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Conditionals and Unconditionals in Universal Grammar and Situation Semantics

DIETMAR ZAEFFERER

> Although conditional sentences are important in all languages, and although their 'logic' has been thoroughly, if inconclusively, investigated by philosophers, our knowledge and understanding of them in the languages of the world is very poor. (Palmer 1986, 188)

Introduction

I don't think the situation in the theory of conditionals is as bad as characterized by Palmer in the above quotation. In a companion paper to the present one (Zaefferer 1990) I have tried to show that cross-linguistic comparison of the constructions that encode conditional functions, together with the assumption that other functions encoded by the same or similar constructions tend to be structurally related, gives good support for those logical analyses of the natural language conditionals that treat them as encoding some kind of restricted modal function. In doing this I have argued that both the research in typology and linguistic universals on the one hand, and formal semantics and language-oriented logics on the other, will profit if they start communicating with one another. Whereas the other paper emphasizes the typological data, while presenting the theory only in rough outline, the present paper will just summarize the typological findings and then spell out the core of the theory.[1] But it begins with some terminological clarifications and methodological remarks that may prove helpful.

[1]In developing it, I have profited from discussions with and comments from Godehard Link, Hans Rott, Barbara Partee, John Perry, and an anonymous referee.

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Robin Cooper, Kuniaki Mukai, and John Perry, eds.

Terminological Clarifications

First: What do I understand by a conditional? A conditional or more explicitly a *conditional form* is a grammatical structure or construction that encodes a conditional function as its primary purpose. And what is a conditional function? A *conditional function* is something that conditionalizes any proposition q, i.e., that converts q into the proposition that something, normally the holding of some given proposition p, is in a way sufficient for the holding of q.

I will call the proposition that is to be conditionalized the *consequent*, the conditionalizing proposition the *antecedent*, and the result of the conditionalization the conditionalized proposition or *c-proposition*, reserving these Latin terms for the semantic level. On the syntactic level, I will use the Greek terms *apodosis* and *protasis*: 'apodosis' for the unmodified (but sometimes marked) superordinate linguistic form (main clause without subordinate clause), 'protasis' for the modifying subordinate form (clause), and *c-construction* for the combination of the two (main clause together with subordinate clause).

Please note that, taken this way, most of the time the apodosis encodes just the consequent, but the protasis does not only encode the antecedent, but also the conditional relation it stands in with respect to the consequent, in other words it normally encodes the whole conditional function that takes the consequent as an argument. So normally the protasis equals the conditional form or, shorter, the conditional. The division of labor among the three linguistic forms varies however from language to language and from construction to construction. Note further that in addition both protasis and apodosis can explicitly encode quantification over various instantiations of the consequent with respect to various instantiations of the antecedent.

Second: What is an unconditional? An unconditional or more explicitly an *unconditional form* is a grammatical structure or construction that encodes an unconditional function as its primary purpose. And what is an unconditional function? An *unconditional function* is something that deconditionalizes any proposition q, i.e., that converts q into the proposition that the holding of any one of a given set of propositions P is in a way sufficient for the holding of q, where P exhausts the set of options that are taken into consideration at the present state of the discourse, in other words the proposition that the holding of q is unconditional on the question which one of the members of P happens to be true, where it is implicated, if not tautological, that at least one of them in fact is true.

Sentences (1) and (2) are examples of an English conditional and unconditional construction, respectively.

(1) If a kangaroo loses its tail, it topples over.

(2) Whether you like it or not, I won't permit smoking here.

Third: What do I understand by universal grammar? By a universal grammar in the wide sense I want to understand the union of the descriptions of all natural human languages, and by a universal grammar in the narrow sense its intersection, i.e., its greatest common denominator. Of course, at the present state of the art in descriptive linguistics, universal grammar in the wide sense is far from being complete even for the contemporary languages, but that does not mean that universal grammar in the narrow sense cannot be approaching a state of relative stability at least in certain domains (although surprises are always possible).

Last: What do I understand by situation semantics? By situation semantics I understand a semantics with the following features:

(a) it is strongly intensional, i.e., it does not reduce intensions to parameterized extensions, but takes them as primitives;
(b) it takes partiality serious, i.e., it accounts for the fact that normally what we talk about is not a complete world, but some portion thereof;
(c) it takes indexicality serious, i.e., it accounts for the fact that natural languages owe their structure to the need for efficient, not for maximally explicit and safe, communication, and that they therefore tend to encode only what is left open by the utterance situation.

Methodological Remarks

The starting point of my investigations was the intuition that the notion of a background, which plays a key role in Barwise's 1986 paper on conditionals, needs more structuring if it is to help in an account of both conditionals and unconditionals. This intuition stemmed from the observation that unconditionals tend to be encoded by a certain class of interrogative sentences, and that sentences of this kind share the property of preparing the grounds for the subsequent discourse in a certain way.

Before I specify what I mean by that, I would like to leave for the following section the domain of abstract considerations and to summarize the cross-linguistic overview of the structural domain of the conditional forms with their relatives and of the conceptual field of the conditional functions with their relatives that I have presented in Zaefferer (1990).

Why? Because it is a well-known universal tendency that polysemy is much more widespread than homonymy, i.e., identical forms tend to encode systematically related concepts rather than being the result of accidental historical convergence of semantically unrelated signs. And this rule can be generalized:

(P1) Identical or related forms tend to encode related concepts,

where relatedness of form is defined as phonological and structural similarity, and this in turn as number of common features, and where relatedness

of concepts is defined as either similarity again (cf. metaphors) or as contiguity, especially in the subconcept-superconcept hierarchy (cf. metonymy).

