable relation' (here: causality) *is* present, changing the order of the two propositions connected by *otherwise* may lead to infelicitous consequences.

3.4 An *otherwise* sentence is conjunctive

The final crucial component of our analysis is the treatment of an *otherwise* sentence as a kind of asymmetric conjunction: the speaker puts the antecedent on the table for adoption, but also includes an explicit claim about how the world must be

---

9 See section 3.5 for more relevant discussion.

in case that it is rejected. In words, we might then say that *otherwise* asserts: *p*; and if not *p*, then *q* will hold:[10,11]

(16)   *An informal description of the meaning of a p* otherwise *q sentence:*

$$p \wedge (\text{if } \neg p, \text{ then } \Box q)$$

If a sentence of the form *p otherwise q* has conjunctive semantics (as proposed in (16)), this ought to predict that its negation could be achieved by falsifying the first conjunct, the second conjunct, or the entire assertion. We show that this is the case in (17):

(17)   *Negating* otherwise *shows conjunction-like behavior*

   A: Sam is always home by 6pm, *otherwise* little Susie has a tantrum.

   $\underbrace{\phantom{\text{Sam is always home by 6pm}}}$ p[12] $\underbrace{\phantom{\text{little Susie has a tantrum}}}$ if $\neg p$, then $\Box q$

   B: That's not true...
   (i)   He often gets home late, and Susie's just fine.
   (ii)   Susie would be just fine if he did ever get home later, although it's true that Sam always get home on time.
   (iii) He often gets home late, although it *is* true that little Susie indeed has a tantrum whenever that happens.

In (i), the speaker is negating both conjuncts: Sam isn't always home on time ($\neg p$), but Susie doesn't have a tantrum because of that ($\neg p \wedge \neg q$).[13] In (ii), only the second conjunct is negated: we assert that the first conjunct is true (Sam is always home on time), but that the implication nevertheless doesn't hold (Susie wouldn't have a tantrum if Sam were late). In (iii) only the first conjunct is negated: we assert

---

10 Here we take the conditional to reflect the modal restrictor view, as in Lewis 1975, Kratzer 1981, 2012, Heim 1982, among others.

11 Note also the similarity of this treatment to 'information parameter change' readings of structural connective *or* as formalized by Klinedinst & Rothschild (2012: 155-6). Under their dynamic account an utterance of the form 'α or β' corresponds to $[\![\beta]\!]^{c,s_{\neg\alpha},w}$ (sc. an utterance of β where the "information parameter" *s* is updated with $\neg\alpha$ (the negation of the first disjunct)).

12 As with other examples we have seen, there are two possible antecedents to *otherwise* in this example: the sentence with *always* and the sentence embedded under *always*. We kept the antecedent constant in our examples for consistency.

13 Recall that an implication is falsified just in case that its antecedent is true and its consequent is false. In (16), the implication under consideration is if $\neg p$, then $\Box q$. It is falsified in case that $\neg p \wedge \neg \Box q$. Recall further that $\neg p \rightarrow \neg \Box p$. (If *p* doesn't hold, then *must p* doesn't hold.)

that Sam is late ($\neg p$); but the implication in the second conjunct holds: if Sam is late, Susie has a tantrum.[14]

3.5   Modal weakening

Here we have claimed that in declarative sentences of the form *p* otherwise *q*, a speaker asserts both *p* and if $\neg p$ then $\Box q$. Notice that a consequence of this proposal is that it predicts the redundancy of *otherwise*-sentences with non-modalized antecedents like those in (18) below:[15]

(18)   *Non-modalized antecedents should lead to infelicitous otherwise statements, given (16), but they are acceptable:*
   a.   Jan is home, *otherwise* she's breaking curfew.   (10-b)
   b.   Sam is always home by 6pm, *otherwise* little Susie has a tantrum.(17)

On the surface, both of these cases ought to be infelicitous: if I assert that, in the actual world, Jan is home, then asserting the conjoined proposition that *If Jan isn't home* (in the actual world) *then she's breaking curfew* ought to be judged as redundant. Similarly, if I'm willing to assert that *Sam is always home by 6pm*, then the claim that Susie has a tantrum shouldn't be verifiable in the actual world.[16]

   In both of these cases, the felicity of the *otherwise* clause appears to require the accommodation of a weakened *p*. For (18-a), note that in contexts where the speaker has direct perceptual access to the subject, the sentence is severely degraded. (18-a′) is infelicitous unless the speaker can be interpreted to have incomplete knowledge of where they are.[17]

(18)   a′. $^{??}$I'm home right now, *otherwise* I'm breaking curfew.

Consequently, we take it that while the speaker of a sentence like (18-a) is willing to confidently assert *p*, their addressee accommodates information about their evidence base for this assumption on the basis of their willingness to admit of an alternative.

---

14 Some speakers we have consulted find our example with 'always' difficult to process, and prefer a variant with 'often'. The same point could be made with such an alteration, but we find our variant in the text even more striking. See section 3.5 for a relevant discussion.

15 We thank Kai von Fintel for discussing the context of this section with us, and Bob Beddor for point us toward some very helpful references.

16 This follows from a Stalnakerian view, where, by asserting *p*, we are proposing to eliminate all non-*p* worlds from the Common Ground (e.g. Stalnaker 1979).

17 Compare von Fintel & Gillies' 2010 treatment of epistemic *must*, the (evidential) use conditions of which are met in this scenario (*viz.* inference/indirect evidence.)

By virtue of a similar pragmatic mechanism, the interpretation of (18-b) involves accommodating a weakened assertion of *p*. The speakers we have consulted appear go about this in two different ways, paraphrased below:

(18)   b′.   Sam is **usually** home by 6pm, *otherwise* little Susie has a tantrum.
        b″.   **These days,** Sam is always home by 6pm, *otherwise* **in the past, when he was sometimes late,** little Susie **would have** a tantrum

By weakening the quantificational force of the adverbial (18-b′) or restricting the domain to a stage-level predication (18-b″), real-world alternatives to 'Sam BE home by 6pm' are made available. Both repairs allow for a non-empty complement set of worlds for *otherwise* to refer to, satisfying the *non-emptiness requirement* we discussed above.

Conversely, weakening is not necessary when we have an imperative or an interrogative antecedent, as both types of clauses by their nature always allow for a non-empty complement set of worlds: an addressee may fail to act on a command, admitting both worlds that satisfy the command and those that don't; likewise, polar and alternative questions presuppose more than one possible answer, requiring a partition with non-empty cells.[18]Along similar lines, when the prejacent to *otherwise* is counterfactual, the non-emptiness requirement can be satisfied without weakening the antecedent:

(19)   I'm home right now, *otherwise* I'd be breaking curfew.

In the next section, we build on these observations about the nature of *otherwise* to develop an analysis rooted in dynamic semantics, and making use of the information structural notions of the Question under Discussion.

---

18 Notice that a prediction that follows from this discussion here is that *wh*-questions will not serve as felicitous antecedents for *otherwise*. Although constituent questions have been argued to impose a partition over the possible worlds in the context (e.g. Groenendijk & Stokhof 1984), there will not be a *complement* set for *otherwise* to refer to:

(i)   a.   ??Who wants to present first in the seminar? *Otherwise* Max will.
       b.   ??Where do you want to go? *Otherwise* we can stay home?

Unlike in the case of declaratives, we are not able to offer a repair such as modal weakening, and instead the examples are judged as marginal. For some speakers, the negations of these questions' presuppositions — *viz.* 'if there is noone who wants to present' and 'if there is nowhere that you want to go' — are retrieved (sc. accommodated) with some amount of effort. We discuss other cases of infelicity due to a lack of a non-empty complement set in section 5.

4   Analysis

Here we draw on tools from the dynamic semantics and information structural literatures to model *otherwise*'s semantic contribution to a sentence. Section 4.1 introduces Discourse Representation Theory (Kamp 1981, Heim 1982), and in particular the notion of "modal subordination" (Roberts 1989, 1995, 2004, 2012). Section 4.2 lays out our proposal for the semantics of *otherwise*. It discusses previously unremarked limitations on the distribution of *otherwise*, and shows that they naturally follow from the modal subordination analysis we lay out. Finally, section 4.3 illustrates our proposal for the pragmatics of *otherwise*, and in particular how information structural notions (notably, the *Question under Discussion*) can be recruited to provide a treatment of *otherwise* as a discourse anaphor. An appendix to the paper provides a more detailed formal definition of modal subordination in the context of *otherwise*.

4.1   Background: Discourse representation & modal subordination

As we have seen, a key property of *otherwise* is its interpretational flexibility, which we have characterized as going beyond what is strictly contributed by the syntax of the utterance it is contained in. A number of authors have proposed dissociated syntactic and semantic notions of "subordination" (e.g. Yuasa & Sadock 2002, De Vos 2007, Culicover & Jackendoff 1997), noting the ostensible independence of these modules. In particular, Craige Roberts' (1989) "modal subordination" formalism provides a way of capturing this dissociation, and consequently of explaining the different interpretations of *otherwise* in the Red Light sentences (1).

Roberts (1989) adapts *Discourse Representation Theory* (DRT), developed in Kamp (1981), in order to formally implement a notion of subordination which operates independently of the syntax (i.e. where even in the absence of a conventional trigger, the interpretation of some quantificational operator is restricted.)

(20)   MODAL SUBORDINATION is a phenomenon wherein the interpretation of a clause α is taken to involve a modal operator whose force is relativized to some set β of contextually given propositions.   (Roberts 1989: 718)

In effect, modal subordination provides a way of understanding the relationship between sentence mood and the nature of an assertion in context. It operationalizes the insights of work on the structure of natural language quantification (*i.e.* the conception of modalized sentences as generalized quantifiers that relate 'restrictor' and 'scope'). An illustrative example is provided in (21).

