On the Semantic Composition of Subjunctive Conditionals

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In this paper, I offer a unified semantic analysis of subjunctive conditionals that purports to account for their truth and felicity-conditions. The proposal is centered on the claim that the temporal morphology that occurs in subjunctive conditionals in several genetically unrelated languages plays an essential role in the composition of their meaning. I will argue for a time-dependent notion of accessibility relation. Furthermore, I will discuss Lewis 1979's semantic analysis of subjunctive conditionals and show that it fails to account for the facts we discuss.

I will call a conditional of the form *if* ϕ*, then* ψ a 'subjunctive conditional' if it displays language-specific morpho-syntactic features which distinguish it from its indicative counterpart. In English, the characteristic feature of a subjunctive conditional is the presence of past morphology in both the antecedent and the consequent clause, together with an overt modal verb in the consequent. The examples below illustrate the contrast.

(1) INDICATIVE CONDITIONAL
   If Charlie plays tomorrow, we will lose the baseball game.
(2) SUBJUNCTIVE CONDITIONAL
   If Charlie played tomorrow, we would lose the baseball game.

These two conditionals are also semantically different. It has often been pointed out that the use of the subjunctive conditional suggests that the speaker believes that the supposition he is making is unlikely to be true, and in fact a subjunctive conditional can be used if the supposition of the antecedent is *known* to be false. However, an indicative conditional cannot.

(3) It is known that Jack is dead.
   a. If he were alive, he would be still leaving in Boston.
   b. #If he is alive, he will be still leaving in Boston.

Because *subjunctive* and *indicative* are the terms used in the philosophical literature on conditionals and because we will refer to that literature in the course of this paper, I have decided to keep these terms in the present discussion. The source of the labels *indicative* and *subjunctive* is the observation that in some languages the distinction between types of conditionals is reflected in the choice of the mood, i.e. indicative mood versus subjunctive mood. This is illustrated in the Italian pair below.[1]

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[1] Abbreviations: FUT = future; PRES = present tense; IMP = imperfect tense; IND = indicative mood; SUBJ = subjunctive mood; COND = conditional mood.

(4) INDICATIVE CONDITIONAL
    Se Carlo giocherà domani, perderemo la partita di calcio.
    If Carlo play-FUT/IND tomorrow, (we) lose-FUT/IND the soccer game
    'If Carlo plays tomorrow, we will lose the soccer game'

(5) SUBJUNCTIVE CONDITIONAL
    Se Carlo giocasse domani, perderemmo la partita di calcio.
    If Carlo play-IMP/SUBJ tomorrow, (we) lose-PRES/COND the soccer game
    'If Carlo played tomorrow, we would lose the soccer game'

However, it would be wrong to believe that the mood choice is a necessary component of the semantic contrast between indicative and subjunctive conditionals we informally described above. Iatridou 2000 has shown that it is cross-linguistically false that the semantics of subjunctive conditionals is necessarily marked by the subjunctive mood: some languages that have a true subjunctive mood (e.g. French) do not use it in 'subjunctive' conditionals. Iatridou argues that what is cross-linguistically present is instead the *past* morphology. Consider the English subjunctive conditional given above: in the antecedent, we see the past tense *played*; in the consequent, the past component is embedded in *would*, which is analyzed as the modal WOLL plus the past. As for the Italian subjunctive and conditional conditional, it can be shown that both the imperfect subjunctive in the antecedent and the present conditional in the consequent of (5) do incorporate a past component.[2,3]. Iatridou's generalization is that it is the *past morphology* and not the subjunctive mood that we need to regard as the essential component of the semantic contrast between indicative and subjunctive conditionals. This generalization is our starting point.

Despite this classification into subjunctive and indicative conditionals, often theories about the semantic analysis of conditionals have not directly addressed the question about what the differences and similarities between these two types of conditionals are. Often theories have focused on one kind of conditionals or the other, and have not approached the difference between these two types in a systematic way. Lewis (1973) analyzes *counterfactual conditionals*, a subset of the subjunctive conditionals, and develops a theory according to which counterfactuals are possible-worlds conditionals. However, little is said about indicative conditionals. In Lewis (1976), he claims that indicative conditionals are not possible-worlds conditionals and should be given the same truth-functional account as material implications. Counterfactuals and indicative conditionals are different, but giving them a completely different semantics seems unpalatable: we would like to understand what the similarities are, and where the differences come from. Moreover, subjunctive conditionals are not necessarily counterfactuals, but in Lewis' theory there is no room for a general account of the contrast between indicative and subjunctive. Kratzer (1981, 1991) analyzes all conditionals as having the same structure, one in which the *if*-clause is the restriction of a (possibly covert) modal operator: thus, for any world *w*, the *if*-clause has the function of restricting the set of worlds accessible from that world *w*. However, like Lewis, Kratzer too distinguishes between *indicative conditionals* on one hand and *counterfactuals* on the other, where counterfactuals are

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[2] On most analyzes, the Romance *imperfect*, whether indicative or subjunctive, is analyzed as an imperfective *past* (Giorgi and Pianesi 1997, Bonomi 1997, Ippolito 2002c, among others). Hence, one component of the imperfect subjunctive occurring in subjunctive conditionals is in fact the past.