Conceptual relatedness need not be universal,[2] but there must be a core domain of universally related concepts in the conceptual fields of all linguistic communities, else mutual understanding and translation would be much harder than it is. Which conceptual fields are in this universal domain, and what is their universal structure? If our principle (P1) is correct, then cross-linguistically recurring patterns of relatedness of forms indicate relatedness of the encoded concepts and make the latter good candidates for universally related concepts. Let me state this as principle (P2):

(P2) Cross-linguistically recurring patterns of formal and conceptual relatedness indicate universality of the conceptual relations.

Concepts like the ones encoded by logical constants, and the relations among them are of course top candidates for universal conceptual structures (van Benthem 1990), but it is also important to see how logical concepts link up with non-logical ones, and here recurring relatedness patterns in both form and function offer an important window on the common denominator of human conceptual systems.

Therefore in order to understand fully what conditionalization in natural languages is, it is helpful, I submit, to look at it in the context of universally related concepts. So the working hypothesis for the following overview is a specialization of principle (P1):

(P1c) Relatives of conditional forms tend to encode concepts that are relatives of conditional functions.

1 Conditional and Related Forms and Functions in Universal Grammar

1.1 Conditional Forms in English

Conditional functions are proposition modifiers, consequently, conditional forms are sentence adverbials.[3] Therefore, like other sentence adverbials, they can be of one of the following types:

(a) Lexical adverbials, i.e., adverbs;

[2]To cite one example: In Western Europe, the concepts 'heart' and 'positive emotion' are related concepts, in Japan, the same holds for 'belly' and 'positive emotion'.

[3]The existence of coordinated conditional clauses as in 'Pay him well and he will do anything for you' and 'You close the door behind you and you feel arrested' (describing a room) seems to be at variance with this statement, but it can be argued that the combination of an imperative-first conjunct with an indicative-second conjunct in fact turns the former into an adverbial, and that in the other case it is not the primary function of the first conjunct to conditionalize the second one.

(b) Phrasal adverbials, i.e., prepositional phrases and other sub-clausal constructions; or

(c) Sentential adverbials, i.e., adverbial clauses.

Lexical conditionals in English are restricted to a few words. Let's examine three examples:

(1) *Then* we are really in trouble.

(2) Mathematical problems are *sometimes* very hard to solve.

(3) Swimming is not *always* easy.

To see what makes *then*, *sometimes*, and *always* lexical conditionals, consider the following three sentences:

(4) *Under these circumstances* we are really in trouble.

(5) Mathematical problems are *in some cases* very hard to solve.

(6) Swimming is not *under all conditions* easy.

And if these examples of phrasal conditionals are not convincing either, consider the following clausal ones:

(7) *If all our money is lost* we are really in trouble.

(8) Mathematical problems are very hard to solve *when they are posed by a malevolent expert.*

(9) Swimming is not easy *if you haven't practiced for a long while.*

Now it is easy to see that not only (7)–(9), but also (1)–(6) involve genuine conditionals. First imagine a context like the one created by (10):

(10) I'm afraid all our money is lost.

Clearly, in such a context, (1), (4) and (7) are local paraphrases of each other. Furthermore, putting special contexts aside, it is obvious that (2) and (5) follow from (8), as well as (3) and (6) follow from (9), and it possible to cook up clausal *if*-paraphrases also for examples (2) and (3).

Now let's have a closer look at the *lexical conditionals.* All of them are structure words, i.e., they encode structural, and not lexical meaning. *Then* is an anaphoric pro-form that refers to a previously mentioned proposition and puts it into the role of an antecedent, i.e., a form that encodes a condition. Its meaning can therefore be analyzed into two parts: the anaphorical pointer at some given proposition, and the two-place conditional function, i.e., the function that takes this proposition and converts it into a one-place conditional function.

Sometimes and *always*, on the other hand, do not refer at all, they are adverbs of quantification that in our examples quantify not over times, but over conditions. Therefore their meaning can be analyzed as consisting of two different parts, a quantifier and a sortal indication of what is quantified over, namely conditions ("times" or "ways").

All examples for *phrasal conditionals* given above were prepositional phrases with the same anaphoric and quantificational properties as just discussed in the context of the lexical conditionals, except that they are more specific than these since they distinguish between cases, conditions, and circumstances. But like the lexical conditionals, they do not spell out the conditions they are alluding at, and this does not come as a surprise, since conditions are propositions in a special role, and propositions are normally encoded by clauses, so the normal, full and independent expression of a condition is a clausal conditional.

Clausal conditionals are exemplified in (7)–(9) above. In (7) the protasis is 'If all our money is lost', expressing the conditional function with the antecedent that all our money is lost. The apodosis is 'we are really in trouble', expressing the consequent proposition that we are really in trouble. (7) itself is the c-construction, and the c-proposition expressed by it is the proposition that the truth of the antecedent, namely that all our money is lost, is sufficient for or requires the truth of the consequent, i.e., that we are really in trouble. In other words whatever circumstances might make it true that all our money is lost also make it true that we are really in trouble. And similarly for (8) and (9).

We haven't looked yet at clausal counterparts for (2) and (3), the quantified examples, but they are easy to construct, cf. (11) and (12).

(11) Sometimes if you want to take a subway train it is already full.

(12) If something is very expensive, it is not always also very good.

The examples show that both quantifying protases and quantifying apodoses exist. The semantic effect is in both cases the same, since what is quantified over are conditions, i.e., circumstances that are sufficient for the truth of the antecedent, and the quantification scope is the consequent. Thus the c-proposition expressed by (11) is the proposition that in some cases the truth of the antecedent, namely that some person wants to take the subway train x , suffices also for the truth of the consequent, i.e., that x is already full. And the c-proposition expressed by (12) is the proposition that the truth of the antecedent, namely that some thing y is very expensive, does not in all cases suffice for the truth of the consequent, i.e., that y is very good.

So we have to distinguish between bare and quantifying c-constructions and accordingly between bare and quantifying c-propositions.