(21)   *An example of modal subordination in discourse:*

    a.   If Edna forgets to fill the birdfeeder, she will feel very bad.

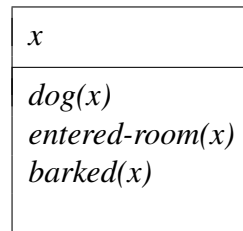   b.   The birds will get hungry.   (Roberts 1989: 683)
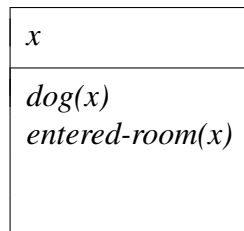
Notice that the birds need not get hungry (an entailment of (21-b), if it were to act as a standalone assertion) for the entire discourse to be true. Instead, (21-b) is *modally subordinate* to (i.e. its interpretation is dependent on) the conditional antecedent in (21-a). Therefore, only in a context in which the antecedent conditions in (21-a) are met must the consequent condition in (21-b) also be satisfied.

We take statements involving *otherwise* to rely on a similar logic. As we have seen, the syntactic form of *otherwise* sentences underdetermines their interpretation. Appealing to MODAL SUBORDINATION allows us to identify the relationship between the linguistic signal and its likely interpretation. Roberts (1989: 712–5) provides a formal syntax and semantics for modal interpretations of DRSs. The pertinent details are presented here.[19]

Next we provide a basic overview of how to interpret the "box diagrammatization" of Discourse Representation Structures (DRSs), familiar from Roberts 1989, Kamp 1979, 1981, Partee 1984, a.o. These visualization conventions are associated with a formal language (the Discourse Representation Language), which is sketched in the appendix to this paper.

For a given DRS K, K denotes a pair $\langle X_K, C_K \rangle$, where X represents the *local domain* – a finite set of variables that represent discourse objects relevant in the context (including participants, eventualities, and times); and C is a finite set of 'satisfaction conditions' that eventually determine the truth value of a given proposition. For diagrams where a DRS K is represented as a box, the top of the box represents the variables X_K and the bottom represents the satisfaction conditions C_K. For a simple discourse as in (22)–(23), we provide a DRS below. Notice that the indefinite is treated as a variable here, and is eventually existentially closed (Heim 1982). DRT allows us to continue to refer to a variable introduced in the prior discourse, as long as it is still accessible:

(22)   A dog entered the room.   (23)   It barked.

$$
\begin{array}{|l|}
\hline
x \\
\hline
dog(x) \\
entered\text{-}room(x) \\
\\
\hline
\end{array}
\qquad
\begin{array}{|l|}
\hline
x \\
\hline
dog(x) \\
entered\text{-}room(x) \\
barked(x) \\
\hline
\end{array}
$$

---

19 An appendix to this paper provides some additional technical detail. The interested reader is referred to Roberts (1989) for a closer reading about the formal apparatus of modal subordination. See also Kamp (2017: 47–58) for a detailed formal presentation of a DRL that handles temporal relations.

Conditions of the form $P(x_{i_1}...x_{i_n})$ (where P is an n-place predicate) are closed under the operations $\neg, \vee, \Rightarrow, \square, \Diamond$. This is illustrated for a simple example below:
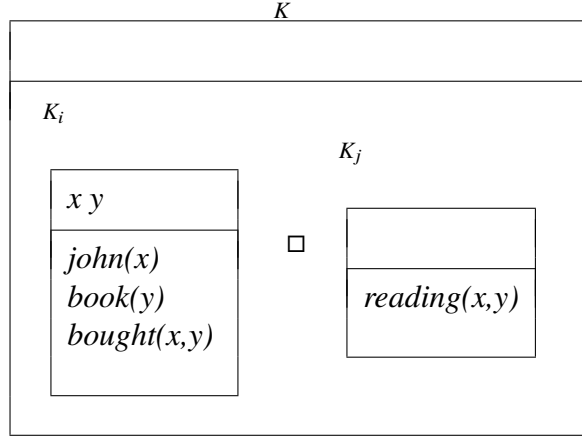
(24)   If a dog is hungry, Pedro might feed it.
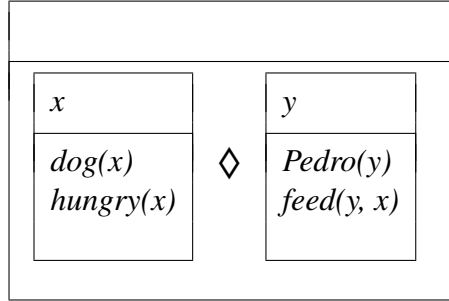
Crucial to the theory is the notion of an "accessible domain" A_{K_i} – a superset of the local domain for any given K_i. As a discourse proceeds, the set of objects that can be referred to expands. The notion of 'accessibility'', then, allows us to predict which objects can be referred to at a given stage in a discourse.

(25)   The accessible domain A_{K_i} contains all the variables that occur:
  a.   In K_i's local domain (X_{K_i})
  b.   In the domains of all DRSs that graphically *contain* K_i
  c.   If K_i is the right element of a (binary) modal condition $(\Rightarrow, \square, \Diamond)$, A_K also contains all the elements of the antecedent's (the DRS on the left's) local domain.
        I.e. $K_\ell \square K_i \rightarrow K_\ell \leqslant K_i$ where $\leqslant$ reads "is accessible from."

In (24), we observe that the consequent box of the conditional makes reference to a variable introduced in the antecedent. We furthermore notice that the entire conditional statement is embedded inside a larger discourse, so that we are not committed to the existence of any dog in the context.

Based on the assumptions introduced in (25), a given DRS K is *modally subordinate* to all those DRSs whose domains it has access to. Example (26) illustrates such a case, from Roberts (1989: 701) . Here, the consequent clause is *modally subordinate* to the antecedent; the entire conditional is taken to assert that 'you will find "John" at home reading a book' *in those worlds* where "John" bought a book (further relativized to a Kratzerian context set – i.e. a modal base and ordering source). Like in (25), we need not be committed to the fact that John bought a book in the actual world; in other words, the entire statement is not a part of the matrix DRS K, but rather further embedded.

(26) *A DRS illustration of modal subordination in a conditional sentence:*
If John bought a book, he'll be at home reading it by now.

$$
\boxed{\begin{array}{l}
\qquad\qquad K \\[4pt]
\hline \\[-6pt]
\boxed{\begin{array}{l} K_i \\ \boxed{\begin{array}{l} x\ y \\ \hline john(x) \\ book(y) \\ bought(x,y) \end{array}} \end{array}} \quad \Box \quad \boxed{\begin{array}{l} K_j \\ \boxed{\begin{array}{l} \\ reading(x,y) \\ \end{array}} \end{array}}
\end{array}}
$$

In (26), the DRS representing the consequent clause (K_j) is *modally subordinate* to its antecedent K_i and, as a result, can access the individuals and eventualities in K_i (i.e. $K_i \leqslant K_j$). Moreover, both K_i and K_j are subordinate to the matrix DRS K (i.e. $K \leqslant K_i \leqslant K_j$); had any variables been introduced in K, they would have been accessible to K_i and K_j.

4.2 Proposal: A dynamic semantics for *otherwise* and the role of discourse

With this background in mind, we are now ready to propose a semantics for *otherwise*. Specifically, we define an operator over DRSs $\ominus$ (and hence the condition $K_i \ominus K_j$) to represent the contribution of *otherwise*:

(27) *Proposal: A dynamic semantics for* otherwise
$K_i \ominus K_j \iff (K_i) \wedge (\neg K_i \Box K_j)$
<u>In words:</u> $K_i \ominus K_j$ is satisfiable iff both K_i and $(\neg K_i \Box K_j)$ are satisfiable.

This proposal can be paraphrased as claiming that: "the conditions in K_i (should) hold"; however, in case that I am incorrect in my claim, the conditions in K_j must then hold." (Recall our discussion of *modal weakening* in section 3.5.) Notice that this treatment takes *otherwise* to be akin in its structure to a conditional, referencing our informal description in (16) that an otherwise statement can be paraphrased as $p \wedge (\text{if } \neg p, \text{ then } \Box q)$. Moreover, we build an asymmetric conjunctive element into the analysis, building on the observations in section 3, especially surrounding example (17).

Notice additionally that we use Roberts' necessity modal operator, building on our observation in (10) that *otherwise* appears to be a modalized operator. The se-

mantics of Roberts' modal operator $\Box$ builds in a modal base m and ordering source o in order to capture the observations made by Kratzer (1981: §2.7) regarding different "flavors" of circumstantial modality.[20]

The satisfaction conditions (including the role to be played by a contextually retrieved modal base) for the condition in (27) are made explicit in the appendix. Although, as (27) makes clear, $\ominus$ can be expressed in terms of other defined operators (viz. $\neg$, $\Box$ and $\Rightarrow$), we use the $\ominus$ shorthand notation for convenience.

Notice further that the definition in (27) leads to the following accessibility relations:

(28)   *The accessibility relations determined by* otherwise*:*
         $(K_i \ominus K_j \in C_K) \rightarrow (K \leqslant K_i \leqslant K_j)$

It follows from (28) that the condition $K_i \ominus K_j$ entails that K_j is modally subordinate to K_i (and both are subordinate to the broader context that they are embedded in).

In section 4.2.1 immediately below, we show how our proposal for *otherwise* can model sentences like the Red Light example, and how it makes use of the notion of modal subordination. In section 4.2.2 we then show that adopting Roberts' notion of the accessible domain into our proposal successfully predicts the range of possible antecedents for *otherwise*, and in particular previously unnoted limitations on its distribution. In section 4.3 we then discuss the role of discourse and pragmatics in calculating the antecedent to *otherwise*, and in the process introduce the notion of the Question under Discussion.

