Updates & discourse anaphora: a dynamic approach to *otherwise*[*]

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1.   Introduction

Straddling the boundary between semantics and pragmatics, dynamic approaches to meaning seek to understand how the 'flow of information' and changes in interlocutors' knowledge states in a discourse affect interpretation. Notable among these approaches are those of Kamp (1981), Heim (1982) and Roberts (1989, 1995, 2004) *i.a.*

The work presented here seeks to apply insights drawn from the dynamic semantics literature to the English adverbial *otherwise*: a particle that has been described as a discourse 'connective' or 'anaphor,' given its apparent interpretive reliance on foregoing elements of discourse (e.g. Webber et al. 2001, Kruijff-Korbayová and Webber 2001). A satisfactory approach to *otherwise*, then, requires a consideration of the structure and 'flow' of information in a given discourse context. Consider the sentence pair in (1), from Webber et al. (2001, 7), which will be a main focus of this paper:[1]

(1)   a.   If the light is red, stop. *Otherwise* go straight on.
                    ≈ if the light is <u>not</u> red...
        b.   If the light is red, stop. *Otherwise* you'll get a ticket.
                    ≈ if the light is red and you <u>don't</u> stop...

For each example, we provide a paraphrase of its intended meaning. Intuitively, *otherwise* has the semantics of a conditional here: *otherwise* targets a set of worlds in which some anaphoric proposition does <u>not</u> hold. A tentative denotation is provided in (2) below.

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[1]For the purposes of this current paper, we restrict our attention to these "interclausal" adverbial uses. As we will discuss in §4, however, we anticipate that the account provided here could be expanded to account for other uses as well.

(2) A first attempt at defining *otherwise* (to be revised)

$[\![otherwise]\!] = \lambda p_{\langle s,t \rangle} \lambda q_{\langle s,t \rangle} \lambda w_s. \neg p(w) \rightarrow q(w)$

Given two propositions p, q and a world s, *otherwise* states that, if it is not the case that p holds in w, then q will hold in w.

As example (1) makes clear, the question of *how* to determine the nature of the antecedent p is quite subtle. While the syntactic environment of *otherwise* is identical in both (1a) and (1b), it is clear that the understood antecedent proposition in each case is different. How, then, do speakers retrieve an antecedent to *otherwise*? In order to answer this, we take a view that emphasises the *flow of information* in a discourse (see also Roberts 1996 *et seq.*)

In a nutshell, we develop an analysis of *otherwise* which draws on previous dynamic semantic analyses of conditionals, including Biezma and Rawlins (2016) on *conditional or*. We'll argue that *otherwise* contributes a discourse move whose content is to predicate a subsequent proposition of the *complement* set of worlds contributed by a prior proposition. Unlike other conditionals, however, the content of the antecedent is not contributed strictly by the syntax, but requires reference to the QuD and the current Information Structure (IS). 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. We conclude by briefly discussing an expansion of this work to nonclausal uses of *otherwise.*

2. Analysis

We draw on tools from the dynamic semantics and information structural literatures to model *otherwise*'s semantic contribution to a sentence. Section 2.1 introduces Discourse Representation Theory, and in particular the notion of "modal subordination." Section 2.2 shows how information structural notions (notably, the *Question under Discussion*) can be recruited to provide a refined semantics for *otherwise* as a discourse anaphor.

2.1 Discourse representation & modal subordination

The difference between the two interpretations in (1) can be captured using a modal subordination analysis, following Roberts (1989):

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

This semantic notion of "subordination" allows us to identify the relationship between the linguistic signal and its likely interpretation. The (potential) independence of the semantic notion of subordination from its syntactic counterpart is shown in Figures 1–2, adapting the Discourse Representation Structures (DRS) of Kamp (1981) and Roberts (1989). Each box (DRS) represents a proposition (a set of worlds), and their arrangement represents the scopal and modal relationships that exist between DRSs. Here, we introduce the operator ∘ to represent the contribution of *otherwise*.