1.2 Conditional and Related Forms with their Functions Across Languages

So far we have looked only at markers for protasis clauses that happened to be particles or subordinating conjunctions like *if*, or *in case*, but it is well known that there are more means for marking clauses as protases, or

more generally as c-constructions, in the languages of the world (cf. Comrie 1986, Danielsen 1968), and also in English and German.

They can be arranged in the following four groups:

(a) Morphological conditional markers
  i. Conditional verbal mood affixes
  ii. Conditional clausal function affixes
(b) Lexical conditional markers, such as subordinating particles
(c) Phrasal conditional markers, such as prepositional phrases or modifications of some complementizer
(d) Structural conditional markers, such as marked constituent order

We next look at the relatives of the conditional forms, including the same forms with different readings, and at their functions. If (P1c) above is correct, this will amount to giving an overview of those concepts that are tendentially most closely related to the conditional function.

(a) Formal relatives of the morphological conditional markers with their functions
  i. Verb inflection: Other verbal moods, aspect, time reference
  ii. Clausal topic markers: Topicality
(b) Formal relatives of the lexical conditional markers:
  i. Interrogative subordinators: Interrogative sentence mood
  ii. Temporal subordinators: Time reference
  iii. Local subordinators: Spatial location
  iv. Causal subordinators: Causal connectedness
  v. Concessive subordinators: Marked (unusual) co-occurrence
(c) Formal relatives of the phrasal conditional markers
  Prepositional phrases: spatial, temporal, causal and concessive specification, restriction of the validity of a claim to certain aspects of its topic situation, as in (*):
  (*) In certain respects, this has been an extraordinary meeting.
(d) Formal relatives of the structural conditional markers
  Marked constituent order: sentence mood, especially interrogative and imperative

This is considerable evidence that the concepts of verbal and sentential mood, especially interrogativity and imperativity, aspect, topicality, temporal and spatial location, causal connection, and marked co-occurrence are relatives of the notion of conditionality. This is especially true with respect to temporal location, more precisely co-occurrence, which is a typical companion of conditionality. The relation to interrogativity is also quite obvious since both interrogative and conditional utterances raise issues, and the same holds for clausal topics.

1.3 Summary

Summing up the results of our attempt in Section 1 to place conditionals into the context of their conceptual relatives across languages, we can say that we have found good evidence for the following assumptions:

(a) Conditionalization is a modal concept, i.e., a conditionalized proposition is a modalized proposition. Hence conditionals are modal operators. Just as you can say 'possibly' and 'necessarily', you can say in a way 'conditionally', 'unconditionally', and 'p-conditionally.'

(b) To conditionalize a proposition is to localize it (in a metaphorical sense) in a hypothetical domain and thereby to relativize the validity of the consequent.

(c) The kind of modality expressed is according to the quantifier in the explicitly quantifying conditionals (just as their temporal and local relatives), and it is some kind of accompaniment with bare conditionals, whose precise nature cannot determined from the data and remains to be specified.

It is interesting to note that the research on conditionals in logically oriented formal semantics in the last twenty years came up with several accounts that can be interpreted as different attempts at spelling out one or the other specification of exactly this idea, although most of their authors did their in-depth-analyses without looking at languages other than their own.

2 A Situation Semantics for Conditionals and Unconditionals

2.1 The Inadequacy of Material Implication and Some Proposals for How to Overcome It

Several years ago, at the 1986 CLS meeting, Angelika Kratzer told the sad story of the decline of the Gricean account in the analysis of natural language conditionals (Kratzer 1986). The Gricean account tries to stick to material implication by explaining away its well-known problems with Grice's well-known implicatures, and Kratzer argues that this does not work. All her arguments have to do with quantification and modality and are therefore in line with our cross-linguistic evidence that conditionalization is a modal concept. It is interesting to note in passing that she does not mention a very simple way to show that modality is involved, an account of which can be found in Link (1979) and elsewhere. It goes as follows. From the assumption that the natural conditional construction encodes the material implication and that the 'it is not the case'-construction encodes weak negation, it follows that (1) and (2) below are paraphrases of each other (the corresponding formulae are logically equivalent). But they are not paraphrases. (1) follows from (2), but not vice versa.

(1) It is not the case that it thunders if it lightens.

(2) It lightens and it doesn't thunder.

What does follow from (1), and indeed seems a good paraphrase of it, is (3), and this shows that (1) contains a hidden generalizing modal element under the negation operator.

(3) It's possible that both it lightens and it doesn't thunder.

Therefore what at first glance looks like a good paraphrase for the conditional construction in the 'that'-clause of (1), namely (4), turns out to be an implicit way of saying what is more explicitly said by (5):

(4) Lightening doesn't occur without thundering.

(5) Lightening doesn't possibly occur without thundering.

Example (5) in turn invites paraphrases like (6) or (7), and there we are right at the heart of a modern formal account of conditionals.

(6) Any lightening situation comes with a situation where it thunders.

(7) Any case of lightening is accompanied by a case of thundering.

One important step in the right direction was Lewis's treatment (1975) of adverbs of quantification as quantifiers over cases. Then Angelika Kratzer (1978, 1981), drawing on Lewis's and other work, developed a unified theory of modality, that included not only a treatment of deontic and doxastic modal verbs, but also indicative and subjunctive conditionals. Lewis (1973) had treated the latter in a very similar fashion, introducing the notion of a variably strict conditional. Irene Heim (1982), working in parallel with Hans Kamp, embedded the conditionals into an incremental semantics, and Jon Barwise (1986) rethought the old story in terms of strong intensionality, i.e., without possible worlds but, like Kratzer, with the important notion of background as a relativization device.