4.2.1   The proposal in action

We begin with the *otherwise* clauses in (1-a) and (1-b), repeated in (29). As in section 4.1, each DRS is represented as a box: its 'local domain' (the discourse objects that it introduces) at the top and its condition set at the bottom. These two examples differ in terms of the material that acts as the prejacent to *otherwise*. In (1-a), the DRS representing the prejacent to *otherwise* is *modally subordinate* to the entire conditional statement represented in the left box in (29-b). In (1-b), the DRS representing the antecedent to *otherwise* is *modally subordinate* to the antecedent of the *if*-clause.

---

20 For the sake of exposition, we abstract away from appeal to the ordering source, although this can easily be added back in following the semantics in Roberts (1989: 714). In effect, Roberts treats the material conditional as a modal with a singleton (i.e. "totally realistic") modal base. See also Kratzer 1986 for another modalized analysis of conditionals, and e.g. Cantwell 2008, von Fintel 2011, Yalcin 2012 for arguments for preferring such an analysis to a material implication theory of conditionals.

(29) a. If the light is red, stop. *Otherwise* go straight on.   = (1-a)
      b. *A* DRT *analysis of (1-a)*

x		**y**	
light(x) red(x)	□	Addr(y) stop(y)	⊖ go.on(y)
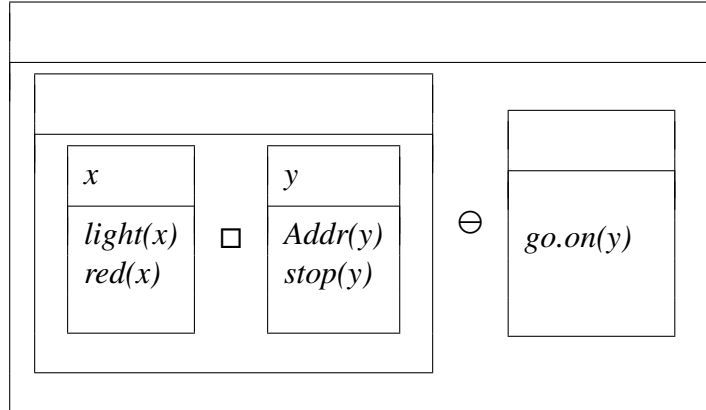
(30) a. If the light is red, stop. *Otherwise* you'll get a ticket.   = (1-b)
      b. *A* DRT *analysis of (1-b)*

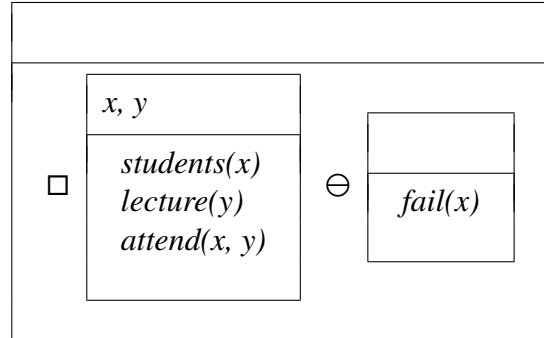|			
x		**y**	
light(x) red(x)	□	Addr(y) stop(y)	⊖ get.ticket(y)
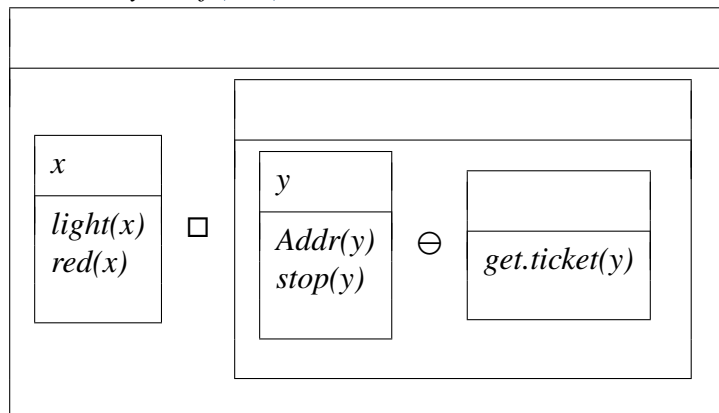
    We provide a second illustration using example (11), repeated below. Again, the antecedent can lead to two distinct *otherwise* statements. The DRSs in (31) show how modal operators rely on the accommodation of material that is made available by preceding discourse elements. In the (31-a), the consequent clause is relativized to worlds where students attend the lecture. In (31-b), it is relativized to worlds in which students are *obliged to* attend the lecture (i.e. the entire modalized sentence is accommodated.)

(11)   Students are required to attend the lecture, *otherwise*...

      a. ≈ If ¬ (they ATTEND)...   ...they'll fail the class.

      b. ≈ If ¬□ (they ATTEND)...   ...it'll be empty.

(31)   *Different continuations mean that different antecedents are accommodated:*

    a.   *The* non-modalized *statement served as the prejacent to* otherwise:

            □   [*x, y* / *students(x)* *lecture(y)* *attend(x, y)*] ⊖ [*fail(x)*]

    b.   *The* modalized *statement served as the prejacent to* otherwise:

            □   [[*x, y* / *students(x)* *lecture(y)* *attend(x, y)*] ⊖ [*empty(y)*]]
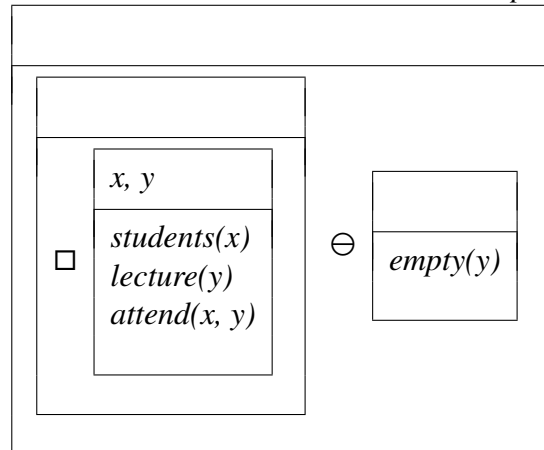
Once again, then, the choice of prejacent for *otherwise* varies between the two examples, and cannot be determined from the preceding syntax alone. Instead, the **consequent clause** plays a crucial role in the reasoning about the set of worlds under consideration in the evaluation of an *otherwise*-sentence, as we will discuss in detail in section 4.3.

4.2.2   Constraining the choice of antecedent

In this section, we further illustrate the utility of the notion of modal subordination in our analysis. To do so, we turn our attention to the available readings of *otherwise*. As we have seen, the choice of an antecedent for *otherwise* isn't guided deterministically by the syntax. Nonetheless, its selection is not unconstrained. To

see this, consider example (32), which is judged as infelicitous with the intended reading of "If the light is red, stop. If it isn't red, it will be green."[21]

(32)   #If the light is red, stop; *otherwise* it'll be green.
             INTENDED ≈ If the light is <u>not</u> red...

This is crucially predicted by the modal subordination account described in this section. The "accessible domain" of *otherwise* will contain precisely those DRSs which can be felicitously accommodated as its antecedent. For sentences with conditionals such as the Red Light examples, the accessible domain will contain the content of either the *consequent* clause of the conditional or the *entire* conditional sentence — but there is no way to choose the antecedent of the conditional to the exclusion of the consequent. But this is precisely what would be required for (32) to be felicitous; its infelicity follows naturally from the use of modal subordination in our analysis.

To this point, compare the sentences in (33), adapted from Kruijff-Korbayová & Webber (2001: 76). Whereas (a) can be shown to encounter similar interpretation problems to (32), it is vastly improved in (b) when the relevant if-clause receives focus and associates with *only*.

(33)   a.   #If the light is red, stop; *otherwise* you'll get rear-ended.
                INTENDED ≈ If the light is <u>not</u> red and you do stop...
       b.   Only if the light is RED, stop; *otherwise* you'll get rear-ended.

In fact, as shown by McCawley (1974), Barker (1993) and von Fintel (1994, 1997), the felicity of (33-b) follows naturally from a standard semantics for *only*, where *only* is taken to assert the negation of alternatives to its prejacent.[22] These authors show that the truth-conditional content of *only if* can be derived compositionally (i.e. as a function of the standard semantics of *only* and *if*), where the assertive content of *q only if p* is modelled as $\neg p(w) \rightarrow \neg q(w)$ (that is, *q* holds in no worlds other than those in which *p* does).

(34)   *Presuppositional and assertive components of (33-b):*
       Only if the light is RED, stop; *otherwise* you'll get rear-ended.
       <u>Presupposes</u>: If the light is red, you stop.
       <u>Asserts</u>: If the light is {yellow, green}, you dont stop. If you do stop, you get rear-ended.[23]

---

21 Speakers consulted frequently cited a reading where failing to stop at a red light would cause it to change color. This is predicted by our account.

22 Formally, *only* presupposes $P(x)$ and asserts that for all alternatives y distinct from x: $P(y)$ is false. $\llbracket only \rrbracket = \lambda P \lambda x : P(x).\neg \exists y (y \neq x \wedge P(y))$ following Horn (1969: 99).

23 Assuming here that *red*, *yellow*, and *green* are the contextually relevant alternatives to *red*.

This can then be schematized as in (35), where the *otherwise* clause is modally subordinate to all other content in the utterance, and interpreted as predicating into to 'the set of non-red-light worlds in which you stop.'