Figures 1 and 2 present an analysis of (1a) and (1b), respectively. We see that these two examples differ in terms of the material that is accommodated.[2] The prejacent to *otherwise* (α) is relativised to a different set of propositions (β) in each case. In (1a), the DRS representing the prejacent to *otherwise* is *modally subordinate* to the entire conditional statement represented in the left box in Figure 1. In (1b), the DRS representing the antecedent to *otherwise* is *modally subordinate* to the antecedent of the *if*-clause.
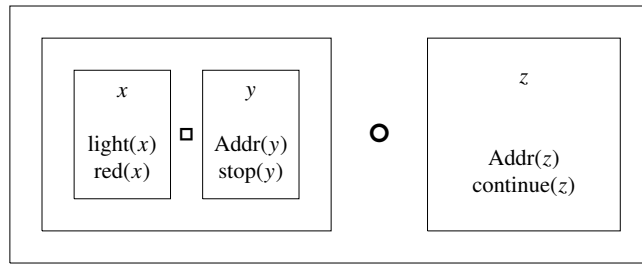
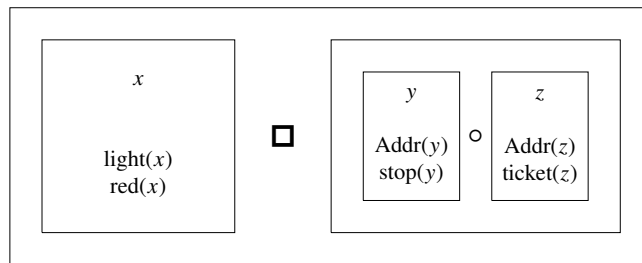Figure 1: An analysis of example (1a)

Figure 2: An analysis of example (1b)

Similarly, in each sentence of (4), *otherwise* receives a distinct interpretation. The DRSs in Figure 3 illustrate how modal operators rely on the accommodation of foregoing material that is made available in preceding discourse. In the figure on the left, the consequent clause is relativised to worlds where students attend the lecture. In the right figure, it is relativised to worlds in which students are obliged to attend the lecture.

(4)   Students must attend the lecture, *otherwise*...

      a. $\approx$ If $\neg$ (they ATTEND)...   ...they'll fail the class.

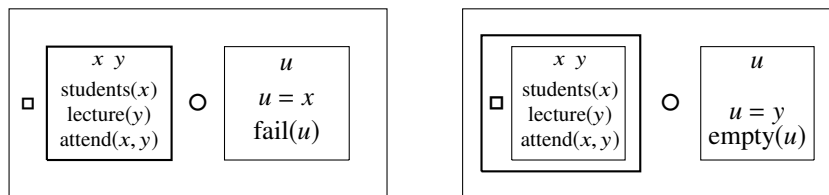   b. $\approx$ If $\neg\Box$ (they ATTEND)...   ...noone would turn up.

Figure 3: The accommodation of different antecedents in (4)

[2]I.e. where K_j is a given proposition, a condition $K_i \circ K_j$ entails that K_j is "modally subordinate" to K_i.

2.2 Finding the antecedent

The examples above demonstrate the crucial role of the **consequent clause** for reasoning about the set of worlds under consideration in the evaluation of an *otherwise*-sentence. We propose that the set of worlds, the complement set of which *otherwise* operates on, is calculated pragmatically from the prior discourse and the nature of the consequent clause.[3]

By deploying the information structure formalism proposed in Roberts (1998), we can conceptualise 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. Specifically, in a given discourse $\mathcal{D}$, IS can be understood as a tuple $\langle \mathfrak{M}, Q, A, \prec, Acc, cg, \text{QuD} \rangle$.[4] Several assumptions in Roberts will play a crucial role in our analysis:

(5)   a.   The **common ground** is a function from a stage in the discourse to a set of propositions ($cg : \mathfrak{M} \to \wp(\mathcal{W})$), such that $cg(m)$ represents the set of things in the common ground 'immediately before' the utterance of m;

   b.   The common ground is a superset of prior accepted assertions;[5]

   c.   The **QuD** consists 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 context.)

This approach provides 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 additionally propose that *otherwise* represents a discourse "setup" move with the effect of adding to the QUD ($m \in Q \subset \mathfrak{M}$). This analysis is spelled out for (6) below.