Backgrounds can of course be compared with epistemic states, which are at the core of conditional logics like Gärdenfors's, but at least one important difference has to be born in mind: As Barwise has argued, I think convincingly, the speaker might not know all the relevant background conditions. However, if one rethinks belief change as incremental (or better step-by-step) specification of the described situation, theories of epistemic dynamics can be brought to bear in the development of situation semantics, and that is exactly what I am going to propose.

Gärdenfors's logic for conditionals is based on the Ramsey test, which says that a c-construction is an element of a given epistemic state K just in case its apodosis is an element of the epistemic state that is the result of revising K to contain the protasis. This is what the following formula says:

(R) $A > B \in K$ *iff* $B \in K_A$

Recently, Gärdenfors (1988, chap. 7) has come to doubt the role of the Ramsey test as a basic ingredient of conditionals, since in non-trivial cases,

it contradicts some monotonicity assumptions. But Hans Rott (1989) has argued that monotonicity is questionable anyway and that the incompatibility results should therefore not be turned against the Ramsey test. Since the Ramsey test-based conditional relation holds between any two sentences A and B that are already in K, which doesn't seem to be desirable, Rott proposes to replace it by a relation that is based on what he calls the strong Ramsey test. It requires not only the presence of B in the A-revision of K, but also its absence in the non-A-revision of K. This is formally expressed in (SR):

(SR) $A \gg B \in K$ *iff* $B \in K_A$ & $B \notin K_{\sim A}$

The strong Ramsey test shows clearly the modal or dispositional character of conditionals, for it relates 'if A, then B' with two mutually exclusive alternative revisions of K.

I think that the intention behind the strengthening of the Ramsey test is correct, but that it results in an overkill. Remember that according to the original Ramsey test both 'if A then B' and 'if B then A' are in K, once both 'A' and 'B' are in K. That certainly does not seem to be intuitively warranted. But now with the strong Ramsey test we exclude the possibility that both 'if A then B' and 'if not-A then B' are in K, which doesn't seem to be intuitively adequate either, especially since the conjunction of the latter two seems to be a good paraphrase for a special case of our unconditionals, namely 'whether A or not-A, B'.

So it looks like we may be better off if we give up epistemic state revisions altogether in favor of something else, which could be called situation specification updates. Here is how such an approach can be conceived.

2.2 Situation Specification Updates and an Update Semantics for Conditionals

The following picture of a typologically backed account of conditionals and related constructions integrates features from all the approaches mentioned in the last section. Its main innovation is a distinction between that characterization of the described situation that is actually accepted, and those characterizations of the same or some related situations that are only taken into consideration. This differentiation seems to be needed if one wants to account for both the similarities and the differences between conditionals and their relatives, especially unconditionals, but its introduction has been motivated in the first place by the desire to account for non-declarative sentences. Interrogatives for instance in their normal use don't contribute to the accepted description of the intended topic situation, but only to the stack of descriptions that are thematized.

I call this approach update semantics because progress in discourse is conceived of as constant updating at both the discourse level, i.e., the de-

velopment of the discourse situation(s), and the discourse content level, i.e., the characterization of the described situation(s). Every update takes place with respect to a background that has been created by the preceding discourse, if any, or else by the start-up assumptions.

The *factual discourse background* contains the actual discourse situation including its history, i.e., (at least) the situations that are made real by the preceding discourse, as subsituations, together with some characterization of it; the *actual discourse options* are those possible continuations of the actual discourse situation that are open to the participants. E.g., if Max utters to Mia first "It's getting dark." and then "What time is it?", then normally that creates first a factual discourse background containing a situation of the type Max asserting towards Mia that it is getting dark and a set of actual discourse options containing for Mia among others the option of commenting on that, and then a factual discourse background containing in addition a situation of the type Max asking Mia for the time and a set of actual discourse options containing for Mia among others the option of answering the question and the option of rejecting it.

Now before I go on to say something about the factual and the virtual content background, I have to answer three questions:

(a) What corresponds to a belief revision in update semantics?
(b) How does this notion of background relate to Barwise's notion of background?
(c) How do the answers to these two questions relate to the Austinian conception of a proposition?

The answer to the first question and to part of the last one is this: A proposition p is always about a situation s_p, which I will call the intended topic situation of p; and it says of this s_p that it is of a type t_p, which I will call the characterizing situation type of p, or simply the type of p. Formally, a proposition p is an ordered triple $\langle s_p, sup, t_p \rangle$, written $(s_p\ sup\ t_p)$, where *sup* is the supports-relation. This makes sense since situation types are not distinguished from informational units or infons. A proposition p is true just in case s_p supports t_p.

Now the update semantical counterpart of a belief change in epistemic dynamics is in the simplest case (and only this case will be considered here) an additional characterization of the same intended topic situation (expansion). So the Austinian notion of a proposition is dynamicized into an Austinian picture of growing discourse content. Once the end of a discourse stretch is reached, this is of course indistinguishable from the old picture. But the dynamic picture helps also to state identity criteria for discourse stretches: The end of a stretch of discourse is reached once the intended topic situation is changed. E.g., Max's two utterances cited above belong to the same stretch of discourse since they are about the same intended topic

situation, namely the factual discourse situation. An utterance of 'Joe is probably still asleep' would change the topic situation, if it is known to Max and Mia that Joe lives in Hawaii.

How does this picture go together with Barwise's notion of a background? A discourse cannot start off from zero, i.e., without any characterization of what the intended topic situation is and what it looks like, but it has to start off from some mostly quite general initial characteristics, which come from the pre-discourse situation and which I would like to call the *initialization of a discourse content.* So the content of a discourse at any of its states is the result of a sequence of updates of its initialization. Barwise's examples are compatible with the view that what he has in mind when he speaks of backgrounds for conditionals is exactly what I call the initialization of a discourse content. One of his main points, that backgrounds need not be (fully) known to discourse participants, can be argued analogously with respect to content initializations.