(35)   *A* DRT *analysis of the* otherwise *clause in (33-b)*
         If the light isn't red, don't stop; if you do stop, you'll get read-ended.
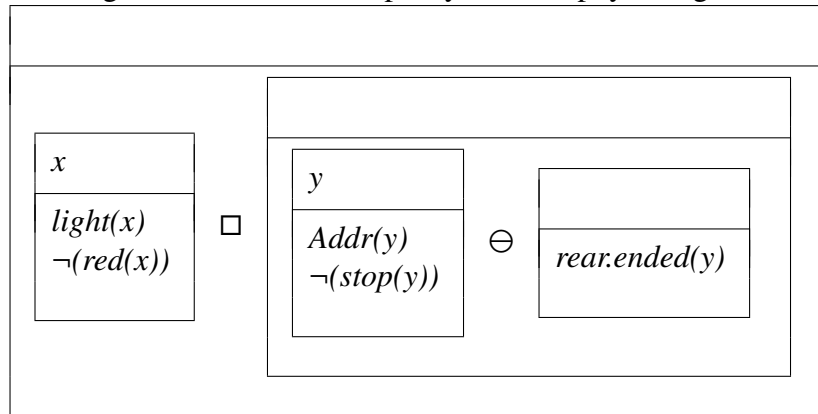
This phenomenon is shown additionally in (36), where either all three conjoined clauses or the *final* conjunct can be easily accommodated as an antecedent proposition to *otherwise*. The other conjuncts are not accessible antecedents for *otherwise* in this context. Again, this is precisely what is predicted from the modal subordination account.

(36)   You should have a snack, chill out for a bit, and then you should go to the gym, otherwise you'll feel bad later on.

Having established that the choice of prejacent of *otherwise* is not syntactically determined but is rather constrained by the notion of the accessible domain, we now turn back to the role of context in determining the nature of the chosen prejacent of *otherwise*.

4.3   Proposal: *otherwise* as a discourse anaphor

As the preceding sections make clear, there is often more than one possible choice for the prejacent of *otherwise*. How is the prejacent chosen, then? We propose that the set of worlds that the complement set of which *otherwise* operates on is cal-

culated pragmatically from the prior discourse and the nature of the consequent clause.[24,25]

By deploying the information structure notions proposed in Roberts (1996/2012), we can conceptualize of *otherwise* as representing a DISCOURSE MOVE (in effect, a stage in a given discourse), which adds to the QUESTION UNDER DISCUSSION in a given context.

(37)   *Two useful definitions:*
      a.   The **common ground** is a set of mutually assumed background information. The *cg* is often modeled as a set of propositions, i.e. a set of sets of possible worlds (e.g. Stalnaker 1979).
      b.   The **QuD** is a partially structured set of questions which discourse participants are mutually committed to resolving at a given point in time. It is often modeled as a stack, consisting of ordered subsets of accepted question moves, the answers to which are not entailed by the *cg* (i.e. a set of "open" questions in the discourse at a given time.)

With these concepts, we have a means of representing the 'flow' of information and changes in the interlocutors' information states over time. We take a sentence of the form *p otherwise q* to consist of (at least) three discourse moves. We propose that *otherwise* represents a discourse "setup" move with the effect of adding to the QuD.

(38)   *Proposal: the pragmatics of* otherwise
      Otherwise represents a discourse "setup" move with the effect of adding to the QuD stack a question about the COMPLEMENT of the set of worlds established elsewhere in the discourse.

The importance of this pragmatic aspect of our analysis is illustrated for example (39) below.

(39)   [*You must eat*]$_{m_i}$, **otherwise**$_{m_j}$ [*you won't grow!*]$_{m_k}$

   m_i This clause represents a modalized assertion: in all worlds in some unspecified (here, likely teleological) conversational background f, the addressee eats.

$$\forall w' \in \cap f : \text{EAT}(Addressee)(w')$$

---

24 This claim bears some similarity to the notion of a "anaphorically-derived contextual parameter" that features in the analysis of Webber et al. (2001: 14).

25 Relatedly, Corblin (2002) notes the possibility of *negative accommodation* without *otherwise* in *I didn't buy the car. I wouldn't have known where to put it (otherwise)* and *I should have accepted. I wouldn't have been fired.* (our translations: 256, 258).

m_j *otherwise* represents an instruction to consider the COMPLEMENT of some set of worlds established elsewhere in the discourse. This can be thought of as signaling the addition of a question to the QUD stack of the form:

what if we are in some $w \in \textbf{COMPL}(p)$?

In other words, what if we are in a world in which the addressee doesn't eat?

m_k The consequent clause encodes the prejacent to *otherwise*. It is to be interpreted as proffering a (partial) answer to the current question under discussion by making a (modalized) assertion that the addressee won't grow in the set of worlds picked out by *otherwise* (viz. the **complement** of the set of worlds in which the addressee eats).

$$\forall w''.w'' \in \textbf{COMPL}\big(\text{EAT}(Addressee)\big) \rightarrow \neg\text{GROW}(Addressee)(w'')$$

As we know, the process of establishing the context set for a given *otherwise* sentence is underdetermined by the syntax of the sentence. We dub this the "RED LIGHT PUZZLE", repeated in (40). Recall that the syntactic antecedents of the *red light* sentences are identical (hence m_i, m_j, m_k represent the same operation in each sentence), but they appear to constrain the interpretation of *otherwise* in markedly different ways, m_a vs m_b.

(40)   THE RED LIGHT PUZZLE
   a.   [*If the light is red,*]$_{m_i}$[*stop;*]$_{m_j}$ *otherwise*$_{m_k}$ [*keep going!*]$_{m_a}$
   b.   [*If the light is red,*]$_{m_i}$[*stop;*]$_{m_j}$ *otherwise*$_{m_k}$ [*you'll get a ticket!*]$_{m_b}$

We provide an Information-Structure based analysis for (40-a) and (40-b). We first consider the two discourse moves in the *if*-clause, viz. m_i & m_j.

(41) m_i The *if*-antecedent temporarily constrains the context set (Roberts 1989: 687). It adds a question to the QUD stack of the form:

what if we are in $\{w' \mid \text{RED.LIGHT} \in w'\}$?

m_j Imperative *stop* represents an answer to QUD(m_i). As with the antecedent in (39), we treat it as a modalized proposition (again with some conversational background f)[26] which further restricts the domain established by m_i.

$$\forall w''. \ w'' \in \text{RED.LIGHT} \cap f \rightarrow \text{STOP}(Addressee) \in w''$$

---

26 See Portner (2007) a.o. for a modal treatment of imperative sentences.

As per our proposal, *otherwise* marks the addition of a question to the QUD stack which considers what would happen if we were *not* in a world introduced in the prior discourse:

(42)   The *otherwise* discourse move:

   m_k *Otherwise* represents an instruction to consider the **complement** of some set of worlds established elsewhere in the discourse.

   what if we are in some $w \in \textbf{compl}(p)$?

Given the salience of w' and w'' in (41), which have been added to the *cg* in m_i, m_j respectively, both are possible candidates to form the set that *otherwise* builds on. The Addressee is thus required to *infer which* discourse move *otherwise* is anaphoric upon (*i.e.* its antecedent.), based on the content of the consequent. We dub this the *jeopardy! effect*: The addressee is given the consequent (=the answer) and must compute the correct antecedent (=question) based on it:

(43)   *The* JEOPARDY! *effect*

   m_a *keep going* is interpreted as an answer to *what if we are in* **compl**(red.light)?

   Here the propositional variable is saturated by the partition evoked in m_i

   $$\forall w''.w'' \in \textbf{compl}(\text{RED.LIGHT}) \rightarrow \text{KEEP.GOING}(w'')$$

   m_b *get a ticket* is interpreted as an answer to *what if we are in* RED.LIGHT \ STOP? (I.e. the complement of STOP *relative* to RED.LIGHT)

   Here a sub-partition (within the set of "red light worlds") evoked in m_j saturates the propositional variable.

   $$\forall w''.w'' \in \text{RED.LIGHT} \cap \textbf{compl}(\text{STOP}) \rightarrow \text{GET.TICKET}(w'')$$

Our claim, then, is that computing the antecedent of *otherwise* is a pragmatic process, subject to reasoning by the addressee and depending on the given context in which the sentence is uttered.[27] This follows from the pragmatic stipulation that, in a discourse, assertions represent 'at least partial answers [...] to the question under discussion at the time of utterance' Roberts (2012: 20–21).[28] Broadly, the discourse contribution of *otherwise* can be understood as representing a "set-up move": it signals to the addressee that its prejacent is to be understood as a modal claim, relativized to the complement of a set of worlds established elsewhere in the discourse context.

---

27 This makes predictions for online sentence processing — for example, that a given reading could be primed or ruled out by supporting contexts. We leave this for future work.

28 In fact, this effectively serves as a reformulation of Grice's maxim of Relation, adapted for an information-structural framework.

5 NON-EMPTINESS and possibility modals

Given that, by our analysis, *otherwise* requires reference to a set of "eliminated worlds" — the complement set of worlds to that introduced by the prejacent of *otherwise* — it follows that a sentence of the form $\alpha\, otherwise\, \beta$ will be uninterpretable in discourses in which **no** worlds have been eliminated (i.e. where $\overline{\alpha} = \varnothing$). This principle is given in (44), and reflects the *non-emptiness* requirement we observed in section 3.2.

(44)   EXCLUSION*: a felicity condition for* otherwise
        The interpretation of *otherwise* β depends on the retrieval of some antecedent discourse move α whose function was to eliminate a set of worlds $\overline{\alpha}$ from consideration.
        Otherwise β predicates β of $\overline{\alpha}$.

In this section we show two consequences of this requirement for the interpretation of *otherwise* in modalized sentences.

5.1 Unambiguous scope

A sentence like *Sam may not be a doctor* is ambiguous between circumstantial and epistemic readings. This observation notwithstanding, the contrast between (45) and (46) further demonstrates the interpretive constraints that *otherwise* is subject to — namely, that it must be able to refer to a non-empty complement set of worlds, computed on the basis its antecedent and other components of the context. To illustrate this, consider the two contexts below, designed to support the circumstantial and epistemic readings, respectively, in the context of an *otherwise* statement:

(45)   CONTEXT. Sam got horrible grades in school and is very clumsy
        a.   She may not be a doctor, *otherwise...* $\neg \gg \Diamond_{\text{circ}}$
        b.   ≈ If she were (to become) a doctor...   ...she might kill someone.