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

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

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

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

$$\lambda p_{\langle s,t\rangle}.\text{what if we are in some } w \in \textbf{COMPL}(p)?$$

m_k The consequent clause encodes the prejacent to *otherwise*. It is to be interpreted as proffering an (partial) answer to the current question under discussion (QuD(m_k)) by making a (modalised) assertion that the addressee won't grow in the **complement** of a pre-established context set (viz. the 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 have already seen, the process of establishing of a context set for a given *otherwise* sentence is underdetermined by the syntax of the sentence. We dub this the "RED LIGHT PUZZLE", repeated in (7). Recall that the syntactic antecedents of the *red light* sentences are identical (hence $m_i, m_{i'}, m_j$ represent the same operation in each sentence), but they appear to constrain the interpretation of *otherwise* in markedly different ways.

(7)   **THE RED LIGHT PUZZLE**

     a.   [*If the light is red,*]$_{m_i}$[*stop;*]$_{m_{i'}}$ *otherwise*$_{m_j}$ [*keep going!*]$_{m_k}$
     b.   [*If the light is red,*]$_{m_i}$[*stop;*]$_{m_{i'}}$ *otherwise*$_{m_j}$ [*you'll get a ticket!*]$_{m_k}$

An IS-based analysis for these sentences is spelled out below:

m_i The *if*-antecedent 'temporarily constrains the context set' (Roberts 1989, 687). It adds a "question" to the QUD stack of 'what if we are in $\{w' \mid \text{RED.LIGHT} \in w'\}$'?

$m_{i'}$ Imperative *stop* represents an "answer" to QuD(m_i). Similarly to the antecedent in (6), we model it as a modalised proposition (again with some conversational background f)[6] which further restricts the domain established by m_i.

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

m_j *otherwise* represents an instruction to consider the **COMPLEMENT of some set of worlds established elsewhere in the discourse**.

     Given the salience of w' and w'', which have been added to the *cg* in $m_i, m_{i'}$ respectively, **both are possible candidates to form the set that *otherwise* builds on**.

     Otherwise marks the addition of some question to the QUD stack of the form:

$$\lambda p_{\langle s,t\rangle}.\text{what if we are in some } w \in \textbf{COMPL}(p)?$$

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[6]See Portner (2007) a.o. for a modal treatment of imperative sentences.

m_k **The JEOPARDY! effect**

The consequent clause is understood as proffering **a (possible) answer** to the question/setup move that is triggered by *otherwise.* (Which we model as 'saturating the propositional variable' $p_{\langle s,t\rangle}$). This interpretive convention requires the Addressee to infer *which* discourse move *otherwise* is anaphoric upon (*i.e.* its antecedent.)

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

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

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 subpartition (within the set of "red light worlds") evoked in $m_{i'}$ saturates the propositional variable.

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

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 the sentence is uttered in.[7]

2.3   Constraining the pool of antecedents

While selection of an antecedent isn't chosen by the syntax deterministically, it is – nonetheless – not unconstrained. Consider for example (8), which is generally judged as infelicitous with the intended reading of "If the light is red, stop. If it isn't red, it will be green."[8]

(8)   [#]If the light is red, stop; otherwise it'll be green.

This is crucially predicted by the modal subordination account described in §2.1. The notion of an "accessible domain" — formalised in Roberts (1989) — will contain precisely those DRSs (*sc.* propositions) which can be felicitously accommodated as an antecedent for *otherwise* (here the consequent clause or the *entire* conditional.) This phenomenon is shown additionally in (9), 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 *otherwise* in this context.

(9)   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.

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[7]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.

[8]Speakers consulted frequently cited a reading where failing to stop at a red light would cause it to change colour.

3. Predictions: felicity of *otherwise* and possibility modals

It follows from our analysis that *otherwise* will be infelicitous in discourses in which no worlds have been eliminated. In this section we show how this prediction is borne out. We additionally discuss cases that may initially appear to problematic for this prediction, but upon further reflection actually provide additional support to our analysis.

Consider first the contrast in (10):

(10)   I must/#can go to school, *otherwise* I'll get in trouble.

This contrast emerges because the necessity modal *must* eliminates a set of worlds from consideration (*viz.* those in which I don't go to school); it is thus able to make a claim about those worlds (namely, all of them, I get into trouble). In contrast, the circumstantial possibility modal *can* fails to exclude any worlds from consideration, instead simply asserting the existence of a world in which I don't go to school. As such *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 (11), which speakers judge as acceptable:

(11)   I can go to school, *otherwise* I wouldn't be able to get an education.