If this is correct, then my notion of a factual content background differs from Barwise's insofar as it does not only refer to the initialization of a discourse content, but also to its state at the moment when a new discourse contribution is made, and the two coincide only in the case of the very first contribution to a discourse. But maybe I am missing here what Barwise had in mind and the two notions coincide entirely.

The default initialization of a standard discourse (as opposed to its content) could be spelled out as 'Normal circumstances obtain'. This excludes spatial separation of the discourse participants as well as emergency situations etc. Cooperative discourse participants are obliged to update this initialization explicitly if it is not obvious that it is wrong.

Having said this I can say what the *factual content background* is. It is the Austinian proposition characterizing the intended topic situation as being of that type that is the result of changing the discourse initialization by the preceding discourse contributions and that is accepted as factual by the discourse participants. By contrast, the *virtual content background* is a set of alternatives, of ways the intended topic situation and some related situations could be and that are thematized. The set of all these issues, as I will call them with a term borrowed from Perry, exhausts the alternatives of the factual proposition that are taken into consideration at the present state of the discourse. So issues are propositions, that need neither be asserted nor accepted as true, and a content background can be modeled as a triple $\langle p, I, \leq_I \rangle$ with $p \in \mathit{Prop}$, $I \in 2^{\mathit{Prop}}$, and $\leq_I$ a pre-order, i.e., a reflexive and transitive relation, on I, where p is the accepted proposition alias actual content background, I is the set of thematic issues alias virtual content background, and $\leq_I$ induces a saliency ranking on them with normally, but not necessarily, one topmost element.

Every assertive discourse contribution updates first the virtual content

background and only if it is accepted is it copied to the factual content background. If it is rejected or retracted, it stays in the virtual part of the background or is even deleted from there.

Formally, this means that the update-function, which is 2-place, taking content backgrounds and discourse contributions to content backgrounds (update: $B \times C \rightarrow B$), needs contributions from all discourse participants (including silence), before it affects the factual discourse background.

In the above example, Max's first discourse contribution has added to the virtual content background and then, because Mia didn't object, to the factual content background, a characterization by the type 'it is getting late':

(a) update($\langle (s\ sup\ \sigma), I, \leq_I \rangle$, Max says to Mia $(s\ sup\ \tau)$)
$= \langle (s\ sup\ \sigma), I', \leq_{I'} \rangle$,
where s is the discourse situation, σ the initialization type,
I and $\leq_I$ the initial issues with their pre-order,
and $\tau = \langle\!\langle$getting-late$\rangle\!\rangle$;
$I' = I \cup \{(s\ sup\ \sigma \wedge \tau)\}$; and $\leq_{I'} = \leq_I \cup \{\langle (s\ sup\ \sigma), (s\ sup\ \sigma \wedge \tau) \rangle\}$
(where $\langle (s\ sup\ \sigma \wedge \tau), (s\ sup\ \sigma) \rangle \notin \leq_{I'}$).

(b) update($\langle (s\ sup\ \sigma), I', \leq_{I'} \rangle$, Mia accepts) $= \langle (s\ sup\ \sigma \wedge \tau), I', \leq_{I'} \rangle$.

Max's second discourse contribution has not changed the factual content background, but has changed the virtual content background by adding an issue whose type subsumes the parametric type 'it is x o'clock'.

(c) update($\langle (s\ sup\ \sigma \wedge \tau), I', \leq'_I \rangle$, Max says to Mia $(s\ sup\ \rho)$)
$= \langle (s\ sup\ \sigma \wedge \tau), I'', \leq_{I''} \rangle$,
where $\rho = \langle\!\langle x$, o'clock$\rangle\!\rangle$,
$I'' = I' \cup \{(s\ sup\ \sigma \wedge \tau \wedge \rho)\}$,
and $\leq_{I''} = \leq_{I'} \cup \{\langle (s\ sup\ \sigma \wedge \tau), (s\ sup\ \sigma \wedge \tau \wedge \rho) \rangle\}$
(where $\langle (s\ sup\ \sigma \wedge \tau \wedge \rho), (s\ sup\ \sigma \wedge \tau) \rangle \notin \leq_{I'}$).

The factual content background is modeled by an Austinian proposition with a parameter for the intended topic situation and a possibly parametric type for its characterization. A discourse will be called true just in case the result of anchoring the former parameter to the factual intended topic situation s, and of anchoring all parameters in the type to constituents of s is a true proposition. The set of propositions that forms the virtual content background of a discourse does not play a direct role in its truth conditions, only indirectly via the build-up of the factual background.

With this basic picture of update semantics in mind, how can we capture the semantics of conditionals? In other words, how can we now make formal sense of intuitions like the one expressed in sentence (7) (which is repeated below)? Especially, what do 'Any case' and 'accompany' mean in that context?

(7) Any case of lightening is accompanied by a case of thundering.

I think, the lesson to be learned from Ramsey and Gärdenfors is that conditional propositions are about updates and that therefore updating by a contribution with a conditional propositional content is some sort of meta-update that concerns other updates, be they in the future or in the past. So what we need in order to model that idea is quantification over situations and corresponding anchors.

Here is the formal setup:

Situations and relations with their argument roles are taken as primitives. Arguments may be primitive or defined entities. Types or infons are defined as follows:

Basic infons: If R is a relation and $\mathbf{a}$ is a (possibly empty) function from the argument roles of R to its arguments, then $\langle\langle \mathbf{a}R \rangle\rangle$ is a basic infon. Nullary basic infons are written simply as $\langle\langle R \rangle\rangle$. Sometimes, if $\mathbf{a}(r_0) = x_0, \ldots$, and $\mathbf{a}(r_n) = x_n$, $\langle\langle x_0, \ldots, x_n, R \rangle\rangle$ is used instead of $\langle\langle \mathbf{a}, R \rangle\rangle$.