(46)   CONTEXT. Sam works in a hospital and wears a white coat; I'm unsure what exactly it is that she does.
        a.   She may not be a doctor, *otherwise...* $\Diamond_{\text{epist}} \gg \neg$
        b.   INTENDED ≈ If she <u>is</u> a doctor... $^{??}$...she's probably a surgeon.

A crucial difference between the circumstantial (45) and epistemic (46) readings of the antecedent is the scope relation between the modal and negative operator. Just like in (12) above, *otherwise* is only licit if it can predicate into a non-empty set of worlds. In the $\neg \gg \Diamond$ case, we can successfully achieve this result. But in the $\Diamond \gg \neg$ case, where no worlds are eliminated, *otherwise* is unavailable. Given *otherwise*'s

observed infelicity with possibility readings of *may*, the epistemic reading is ruled out, leaving only the circumstantial one available.

5.2 Epistemic strengthening

A second, related result concerns so-called 'weak necessity' readings of possibility modals (Rubinstein 2012, von Fintel & Iatridou 2008).

The modals *ought* and *should* are described as encoding "weak" necessity, distinguishing them from other modal necessity expressions (e.g. *have to* and *must*.) Two examples demonstrating the relation between weak and strong necessities from von Fintel & Iatridou (2008: 117) are provided below.

(47)   *Weak and strong necessity:*

    a.   You *ought to* do the dishes but you don't *have to*.
    b.   #You *must* do the dishes but you don't *have to*

(48)   a.   You *ought to* wash your hands – in fact, you *have to*.
    b.   ?You *have to* wash your hands – in fact, you *ought to*.

Additionally, as with other modals, *ought* appears to admit of ambiguity between epistemic and circumstantial (e.g. deontic) readings, as shown in (49).[29]

(49)   *Weak necessity and modal flavors:*
Morris *ought to* be in his office.   (von Fintel & Iatridou 2008: 116)

In view of the co-occurence constraints on epistemic possibility modals with *otherwise*, compare the two sentences (both judged as acceptable) in (50) below.

(50)   *A felicitous epistemic possibility modal with* otherwise*:*

    a.   She *must* be sick, otherwise she'd be here.

$$\alpha = \{w \in f_{\text{epist}} \mid \text{She is sick in } w\}$$
$$\overline{\alpha} = \{w \in f_{\text{epist}} \mid \text{She is not sick in } w\}$$

    b.   She *might* be sick, otherwise she'd be here.

The first clause of (50-b), uttered in isolation, asserts the existence of epistemically-accessible worlds in which the subject is sick (i.e. $\exists w' \in \cap f_{\text{epist}}.$She is sick in w'). In such a case, as we have seen in the foregoing sections, a pure possibility reading is not available because no possible worlds have been excluded from consideration

---

29 Cf. Yalcin (2016) for a dissenting view, namely the claim that epistemic modality cannot be 'sensitive to normality orderings' (239) and that *ought* and *should* don't actually admit of a true epistemic reading.

(that is, as far as the speaker is concerned, the subject may or may not be sick). Consequently, the felicity condition for *otherwise* as laid out in (44) is not met.

This problem is repaired here by *strengthening* the meaning of *might*, so that it is now interpreted as excluding possible worlds (requiring that it function as a universal quantifier: a hallmark of necessity modals). While the intended interpretation of (50-b) is weaker than that of its counterpart in (50-a), it can still be understood as quantifying universally over possible worlds, albeit over a more restricted set.

Following von Fintel & Iatridou (2008: 116), 'while strong necessity modals say the prejacent is true in all of the favored worlds, weak necessity says that it is true in all the very best (by some additional measure) among the favored worlds.' With respect to the epistemic domain specifically, the difference could be understood as the difference between relativizing the prejacent to "hard and fast evidence" and "unreliable assumptions about the normal course of events."[30]Consequently, we propose the paraphrases below:

(51)   *With* otherwise *the possibility modal is strengthened to weak necessity:*

     a.   She *must* be sick, otherwise she'd be here.
         ≈ *In all worlds consistent with what I know,*
            if she is not sick, she'd be here.

     b.   She *might* be sick, otherwise she'd be here.
         ≈ *In all worlds consistent with my perception of her general behavior*,
            if she is not sick, she'd be here.

The finding that *might/may* — generally understood as encoding modal possibility — are encoding weak necessity suggests that the felicity conditions of *otherwise* coerce a non-canonical interpretation of these modals. This result follows from our proposal in section 4.2, that some non-empty set of worlds must be available for *otherwise* to predicate of.

---

30 von Fintel & Iatridou (2008) and Rubinstein (2012) model weak necessity by appealing to at least one additional ("secondary") ordering source. In the current case, the secondary ordering source might be described as *stereotypical* (g_{st}) following Kratzer (1981). Adopting this analysis, the relevant sets of worlds for (50-b) are:

(i)   a. $\alpha = \{w \in \mathbf{max}_{g_{st}}(f_{\text{epist}}) \mid \text{She is sick in } w\}$
       b. $\overline{\alpha} = \{w \in \mathbf{max}_{g_{st}}(f_{\text{epist}}) \mid \text{She is not sick in } w\}$

Where $\mathbf{max}_g(f)$ is a function that returns the "best" worlds in a set of worlds f as determined by an ordering source g (i.e. those worlds in f best conforming to the ideal contained in g).

# 6 Intra-sentential *otherwise* and complement anaphora

So far, the data we have focused on in this paper has comprised uses of *otherwise* that appear to signal a relation between clauses. We have claimed that, in these cases, *otherwise* adds a question of the form *what if the antecedent proposition doesn't hold?* to the QuD stack. Nevertheless, as shown in section 1, intra-sentential uses of *otherwise* — namely, those which coordinate smaller structures — are also available. In this section, we briefly show how our analysis can be extended to account for such uses. We then relate our analysis to the phenomenon of *complement anaphora*, which has also benefitted from an analysis within a dynamic semantic framework.

6.1 *Otherwise* with donkey anaphors

A key advantage of DRT is in providing an analysis of so-called Donkey Sentences, such as in (52):

(52)   *Donkey anaphora:*
      a.   If a woman is rich, she owns a donkey.
      b.   If a dog is hungry, Pedro will feed it.   =(24)

Such sentences were famously used as a counter-examples to Montague's formal analysis of quantification in natural language (1973), as they defy an analysis in first-order predicate logic.[31] As we saw in section 4.1, DRT is able to provide a natural account, treating indefinites as variables rather than existential quantifiers (see Kamp 1981, Heim 1982). This is exemplified again in (53):

(53)

x		y
woman(x)	$\Longrightarrow$	donkey(y)
rich(x)		owns(x, y)
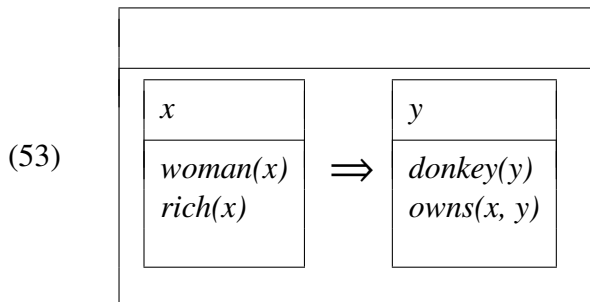
One payoff of the approaches espoused by these authors is the conception of universal expressions as complex conditions of the form $K_i \rightarrow K_j$, where K_i and K_j
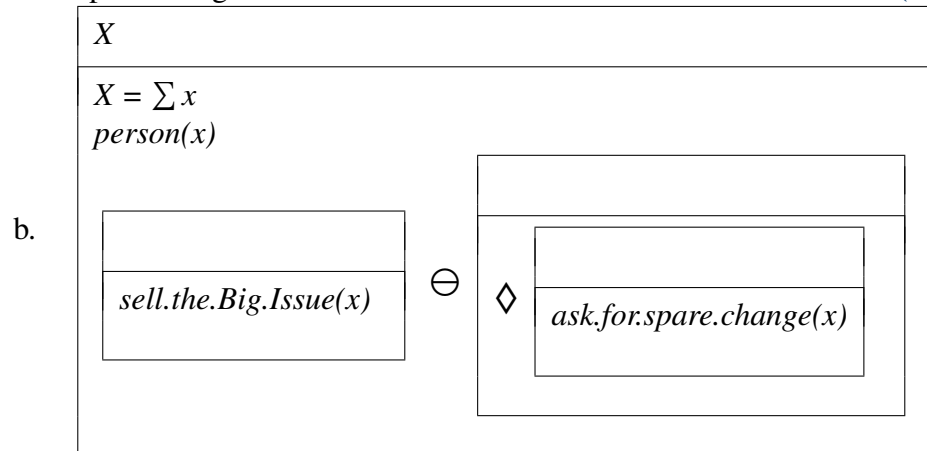
---

31 A formula can be given, but only if the indefinite is translated using a universal quantifier — an arguably undesirable result.

are sub-DRSs representing the restriction and the scope of the quantified statement, respectively (Roberts 1989: 693-4).

Appealing to these same notions, we are able to naturally account for some intra-sentential uses of *otherwise*, as in (54) from Webber et al. 2001: 7, repeated here for convenience:

(54)   *Intra-sentential* otherwise*:*

    a.   Every person selling "The Big Issue" might *otherwise* be asking for spare change. = (7-a)

    b.

$$
\begin{array}{|l|}
\hline
X \\
\hline
X = \sum x \\
person(x) \\
\\
\boxed{sell.the.Big.Issue(x)} \ominus \Diamond \boxed{\boxed{ask.for.spare.change(x)}} \\
\hline
\end{array}
$$

    c. $\approx$ In all worlds in which a person x isn't selling the Big Issue, it's possible that the person x is asking for spare change.