Here, crucially, *otherwise* is anaphoric on the entire modal claim: the resulting assertion is that in 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, those in which I <u>can't</u> go to school). We correctly predict that the use of *otherwise* is allowed in such sentences.

This constraint has additional consequences on the interpretation of *otherwise*. We consider next two such consequences.

3.1   Unambiguous scope

A sentence like *Sam may not be a doctor* is ambiguous between circumstantial and epistemic readings. Notwithstanding this observation, the contrast between (12) and (13) further demonstrate 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 based on the context and its antecedent. To illustrate this, consider the two contexts below, designed to support the circumstantial and epistemic readings, respectively, in the context of an *otherwise* statement:

(12)   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 became a doctor...   ...she might kill someone

(13) 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 $\approx$ If she isn't not a doctor   [#]...she could be a nurse practitioner.

A crucial difference between the circumstantial (12) and epistemic (13) readings of the antecedent is the scope relation between the modal and negative operator. Just like in (10) 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.

3.2   Epistemic strengthening

A second, related result concerns so-called 'weak necessity' readings of possibility modals (Rubinstein 2012, von Fintel and 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 are provided below from von Fintel and Iatridou (2008, 117).

(14)   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*

(15)   a.   You *ought* to wash your hands – in fact, you *must*.

          b.   [?]You *must* wash your hands – in fact, you *ought* to.

Example (16b) shows that the possibility modal *might* can likewise receive a strengthened interpretation in the context of *otherwise*:

(16)   a.   She must be sick, otherwise she'd be here.

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

In such a case, as we have above, a pure possibility reading is impossible because no worlds are excluded from consideration and hence the necessary conditions for *otherwise* sentence are not met. This problem is repaired here by strengthening the meaning of *might*, so that it now allows for some excluded worlds. While the intended interpretation of (16b) is weaker than that of its counterpart in (16a), (16b) can still be understood as universally quantifying over a set of worlds (see Rubinstein 2012). This sentence might be paraphrased as: "in all the worlds that I can think of right now, she is sick; I can't think of another reasonable reason that she wouldn't be here."

4. Conclusion & further work

In this paper, we have proposed an analysis of *otherwise* as a discourse-sensitive conditional: *otherwise* adds to the common ground a Question under Discussion of the form: *what if the antecedent doesn't hold?*, where the nature of the antecedent must be computed from the preceding discourse context. We showed that this pragmatic account is able to naturally explain cases of ambiguity in the choice of antecedent, as well as how it is constrained. In particular, the notion of modal subordination from Roberts 1989 *et seq* played a crucial role in this regard. We claim that the syntax on its own cannot on its own furnish the right antecedent for *otherwise* in all the cases we considered.

Throughout, we focused on clausal cases, as in (1). However, other, "intrasentential" uses of *otherwise* are also available:

(17) 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, translated)
      c. Every person selling "The Big Issue" might *otherwise* be asking for spare change.   (Webber et al. 2001)

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 also Webber et al. 2001). We tentatively propose a generalized semantics for *otherwise* as in (18).

(18) A generalized semantics for *otherwise*
      $[\![\text{otherwise}]\!] = \lambda p_{\langle\sigma,\tau\rangle}\, \lambda q_{\langle\sigma,\tau\rangle}\, \lambda u_\sigma\, .\, \neg p(u) \rightarrow q(u)$
      Discourse object q holds of u only if we exclude p from consideration.

We additionally propose that this generalized entry — and the pragmatic process of choosing an antecedent on a whole — might be related to the notion of **Complement Anaphora**, famously available with quantifiers such as *few, less than half, hardly any*:

(19) Few congressmen admire Kennedy.   (Nouwen 2003)

      a. *They* are (all) very junior. $A \cap B$
      b. *They* think he's incompetent. $A \setminus B$

Parallel to (19), *otherwise* picks out a complement set of <u>worlds</u>. Adopting an E-type anaphora analysis, discourse referents could be made salient for reference in subordinate discourse structures (DRSs). This could explain cases such as (17c) above. Finally, we note that similar effects in the temporal domain, a fact that may help explain examples like (17b).

(20) Senators *rarely* vote their conscience. They do what the party tells them to.

We leave a closer investigation of these generalizations to future work.

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