[3] See Iatridou 2000:266, for an argument that the conditional mood incorporates a past feature. Her argument is about French, but it can be applied to Italian as well.

a special kind of conditionals characterized by an empty modal base and a totally realistic ordering source (see references cited above). Again, where does this difference come from and what is the place of *subjunctive conditionals* in general? Other scholars simply do not raise the issue of what the truth-conditions of these two types are: for example, Karttunen and Peters (1979) propose that different presuppositions are associated with indicative and subjunctive conditionals but remain agnostic as to what their truth-conditions are. To conclude, the theories that address the issue of what the semantic analysis for conditionals should be seem to regard the distinction between *indicative conditionals* and *counterfactuals* as the relevant distinction, rather than the distinction between indicative and subjunctive conditionals. Nevertheless, there exist differences between indicative and subjunctive conditionals regardless of the latter being counterfactuals: if I say *If Charlie played tomorrow, we would lose the game*, I suggest that Charlie is likely not to play (regardless of whether Charlie will play or not), but if I say *If Charlie plays tomorrow*, I do not. If I say *If the butler had done it, the police would have found a knife* I may still believe that the butler did it and it may be true. Still, if I utter that sentence, I am suggesting something different from what I would suggest were I to utter *If the butler did it, the police found a knife*. The distinction subjunctive /indicative is real, regardless of counterfactuality.

In this scenario, Stalnaker (1975)'s proposal points precisely in the direction of a systematic account of the difference between *indicative* and *subjunctive* conditionals. According to Stalnaker, both kinds of conditional statements are given the same semantic analysis but different pragmatic constraints, and these different pragmatic constraints affect the truth-conditions, so that subjunctive and indicative conditionals may actually express different propositions. Furthermore, Stalnaker suggests that this difference is reflected in the different mood (indicative versus subjunctive). In this paper, I assume the semantic analysis of conditionals as possible-worlds conditionals developed and defended in Stalnaker (1968), Stalnaker and Thomason (1970), and Lewis (1973) (not for indicative conditionals). For the purpose of this discussion, the differences between Stalnaker's and Lewis' theories do not matter, and – as we shall see below – my formulation of the truth-conditions for conditionals will be closer to Lewis.

The central idea of Stalnaker's analysis is that a conditional statement of the form *If* ϕ, ψ "is an assertion that the consequent is true, not necessarily in the world as it is, but in the world as it would be if the antecedent were true" (Stalnaker 1999: 68). Formally, this is accomplished by means of a function f that takes a proposition (the antecedent) and a world (the actual world) into a possible world (the world as it would if the antecedent were true). The possible world that is the value of the function is the world where the antecedent is true and which is maximally similar to the actual world (one of the arguments of the function). The semantic rule is given below.

(6) **Semantic Rule for Conditionals** (Stalnaker 1975)
A conditional *if* ϕ, ψ is true in a possible world w just in case ψ is true in $f(\phi, w)$.

The rule above gives the form of the truth-conditions of conditional statements but says nothing about how the possible worlds are selected. In this respect is simply avoids Goodman's problem of how antecedents select counterfactual worlds. The only property of the selection function above is that it will select the world most *similar* to the actual world, but not much more can be said to specify what the criteria

for similarity are without running into all those problems that Goodman ran into and that made him conclude that there is no non-circular way to define the selection function. In this theory, the vagueness of conditionals is the vagueness of the selection function. And if the specification of the selection function cannot be part of the semantics of conditional statements, it will part of their pragmatics. However, what we can say is what the *domain* of the function is. In order to do this, it is necessary to introduce a few related notions.

The *context set c* is the context as defined in the possible worlds framework. The *context set* is the set of possible worlds not ruled out by the presupposed background information, i.e. the set of possible worlds where all the presupposed information is true. This presupposed information is the common knowledge or presumed common knowledge and assumptions of the participants in the conversation.[4]

Stalnaker appeals to the notion of context set in order to specify how the selection function works in conditionals. The idea is that if the conditional is evaluated at a world that is a member of the context set, then the world that is selected (the value of the function) must be a member of the context set too. The intuition behind this constraint is that when a speaker utters a conditional statement, everything that she is presupposing in the actual world is presupposed to hold in the hypothetical situation in which ϕ is true. However, the selection function can also reach outside the context set to select a counterfactual world. Stalnaker views the subjunctive mood (in English as well as other languages) as a conventional device "for indicating that the presuppositions are being suspended, which means in the case of subjunctive conditional statements that the selection function is one that may reach outside of the context set" (Stalnaker 1999: 70). Because indicative conditional statements are only appropriate if the antecedent is compatible with the context, counterfactual conditionals must be subjunctive conditionals. This explains the contrast between indicative and subjunctive conditionals, which I repeat below.