For Webber et al. 2001, example (53) requires the use of E-type pronouns. It thus receives a different analysis than inter-sentential uses such as (1). Our account, on the hand, doesn't resort to any additional assumptions, and does not predict any distinction between such examples. We take this to be another advantage of our approach here.

6.2   "Intrapredicative" *otherwise*

Expanding on examples such as (53), in this section we investigate intra-sentential uses of *otherwise* (termed *intra-prédicative* by Flament-Boistrancourt 2011). We show how such cases can be united with the analysis presented above. The examples in (55) illustrate several relevant cases:

(55) *"Intrapredicative"* otherwise*:*

    a.   I started meditating to find a bit of stillness in an *otherwise* hectic life.

    b.   The income they earn from [tea production] is likely to be the only source of cash to supplement their *otherwise* subsistence economy.

        (OED)

    c.   Amelia behaved well *otherwise*.   (Flament-Boistrancourt 2011)

    d.   She's blonde. *Otherwise* she totally looks like her dad.

        (Inkova-Manzotti 2002: 124)

Observe that all of these uses are united insofar as they rely on processes of **association** (contextual retrieval of some domain set) and the **exclusion** of the complement of the prejacent from that set (see Webber et al. 2001).

For the intrapredicative uses shown here, then, *otherwise* can be understood to denote a relation that holds between PROPERTIES ($P, Q \in \mathcal{D}_{\langle s, \langle e, t \rangle \rangle}$). Namely, where P is some accommodated property, *otherwise* Q can be understood as a property where if P didn't hold of x in w, then Q would. Building on our proposal in section 4, then, we would allow the (complement) set of worlds predicated of by *otherwise* to be constructed not only by considering a proposition (or set of propositions) and its negation, but also by considering a property (or set of properties) and *its* negation. In both cases, *otherwise* is to be understood to **quantify over intensions**. We leave the precise formulation of this extension to our analysis to future research.

6.3   Complement anaphora

Finally, we point out similarities between our analysis of *otherwise* and the phenomenon of complement anaphora, exemplified in (56) (Evans 1977, 1980, Nouwen 2003).[32] Complement anaphora occurs in sentences where an anaphor appears to refer to the *complement* of a set of individuals introduced earlier in the discourse:

(56) *Complement anaphora:*
    Few congressmen admire Kennedy.

    a.   *They* are (all) very junior. $A \cap B$

    b.   *They* think he's incompetent. $A \cap \overline{B}$

---

32 Some speakers struggle with the complement anaphora reading. The existence of complement anaphora was first extensively studied in a series of psycholinguistic experiments (Moxey & Sanford 1986, Sanford et al. 1994). These authors identify a small set of proportional determiners, including *few, few, very few, not many*, and *hardly any*, as allowing reference to the *complement* of a set of individuals introduced earlier in the discourse.

Moreover, although to our knowledge this has not been previously noted in the literature, we find similar effects in the temporal domain:[33]

(57)   *Complement anaphora in the temporal domain:*
       Senators *rarely* vote their conscience. They do what the Party tells them to.

Building on Kibble 1997, Nouwen (2003) develops a dynamic semantic analysis of complement anaphora, where reference to a complement set of <u>individuals</u> arises out of pragmatic constraints, key among them is the Non-Emptiness constraint.[34]

(58)   NON-EMPTINESS:
       As the antecedent of an expression do not choose a set which is potentially empty, except when this set is the reference set of a quantificational sentence.

Parallel to this proposal, we have argued that *otherwise* picks out a complement set of <u>worlds</u>, and is subject to the exclusion felicity condition, (44). We take *otherwise* to lexically specify complement set reference, which is therefore not subject to the same pragmatic constraints as complement anaphora. We take (59) to be a felicitous paraphrase of a sentence such as (56-b):

(59)   *Complement anaphora with* otherwise*:*
       Very few congressmen admire Kennedy. *Otherwise* they (all) think he's incompetent.

Otherwise encodes the instruction to consider a complement set of worlds as part of its semantics. As a consequence, *otherwise* sentences are not marginal and are not subject to the same distributional restrictions as complement anaphora. This observation is similar to an observation Nouwen (2003: 109ff) makes about the phrase 'the others':

(60)   *Complement anaphora with* 'the others'*:*
       Very few congressmen admire Kennedy. *The others* (all) think he's incompetent.

As Nouwen notes, *the others* refers to the *maximal set* of individuals which forms the complement to the set introduced in the antecedent sentence. This use is felicitous is cases where this complement set is necessarily non-empty. Again, the

---

33 Such effects may be predicted by the discussion of 'generalized discourse subordination' effects of temporal quantifiers (Roberts 1989: 716ff, Corblin 1994: 8).

34 See Corblin 1986 and Geurts 1997 for an alternative account whereby sentences described as involving complement anaphora in fact make reference to the *maximal set*, and not truly to the complement set. Nouwen 2003 provides several arguments against this *pseudo-reference* view.

resulting sentence, like in our *otherwise* examples, is then predicated of *all* individuals in this set.[35] See also Corblin (1994, 2002) for a discussion of *relativisations négatives* ("negative accommodation") in a modal subordination framework, which he takes as clear evidence of the need to appeal to some pragamtic phenomenon.[36]

7 Conclusion & further work

In this paper we developed a formal semantic/pragmatic analysis of the interpretation and meaning contribution of the English discourse anaphor *otherwise*. The analysis was couched within the theory of dynamic semantics, and in particular relied on the notion of modal subordination for predicting the distribution of *otherwise* in English sentences.

We proposed that *otherwise* introduces a discourse move (in the sense of Roberts 2012) into the conversation, which encodes an instruction to consider the *complement* of a set of worlds introduced in the clause preceding *otherwise*. That is, *otherwise* introduces a modalized assertion which claims that proposition p holds (to the best of the speaker's knowledge), and that in case that it didn't hold, then some alternative proposition q must be true: $(p) \wedge (\neg p \Rightarrow \Box q)$. We detail the intensional/modal-dependent property of *otherwise*, its asymmetric conjunctive behavior, and the *weakening* process affecting declarative antecedents in section 3.

An interesting consequence of our analysis is that *otherwise* imposes a restriction on the nature of its arguments; namely the NON-EMPTINESS of that complement set into which it predicates. In section 3.2, we empirically motivated this felicity condition; section 5 detailed a number of its consequences.

Following Webber et al. (2001) and other authors, we took as key the observation that the identity of the antecedent clause to *otherwise* cannot be determined by the syntax alone (the so-called *Red Light* puzzle). Instead, we argued that we

---

35 Ezra Keshet (pers. comm.) points out a related similarity between *the others* and *otherwise*. *The others* can pick up the members of the restrictor set *not* including the current individuals being quantified over:

(i)   Few/Most boys ganged up on the others.
        (cf. #Few/Most boys ganged up on them)

In such configurations, *otherwise* is also available. In the examples below, *otherwise* picks up the worlds other than the winning or cheating worlds.

(ii)   a.   If you win, you'll be happier than (you would have been) *otherwise*.
        b.   If you cheat, you'll always wonder if you could have succeeded *otherwise*.

This point is also addressed by Webber et al. (2001: 8).

36 For Corblin (2002: 260) the solution is found in relations from Rhetorical Structure Theory like EVIDENCE and JUSTIFY (apud Mann & Thompson 1988).

must make crucial reference to the current information structure, and in particular to the current Question under Discussion, to determine the nature of the antecedent. We dubbed this phenomenon *the Jeopardy effect*: the nature of the *consequent* to *otherwise* plays a crucial role in its determination of the antecedent.

This proposal allowed us to model both *otherwise*'s flexibility and previously unobserved limitations on its distribution. Specifically, we showed that *otherwise* can only be predicated of sentences that it is *modally subordinate* to, limiting the antecedents available to it in the discourse. We moreover introduce the *exclusion criterion*, whereby *otherwise* must refer to a non-empty set of worlds; in cases where the antecedent does not eliminate any worlds from consideration, an *otherwise* continuation is infelicitous.

Finally, we briefly showed how this dynamic account can naturally be extended to cases of reference to individuals, and in particular how it can be related to the phenomenon of *complement anaphora*.

Authors' address

Josh Phillips & Hadas Kotek
370 Temple Street
New Haven, CT 06511
josh.phillips@yale.edu

Appendix: Modal subordination with *otherwise*: the formal mechanics

In this appendix, we provide further detail about the "discourse representation language" that formalizes the structures (and the satisfaction conditions for $\ominus$) presented above. Further, we show a complete derivation for an "*otherwise*"-sentence as a 'proof-of-concept' for our analysis.

As described in §4.1, formally a DRS K is a pair $\langle X_K, C_K \rangle$. X_K represents K's *local domain* – a finite set of variables that are assigned to discourse objects at a given discourse stage. Consequently, each DRS can be thought of as introducing participants (represented by variables over the domain of individuals) as well as variables over eventualities and times (per Kamp's (1979, 2017) treatment of temporal/aspectual phenomena, see also Partee 1984).

C is a finite set of conditions that eventually determine the truth value of a given proposition. An atomic condition is of the form $P(x_{i_1}...x_{i_n})$ (where P is an n-place predicate). Conditions are closed under the operations $\neg, \bigvee, \Rightarrow, \Box, \Diamond$.