Infons: If σ, τ are infons, x is a parameter, and Σ a set of infons, then all of the following are infons as well:

(a) $\neg\sigma$
(b) $\sigma \wedge \tau$
(c) $\exists x\sigma$
(d) *if* $\sigma(\tau)$
(e) x-*ever* $\sigma(\tau)$
(f) *whether* $\Sigma(\tau)$

Anchoring infons in situations: Let s be a situation and σ an infon. Then f is an s-anchor for σ iff f is a function from the parameters of σ in the constituents of s.

Deciding and supporting infons: A situation s together with an infon σ can be conceived of as an issue, which is decided just in case s is rich enough to contain all constituents of σ including its relations. In that case we say s decides σ, or shorter, s *dec* σ. If s decides σ positively we say s supports σ, or shorter, s *sup* σ. If s decides σ then either s supports σ or s supports $\neg\sigma$, but not both.

Restricted parameters: If x is a parameter and σ an infon that is parametric in x, then $x[\sigma]$ is a restricted parameter. If τ is a parametric object that is parametric in $x[\sigma]$, then for every situation s and any s-anchor f for τ it holds that s *dec* $\tau[f]$ only if s *sup* $\sigma[f]$.

(D1) Truth condition for contents with factual propositions involving basic or existentially quantified infons:

$\langle (s \textit{ sup } \sigma), I, \leq_I \rangle$

(or equivalently $\langle (s \textit{ sup } \exists x\sigma), I, \leq_I \rangle$) is true iff

$\exists f[f \in s\text{-anchors}(\sigma)] : s \textit{ sup } \sigma[f]$.

(D2) Truth condition for contents with factual propositions involving negative infons:

$\langle (s\ sup\ \neg\sigma), I, \leq_I \rangle$

is true iff

$\neg\exists f[f \in s\text{-anchors}(\sigma)\ \&\ s\ dec\ \sigma[f]] : s\ sup\ \sigma[f]$.

(D3) Truth condition for contents with factual propositions involving conjoined infons:

$\langle (s\ sup\ \sigma \wedge \tau), I, \leq_I \rangle$

is true iff both

$\langle (s\ sup\ \sigma), I, \leq_I \rangle$ and $\langle (s\ sup\ \tau), I, \leq_I \rangle$

are true.

So much for the basic set-up; but what do we have to do in order to interpret issues with infons of the critical form (d), i.e., conditionals?

First, we have to model cases not as tuples of participants, as Lewis (1975) did (since, e.g., raining is nullary[4]), but as situations, which in turn are conceived of as supporting situation types or infons.

Second, we have to specify the kind of update that is made if an assertion of a conditional issue (or other speech act with a c-propositional content) is contributed to the discourse. We said that we have to quantify over situations and corresponding anchors in order to spell out the 'any case' and to then say what we mean by 'accompany'. I propose to model the 'any' with the help of a function 'i-frame' that maps the topic situation s_p and the set of alternative situations I to a subset AS of the situations in I that includes s_p,[5] and to limit quantification to AS. The latter subset of I will be called the *i-frame of s_p under I* or the set of *s_p-alternatives under I*. A second restriction comes of course from the obvious requirement that alternative situations have to support the antecedent infon. But now to say that for each such s there must be an s' anywhere in the world under consideration that supports the consequent (cf. Barwise 1989, 274) would certainly miss the intuition behind the notion of accompaniment. My counterproposal, inspired by Kratzer's "accidental negation" (1989, 646) is to further require that the alternative situation be rich enough to decide the consequent infon. One could speak thus of locally (i.e., in the intended situation frame) strict implication. This amounts to the following definition ('$f \in s$-anchors(σ)' is to be read as 'f is an s-anchor for σ'):

(D4) Truth condition for contents with conditional propositions:

$\langle (s\ sup\ if\ \sigma(\tau)), I, \leq_I \rangle$

[4]Location is not an argument role of raining; on the contrary, rain situations are possible arguments of being located at.

[5]'i-' stands for indicative. The corresponding 's-' for subjunctive would not have to meet this requirement. But this will remain my only remark about subjunctive conditionals in this paper.

is true iff

$$\forall s' \forall f [s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(\mathit{if}\ \sigma(\tau)) \;\&\; s'\ \mathit{sup}\ \sigma[f] \;\&\; s'\ \mathit{dec}\ \tau[f]] : s'\ \mathit{sup}\ \tau[f].$$

A content with the proposition that s supports a conditional infon as factual part and with I and a corresponding pre-ordering as virtual part is true just in case for all situations s' in the i-frame of s under I and all s'-anchors f for the c-infon such that s' both (a) supports the f-anchored antecedent infon and (b) decides the f-anchored consequent infon, it holds that s' supports the f-anchored consequent infon, i.e., that it decides it positively. This rules out that situations that fail to support the consequent infon simply because they are not rich enough to even decide it make a c-proposition false. Our initial example in this section,

(1) It is not the case that it thunders if it lightens.

may serve as a good illustration, since scenes, i.e., purely visual situations, would verify (1) without requirement (b), because they do not include the acoustic aspects of a situation.

Suppose Max adds to his above-mentioned monologue: "If it is six o'clock, then Joe is getting up now in Hawaii," his assertion is accepted, Mia says: "It is six o'clock," and this is accepted as well. The effect is that the intended topic situation is widened (accommodation) to include not just Max's and Mia's discourse situation but also what Joe is actually doing in Hawaii. Thus the truth of the resulting accepted content will also depend on Joe. That is my basic picture of the effect of updating the content by adding a conditional issue.