Crucially, Roberts (1989: 713) also defines the notion of an "accessible domain" A_K – a superset of the local domain for any given K. Accessibility is a partial order that obtains over DRSs such that for any K:

(61)   *Accessibility relations for operators and DRSs in DRT:*
$$K_i \vee K_j \in C_K \qquad \rightarrow K \leqslant K_i \, ; K_j$$
$$\neg K_i \in C_K \qquad \rightarrow K \leqslant K_i$$
$$\left.\begin{array}{l} K_i \Rightarrow K_j \in C_K \\[6pt] K_i \,\square\, K_j \in C_K \\[6pt] K_i \,\lozenge\, K_j \in C_K \end{array}\right\} \rightarrow K \leqslant K_i \leqslant K_j$$

The **accessible domain** of a given DRS, then, is given by the set union of all accessible DRSs' local domains: $A_{K_i} = \bigcup_{K \leqslant K_i} X_K$. As pointed out in §4.1, this relation is graphically represented in the box diagrams.

The primary payoff of this conceptualization is the epiphenomenal notion of MODAL SUBORDINATION (Roberts 1989 et seq), where subordinate DRSs depend on access to objects introduced by (i.e. in the local domains of) those DRSs to which they are subordinate:

(62)   MODAL SUBORDINATION is a phenomenon wherein the interpretation of a clause α is taken to involve a modal operator whose force is relativized to some set β of contextually given propositions.   (Roberts 1989: 718)

In (27), we defined the *otherwise* $\ominus$ (and hence the condition $K_i \ominus K_j$) to represent the contribution of *otherwise*. In effect, $\ominus$ can be expressed in terms of other defined operators (i.e. $\vee, \neg, \square$). We repeat this proposal in (63).

(63)   *Proposal: A dynamic semantics for* otherwise
$$K_i \ominus K_j \iff (K_i) \wedge ((\neg K_i) \Rightarrow \square K_j)$$
<u>In words:</u> $K_i \ominus K_j$ is satisfiable iff both K_i and $((\neg K_i) \Rightarrow \square K_j)$ are satisfiable.

Consequently, $K_i \ominus K_j \in C_K \rightarrow K \leqslant K_i \leqslant K_j$. As shown in §4.2.2, Roberts' accessibility relation between DRSs successfully predicts the range of possible antecedents for *otherwise*.

In her extension to the discourse representation language, Roberts (1989: 714-5) provides a recursive definition of truth (*i.e.* verification in a model $\mathcal{M}$) for DRSs. Given in (64), effectively, truth in a model is defined for a DRS K with respect to a world if there is some assignment function that satisfies all of the conditions in K in that world (recalling that K itself is a pair including a condition set C_K.)

(64) $\langle w, f \rangle \vDash_{\mathcal{M}} K \leftrightarrow \forall c \in C_K (\langle w, f \rangle \Vdash_{\mathcal{M}} c)$
A DRS K is verified (or "embedded") in a model ($\vDash_{\mathcal{M}}$) relative to a world w and assignment f iff all the conditions in K are satisfied ($\Vdash$) by w and f.

Roberts spells out a semantics for the satisfaction of all (atomic and non-atomic) conditions in C_K. Extending this, we can define a semantics for the $\ominus$ operator. The satisfaction conditions for $K_i \ominus K_j \in C_K$ are given in (65). These monotonically-growing assignment functions formally model the accessibility relation $\leqslant$ described above, upon which modal subordination hinges. Effectively, they ensure that any modally subordinate DRS will be able to refer to ("access") superordinate structures.

The formalism in (65) spells out the satisfaction conditions inherent in (63), assuming the notational conventions and adapting the proposals in Roberts (1989: 714). It makes use of a function **max** (sometimes rendered *best*) which returns those worlds in a given set $m \subseteq \mathcal{W}$ (the *modal base*) which best conform to a given ordering source o (i.e. contextually provided set of propositions inducing an order over m).[37] Note that the notation $f'_{\langle X \rangle} f$ reads: "f' is exactly the same as f except perhaps for the values it assigns to X" (implying that $f' \supseteq f$).[38]

(65)   *DRL formalization of $\ominus$ satisfaction conditions:*
$$\langle w, f \rangle \Vdash_{m,o} (K_i \ominus K_j) \leftrightarrow \exists g [g_{\langle X_{K_i} \rangle} f \wedge \langle w, g \rangle \vDash K_i] \wedge$$
$$\forall w', g' [g'_{\langle X_{K_i} \rangle} f \wedge w' \in \mathbf{max}_{o(w)} (m(w) \cup \{ w'' \mid \langle w'', g' \rangle \vDash (\neg K_i) \})$$
$$\rightarrow \exists h (h_{\langle X_{K_j} \rangle} g' \wedge \langle w', h \rangle \vDash K_j)]$$

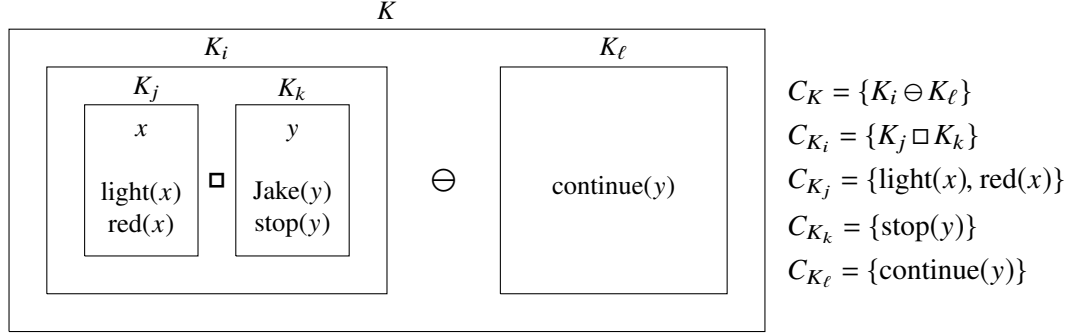A world w and assignment f satisfy the condition $K_i \ominus_m K_j$ iff:

- There is some assignment g that satisfies K_i;

- If the worlds w' — those in the modal base $m(w)$ best conforming to some ordering source $o(w)$ — verify the **negation of K_i**, then there will be an assignment h that **verifies K_j** in w'.

A DRT representation for one of the now-familiar red light examples is spelled out in (66). Alongside this representation, we list the set of satisfaction conditions introduced by the sentence.

---

37 The deployment of a function **max** (given sometimes by other authors as **best**) significantly compresses the formalism given in Roberts (1989: 714, which follows Kratzer 1981). Given that an ordering source o is modelled as a set of propositions which can induce an ordering $\leq_o$ 'relative to o, at least as good as' over a given set of worlds. Consequently, $\mathbf{max}_{o(w)} (m(w))$ returns $\{ w' \in m(w) \mid \forall u \in m(w). w' \leq_{o(w)} u \}$.

38 In Roberts' formalism, $f_{\langle X \rangle} g \leftrightarrow \forall y (\neg (y \in X) \rightarrow f(y) = g(y))$ (1989: 714).

(66)   *A formal DRT analysis of an* otherwise *sentence:*
If the light is red, Jake will stop. *Otherwise* he'll continue straight.

$$K$$

K_i		K_ℓ

K_j x light(x) red(x) $\square$ K_k y Jake(y) stop(y) $\ominus$ continue(y)

$C_K = \{K_i \ominus K_\ell\}$
$C_{K_i} = \{K_j \square K_k\}$
$C_{K_j} = \{\text{light}(x), \text{red}(x)\}$
$C_{K_k} = \{\text{stop}(y)\}$
$C_{K_\ell} = \{\text{continue}(y)\}$

With the satisfaction conditions we introduced above, we can construct the truth-conditions that will verify the matrix DRS K:

(67)   *Satisfaction conditions for (66):*

     a.   The matrix condition:
A world-assignment pair $\langle w, f \rangle$ verifies the entire DRS K iff it satisfies the (complex) condition $K_i \ominus K_\ell$:

$$\langle w, f \rangle \Vdash_{m,o} (K_i \ominus K_\ell) \leftrightarrow \exists g [g_{\langle x_{K_i} \rangle} f \wedge \langle w, g \rangle \vDash K_i] \wedge$$

$$\forall w', g' [g'_{\langle x_{K_i} \rangle} f \wedge w' \in \mathbf{max}_{o_{tel}(w)}(m_{circ}(w) \cup \{w'' \mid \langle w'', g' \rangle \vDash (\neg K_i)\}]$$
$$\rightarrow \exists h (h_{\langle x_{K_\ell} \rangle} g' \wedge \langle w', h \rangle \vDash K_\ell)$$

That is: $\langle w, f \rangle \vDash K$ iff:

       •There is some assignment g that verifies K_i and
       •If those worlds w' in a circumstantial modal base $m_{circ}(w)$ that best conform to a teleological ordering source (likely one that contains Jake's desires to both get where he needs to be and to be an upstanding road user) **verify the negation of K_i**, then there'll be some assignment h that verifies K_ℓ

     b.   The antecedent to *otherwise*:
The antecedent K_i is verified iff some world-assignment pair $\langle w, f \rangle$ satisfies the (complex) condition $K_j \square K_k$:

$$\langle w, f \rangle \Vdash_{m,o} (K_j \square K_k) \leftrightarrow \forall w', g [g_{\langle x_{K_j} \rangle} f \wedge w' \in \mathbf{max}_{o_{tel}(w)}(m_{circ}(w) \cup \{\langle w'', g' \rangle \vDash K_j\})$$
$$\rightarrow \exists h (h_{\langle x_{K_k} \rangle} \wedge \langle w', h \rangle \vDash K_k)]$$

That is: $\langle w, f \rangle \vDash K_i$ iff for all w' in a circumstantial modal base $m_{circ}(w)$ that best conform to a teleological ordering source $o_{tel}(w)$ if w' verifies K_j there's some assignment h that verifies K_k.

c. Simplex conditions:
    The remaining three DRSs — K_j, K_k, K_ℓ all contain only atomic conditions. Each of these DRSs is verified iff there is some world-assignment pair $\langle w, f \rangle$ which satisfies all of their respective conditions.
    E.g.: $\langle w, f \rangle \vDash K_\ell \leftrightarrow \langle w, f \rangle \Vdash \text{continue}(y) \leftrightarrow f(y) \in [\![\text{continue}]\!]^w$

Notably, the y is an unbound variable — however, because K_ℓ is modally subordinate to K_i, it has access to the local domain of this DRS ($X_{K_\ell} \supseteq A_{K_i}$). As a result, the assignment function (h in (67-a) above) is able to assign to y an individual introduced earlier in the discourse (namely 'Jake'). We see, then, that our analysis is able to correctly model an *otherwise* statement, making crucial use of the notion of modal subordination and the tools of dynamic semantics to provide the truth conditions for the sentence.

References

Barker, Stephen J. 1993. Conditional excluded middle, conditional assertion, and 'Only If'. *Analysis* 53(4). 254–61.

Biezma, María & Kyle Rawlins. 2016. *Or what?*: Challenging the speaker. *Proceedings of North-East Linguistic Society (NELS) 46* 1. 93–106.

Cantwell, John. 2008. Changing the modal context. *Theoria* 74(4). 331–351. https://doi.org/10.1111/j.1755-2567.2008.00028.x.

Corblin, Francis. 1986. Quantification et anaphore discursive: la réference aux complementaires. *Langages* (123). 51–74.

Corblin, Francis. 1994. A semantic-pragmatic interface for modal subordination. In *Autumn 1994 meeting of the linguistics association of great britain (lagb)*, Middlesex University London: [Unpublished paper].

Corblin, Francis. 2002. *Répresentation du discours et sémantique formelle: Introduction et applications au français*. Paris: Presses Universitatires de France.

Culicover, Peter W & Ray Jackendoff. 1997. Semantic Subordination despite Syntactic Coordination. *Linguistic Inquiry* 28(2). 195–217.

De Vos, Mark. 2007. Pseudocoordination is not subordination. *Linguistics in the NetherlandsLinguistics in the Netherlands. AVT Publications* 21. 181–192. https://doi.org/10.1075/avt.21.20vos.

Evans, Gareth. 1977. Pronouns, quantifiers, and relative clauses: appendix. *Canadian Journal of Philosophy* 7(4). 777–797.

Evans, Gareth. 1980. Pronouns. *Linguistic Inquiry* 11. 337–362.

von Fintel, Kai. 1994. *Restrictions on quantifier domains* . Amherst: dissertation.

von Fintel, Kai. 1997. Bare plurals, bare conditionals, and only. *Journal of Semantics* 14(1). 1–56. https://doi.org/10.1093/jos/14.1.1.

von Fintel, Kai. 2011. Conditionals. In Klaus von Heusinger, Claudia Maienborn & Paul Portner (eds.), *Semantics: An international handbook of meaning*, vol. 2, chap. 59, 1515–1538. Berlin; Boston: De Gruyter Mouton. https://doi.org/10.1515/9783110255072.1515.

von Fintel, Kai & Anthony S. Gillies. 2010. *Must . . . stay . . . strong!*, vol. 18 4. https://doi.org/10.1007/s11050-010-9058-2.

von Fintel, Kai & Sabine Iatridou. 2008. How to say ought in foreign: The composition of weak necessity modals. In Jacqueline Guéron & Jacqueline Lecarme (eds.), *Time and modality* Studies in Natural Language and Linguistic Theory, 115–141. New York: Springer.

Flament-Boistrancourt, Danièle. 2011. Sinon vs. Autrement : si proches, si loin... *Langages* 4. 129–146.

Geurts, Bart. 1997. Moxey & Sanford's *Communicating Quantities* (1993) [Review]. *Journal of Semantics* 14(1). 87–94. https://doi.org/10.1177/1750698009355679.

Groenendijk, Jeroen & Martin Stokhof. 1984. *Studies on the semantics of questions and the pragmatics of answers*: University of Amsterdam dissertation.

Heim, Irene Roswitha. 1982. *The semantics of definite and indefinite noun phrases*. Amherst: dissertation.

Horn, Laurence. 1969. A presuppositional analysis of only and even. In *Proceedings of cls 5*, 98–107. Chicago: Chicago Linguistics Society.

Inkova-Manzotti, Olga. 2002. Les connecteurs accommodants : le cas de autrement. *Cahiers de linguistique française* 24. 109–141.

Kamp, Hans. 1979. Events, Instants and Temporal Reference. *Meaning and the Dynamics of Interpretation* 53–103. https://doi.org/10.1163/9789004252882_005.

Kamp, Hans. 1981. A theory of truth and semantic representation . In J Groenendijk, Th Janssen & M Stokhof (eds.), *Formal methods in the study of language, part i*, Amsterdam: Mathematsich Centrum.

Kamp, Hans. 2017. Events, Instants and Temporal Reference. *Meaning and the Dynamics of Interpretation* 10. 53–103. https://doi.org/10.1163/9789004252882_005.

Kibble, Rodger. 1997. Complement Anaphora and Dynamic Binding. *Semantics and Linguistic Theory* 7. 258. https://doi.org/10.3765/salt.v7i0.2783.

Klinedinst, Nathan & Daniel Rothschild. 2012. Connectives without truth tables. *Natural Language Semantics* 20(2). 137–175. https://doi.org/10.1007/s11050-011-9079-5.

Kratzer, Angelika. 1981. The Notional Category of Modality. In Hans-Jürgen Eikmeyer & Hannes Rieser (eds.), *Words, worlds, and contexts: New approaches in word semantics*, 38–74. Berlin; NY: Walter de Gruyter.

Kratzer, Angelika. 1986. Conditionals. In Anne M Farley, Peter Farlety & Karl Eric McCollough (eds.), *Parasession on pragmatics and grammatical theory, chicago linguistics society*, 115–135. Chicago: Chicago Linguistics Society.

Kratzer, Angelika. 2012. *Modals and Conditionals*. Oxford: OUP.

Kruijff-Korbayová, Ivana & Bonnie Lynn Webber. 2001. Information structure and the Interpretation of "otherwise". In Ivana Kruijff-Korbayová & Mark Steedman (eds.), *European summer school for language, logic and computation workshop on information structure, discourse structure and discourse semantics*, 67–83. University of Helsinki.

Lewis, David. 1975. Adverbs of Quantification. In Edward L Keenan (ed.), *Formal semantics of natural language.*, 178–88. Cambrdige University Press.

Mann, W C & Sandra A Thompson. 1988. Rhetorical Structure Theory: Toward a functional theory of text organisation. *Text* 8(3). 243–81.

McCawley, James D. 1974. If and Only If. *Linguistic Inquiry1* 5(4). 632–635.

Montague, Richard. 1973. The proper treatment of quantification in ordinary English. In K. J. J. Hintikka, J. M. E. Moravcsik & P. Suppes (eds.), *Approaches to natural language (synthese library 49)*, 221—242.

Moxey, Linda M & Anthony J Sanford. 1986. Quantifiers and focus. *Journal of semantics* 5. 189–206.

Nouwen, Rick W F. 2003. Plural pronominal anaphora in context : dynamic aspects of quantification https://dspace.library.uu.nl/handle/1874/630.

Partee, Barbara Hall. 1984. Nominal and temporal anaphora. *Linguistics & Philosophy* 7. 243–281.

Portner, Paul. 2007. Imperatives and modals. *Natural Language Semantics* 15(4). 351–383. https://doi.org/10.1007/s11050-007-9022-y.

Roberts, Craige. 1989. Modal Subordination and Pronominal Anaphora in Discourse. *Linguistics & Philosophy* 12. 683–721.

Roberts, Craige. 1995. Domain restriction in Dynamic Semantics. In Emmon Bach, Eloise Jelinek, Angelika Kratzer & Barbara Hall Partee (eds.), *Quantification in natural languages*, vol. II, Kluwer: Dordrecht.

Roberts, Craige. 1996. Anaphora in intensional contexts. In Shalom Lappin (ed.), *The handbook of contemporary semantic theory*, Blackwell.

Roberts, Craige. 2004. Context in Dynamic Interpretation. In Laurence Horn & Gregory Ward (eds.), *The handbook of pragmatics*, 197–220. Walden, WA: Blackwell.

Roberts, Craige. 2012. Information Structure in Discourse: Towards an Integrated Formal Theory of Pragmatics. *Semantics & Pragmatics* 5.

Rooth, Mats. 1985. *Association with focus*: University of Massachussetts, Amherst Phd dissertation.

Rubinstein, Aynat. 2012. *Roots of Modality*. Amherst: dissertation.

Sanford, Anthony J, Linda M Moxey & Kevin Paterson. 1994. Psychological Studies of Quantifiers. *Journal of Semantics* 11. 153–170. https://doi.org/10.1093/jos/11.3.153.

Stalnaker, Robert C. 1979. Assertion. In Peter Cole (ed.), *Syntax and semantics*, vol. 9, New York: Academic Press.

Steedman, Mark. 2000. Information Structure and the Syntax-Phonology Interface. *Linguistic Inquiry* 31(4). 649–85.

Webber, Bonnie Lynn, Matthew Stone, Aravind Joshi & Alistair Knott. 2001. Anaphora and Discourse Semantics. Tech. rep.

Yalcin, Seth. 2012. A Counterexample to Modus Tollens. *Journal of Philosophical Logic* 41(6). 1001–1024. https://doi.org/10.1007/s10992-012-9228-4.

Yalcin, Seth. 2016. *Modalities of Normality*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof.

Yuasa, Etsuyo & Jerry M Sadock. 2002. Pseudo-Subordination: A Mismatch between Syntax and Semantics. *Journal of Linguistics* 38(1). 87–111.