Before going on to the last section I will add one remark. It has the purpose to point out that according to this picture, the difference between a straight and a conditional proposition has two aspects: First it is the difference between implicit and explicit antecedents. Remember that in our picture of a proposition, any proposition q asserted in a discourse is implicitly conditional on the initialization from which the discourse started. A conditional proposition *if p then q* therefore explicitly re-relativizes the implicitly conditional q. Second, there is the difference between those propositions that quantify over topic situations and those that don't. Conditional propositions are one kind that do, but so are epistemic and deontic and habitual propositions, that are standardly called modal propositions. So we have formally captured the typologically motivated finding that conditionality is a modal concept too.

2.3 Two Puzzles and their Treatment in Update Semantics

With this picture of conditionalization as restriction by locally strict implication in mind let us attack two puzzles.

Modus-Ponens Conditionals

The *first* one has to do with what I call modus-ponens conditionals, namely conditionals that are asserted in a discourse situation where the truth of the antecedent is in the factual content background.[6] The puzzle is one for the Gricean account: With material implication this is equivalent with an assertion of the consequent, so why do people bother to utter a whole conditional? Are they just talkative, violating the maxim of quantity? I think not. I think they are saying something different, in fact, something more.

Suppose we are talking about some work you did with a computer, and you have just told me by uttering (8) that you didn't save before quitting.

(8) I didn't save before quitting.

I believe you, and the factual content background is correspondingly updated. Then I say (9):

(9) If you didn't save before quitting, then the file is lost.

According to my analysis this is not locally equivalent with (10) (as the material implication analysis would predict, since p entails $((p \rightarrow q) \leftrightarrow q)$), but logically stronger. That is, (9) entails (10) in such a context, but not vice versa.

(10) The file is lost.

What (9) says on that background in addition to what (10) says is that your failing to save before quitting does not just happen to come along with the file being lost, but that it requires it, in other words that any relevant case of the former comes with a case of the latter. And this means that in a situation where you quit three times without saving, three files must be lost in order to make (9) true. By contrast, if in that same situation only the most salient file is lost, then (10) would come out true, whereas (9) would be false.

So far for the first puzzle, the non-redundancy of modus-ponens conditional utterances. The difference between (9) and (10) is modeled in update semantics by different updates that result in propositions with different truth conditions. There remains one problem I have not addressed so far: How does modus ponens work at all? If the factual background situation supports the antecedent infon, then clearly there is an s' in the i-frame of s, namely s itself, and a corresponding f such that s supports the antecedent infon, but it may still fail to support the consequent infon simply because it fails to include all the relevant constituents. Here I think we need some sort of accommodation: if the topic situation is too "thin"

[6]Here I disagree with Hans Rott, who claims that "*if*s are accepted only if the antecedent is not accepted" (1986, 356) and therefore has to deny the very existence of modus-ponens conditionals.

to decide the consequent infon, it is pragmatically enriched to do so (as in the Max, Mia, and Joe story above), and then the consequent follows. This means, given our definition of a stretch of discourse through identity of topic situation, that sometimes, the acceptance of a proposition with a content that entails the antecedent of an accepted c-proposition induces the beginning of an new stretch of discourse.

Unconditionals

The *second* puzzle is posed by an apparent counterexample to my claim that conditionals restrict or relativize the validity of the consequent. There is a class of seemingly conditional constructions that do exactly the opposite: Instead of making a claim depend on some circumstance and therefore in an intuitive sense weakening it (except in the special case of modus-ponens conditionals just discussed), they strengthen it in the same intuitive sense by claiming that its holds independent of the choice from some alternatively conceivable circumstances. And with this, as is easy to see, I am coming back to the unconditionals, because they are the construction type I am talking about here.

Barwise (1986) has drawn attention to the fact that a conditional like (11) presupposes normal background conditions to obtain such as that there is no pollen around that makes Claire rub her eyes and so on.[7]

(11) If Claire rubs her eyes, then she is sleepy.

But human languages allow us to get rid of these background assumptions (or at least some of them[8]), for instance by saying (12) instead of (11):

(12) Whatever the circumstances, if Claire rubs her eyes, then she is sleepy.

So normal conditionals impose further conditions on backgrounds that are restricted anyway, but clauses like '*Whatever* ...' are able to remove background restrictions and thereby strengthen the claim they modify. That's why I have come to call them "unconditionals." Further examples are (13) and (14):

(13) Wherever you go, I will find you.

(14) Whether you like it or not, your talk was simply boring.

[7]Sentence (11) could be paraphrased as 'Under default circumstances, if Claire rubs her eyes, then she is sleepy', if the latter way of phrasing it would not invite the inference that non-default circumstances are taken into consideration, which is exactly what the Barwise example wants to rule out.

[8]This specification has been inspired by the following remark of an anonymous referee: "Precisely what seems to be eliminated ... is various conditions we might be aware of as possibilities but not those we are not aware of." I doubt he would come through with this line of defense in a court trial where a crucially unconditional promise is at stake, but there are certainly contexts where the 'whatever' is interpreted more generously, i.e., in a more restricted way.

Interestingly enough, unconditionals seem to be encoded in most languages by interrogative clauses, more precisely by alternative and constituent interrogatives. How come? Interrogatives of this kind define sets of issues (by enumeration or by parametric characterization) as representing exhaustively the range of options that are currently taken into consideration. And this exhaustiveness is exactly what causes the unconditionalization effect: If all options that come into question require q, then q, unless you are unlucky enough to not even have taken into consideration what really is the case, i.e., unless your frame is entirely mistaken.

Standard conditionals on the other hand, even if they are of a disjunctive or generalizing (i.e., existentially quantified) form, do not implicate that they exhaust what comes into question,[9] therefore they don't have in general the strengthening effect. Let us discuss first the disjunctive type and compare (15) with (16):

(15) If you take the plane to Antwerp, the trip will take three hours; if you take the car or go by train, it will take ten hours.

(16) ?If you take the plane to Antwerp, the trip will take three hours; whether you take the car or go by train, it will take ten hours.

Example (16) doesn't sound as correct as (15), because it presents going by car or by train as the only options under consideration where taking the plane is in the set of thematic issues. This can be only accepted if we suppose that after the first part of the sentence, the thematic issues are redefined, and this hypothesis is corroborated by the observation that the acceptability of (16) increases with the length of a pause after its first half.

Generalizing unconditionals behave analogically.[10] Compare (17) and (18):

(17) Whatever she wears, Amanda looks pretty.

(18) If she wears something, Amanda looks pretty.

Why does (17) sound like a compliment, whereas (18) sounds like a macho-joke that amounts to quite the contrary? Because (17) invites to take only situations into consideration, where Amanda is dressed, (18) does not carry such a restriction and in fact makes us think of the cases where she is not, inviting the inference that then she does not look pretty.

This suggests the following definitions:

(D5) Truth condition for contents with disjunctive unconditional propositions:

$$\langle (s \textit{ sup } \textit{whether } \Sigma(\tau)), I, \leq_I \rangle$$

is true iff

[9] Hans Rott (p.c.) suggests that in effect they implicate the contrary.

[10] The following examples are repeated from Zaefferer (1987).

$$\forall s' \forall f[s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(\textit{whether}\, \Sigma(\tau)) \;\&\; \exists \sigma \in \Sigma : s' \textit{ sup } \sigma[f] \;\&\; s' \textit{ dec } \tau[f]] : s' \textit{ sup } \tau[f].$$

A content with the proposition that s supports a disjunctive unconditional infon as factual part and with I and a corresponding pre-ordering as virtual part is true just in case for all situations s' in the i-frame of s under I and all s'-anchors f for the whole infon such that s' both (a) supports one of the f-anchored antecedent infons and (b) decides the f-anchored consequent infon, it holds that s' supports the f-anchored consequent infon.

(D6) Appropriateness condition for contributions involving disjunctive unconditionals:
A discourse contribution with propositional content
$(s \textit{ sup } \textit{whether}\, \Sigma(\tau))$
is appropriate on a virtual background $\langle I, \leq_I \rangle$ iff
$\forall s' \forall f[s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(\textit{whether}\, \Sigma(\tau))] : \exists \sigma \in \Sigma : s' \textit{ sup } \sigma[f].$

(D7) Truth condition for contents with generalizing unconditional propositions:
$\langle (s \textit{ sup } x\textit{-ever}\, \sigma(\tau)), I, \leq_I \rangle$
is true iff
$\forall s' \forall f[s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(x\textit{-ever}\, \sigma(\tau)) \;\&\; s' \textit{ sup } (\exists x \sigma)[f] \;\&\; s' \textit{ dec } \tau[f]] : s' \textit{ sup } \tau[f].$

A content with the proposition that s supports an unconditional infon that generalizes over x as factual part, and with I and a corresponding pre-ordering as virtual part is true just in case for all situations s' in the i-frame of s under I and all s'-anchors f for the whole infon such that s' both (a) supports the f-anchored existential x-closure of the antecedent infon and (b) decides the f-anchored consequent infon, it holds that s' supports the f-anchored consequent infon, i.e., that it decides it positively.

(D8) Appropriateness condition for contributions involving generalizing unconditionals:
A discourse contribution with propositional content
$(s \textit{ sup } x\textit{-ever}\, \sigma(\tau))$
is appropriate on a virtual background $\langle I, \leq_I \rangle$ iff
$\forall s' \forall f[s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(x\textit{-ever}\, \sigma(\tau))] : s' \textit{ sup } (\exists x \sigma)[f].$

So the rule is: If the antecedent of a c-proposition exhausts the indicative frame of the current topic situation, then an unconditional is appropriate, if not, a regular conditional. In each case it should be encoded accordingly, if the language allows for distinct encoding.

It remains to supplement our definition (D4) by a corresponding appropriateness condition:

(D9) Appropriateness condition for contributions involving standard conditionals:
A discourse contribution with propositional content
$(s \; sup \; if \; \sigma(\tau))$
is appropriate on a virtual background $\langle I, \leq_I \rangle$ iff
$\neg\forall s'\forall f[s' \in \text{i-frame}(s, I) \;\&\; f \in s'\text{-anchors}(if\sigma(\tau))] :$
$s' \; sup \; \sigma[f]$.

So it turned out that although intuitively the difference between unconditionals and conditionals seems to be striking at times, it lies only in the appropriateness conditions of their utterance. They are the reason why the truth conditions of the resulting updated backgrounds are different (entailing versus not entailing the consequent), although the truth conditions of the proposition involved in the update are not.

Unconditionals as Indefinite Modus-Ponens Conditionals

We have claimed that conditional propositions are about updates and that therefore updating by a c-proposition is some sort of meta-update that concerns other updates, be they in the future or in the past. Now we can use this general picture in order to differentiate between standard conditionals, modus-ponens conditionals, and unconditionals. It turns out that the latter two are closely related. If we update with respect to a background that supports already the antecedent infon, then we have a modus-ponens conditional, and the consequent follows immediately. If we update with respect to a background that supports at least one of the enumerated antecedent infons, or at least one instantiation of the parametric antecedent infon, then we have an unconditional, and the consequent follows again. Standard conditionals, by contrast, are used in updates about future updates or about updates that are presently not accepted, so the consequent does not follow.

Finally, if we now look back at the initial distinction between lexical, phrasal and clausal conditionals with our semantic differentiations in mind, it turns out that not only non-argument alternative and constituent interrogatives, but that also some of the supposed lexical and phrasal conditionals are in reality unconditionals, namely non-temporal *always* and *never*, as well as phrases like *in any case*, or *under all circumstances*, in short all those where exhaustiveness is built into the lexical or phrasal meaning.

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