(7) It is known that Jack is dead.
   a. If he were alive, he would still be living in Boston.
   b. #If he is alive, he must be living in Boston.

The indicative conditional in (b) is inappropriate because the supposition that the speaker is making is incompatible with the context. However, the world selected by the selection function in the subjunctive conditional in (a) can be a world outside the context set, that is to say a world where some of the speaker's actual assumptions are false.

In this paper, I will make use of the notion of accessibility relation instead of Stalnaker's similarity function.[5] Hence, it may be useful if I couch Stalnaker's proposal presented above in the same terms that I will be using in the rest of the discussion. Consider the indicative conditional *If Charlie plays tomorrow, his team will win*. This conditional will be true if all the worlds accessible from the actual world and such that it is true that Charlie plays tomorrow, are worlds where his team wins. The constraint at work in indicative conditional is that the set of accessible

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[4] This presumed common ground is the *speaker*'s presuppositions, which do not have to be shared by all the participants in the conversation: what is necessary is that the speaker believes that these presuppositions are common to her and her audience.
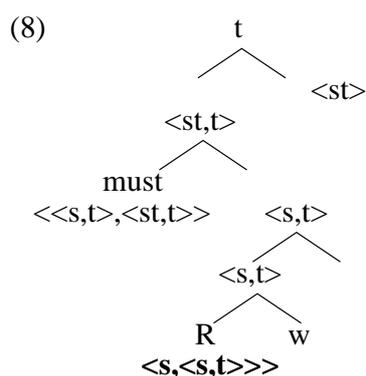
[5] We will see later that I use both an accessibility relation and a similarity relation (see Heim 1992 for a similar proposal).

worlds is restricted to epistemically accessible worlds, i.e. worlds in the context set. However, this is not true for the subjunctive conditional *If Charlie played tomorrow, his team would win*: here the set of accessible worlds is not restricted to worlds epistemically accessible from the actual world but can include worlds inconsistent with the speaker's presuppositions, i.e. worlds outside the context set. Thus, the subjunctive conditional above is true if all the accessible worlds in which Charlie plays tomorrow are worlds where his team wins. And among these worlds, there may be worlds outside of the context set. We will see later that the notion of similarity among worlds will still play a role in addition to the notion of accessibility relation.

In light of Iatridou 2000, I believe that the hallmark of subjunctive conditionals is the past (and not the subjunctive mood) and that the use of the past is an essential component of their interpretation (and not a conventional device). However, I will adopt the core of Stalnaker's analysis of conditionals in terms of possible worlds, the division of labor between semantics and pragmatics and the role played by the context set. More must be said about what worlds need to be selected. In what follows we will see that the generalization that the supposition expressed by the antecedent of a subjunctive conditional can be inconsistent with the context needs to be refined. Moreover, we will see that not all subjunctive conditionals behave in the same way. More generally, the question that needs to be raised is what is the set of worlds that modal operators quantify over.

2. The puzzle of subjunctive conditionals

In order to answer the question of what is the set of worlds that the modal operator in a conditional sentence quantifies over I need to lay down some assumptions about the internal structure of a modal sentence. I will assume that a conditional sentence has the structure argued for in Kratzer 1981, 1986 and 1991. Following Lewis 1975's treatment of adverbs of quantification, Kratzer does not analyze the connective *if* as a two-place operator taking the antecedent and the consequent as its argument. Instead, she analyzes a conditional sentence as a tripartite structure: the *if*-clause is interpreted as the restriction of a possibly covert modal operator, whereas the consequent is interpreted in the nuclear scope. Thus, the structure determined by a modal operator is similar to any other quantificational structure, as shown

(8)

$$
\begin{array}{c}
t \\
\diagup \diagdown \\
\langle st,t \rangle \qquad \langle st \rangle \\
\diagup \diagdown \\
\text{must} \qquad \langle s,t \rangle \\
\langle\langle s,t\rangle,\langle st,t\rangle\rangle \quad \diagup \diagdown \\
\langle s,t \rangle \\
\diagup \diagdown \\
R \qquad w \\
\langle s,\langle s,t\rangle\rangle
\end{array}
$$

ϕ is the proposition expressed by the antecedent. ψ is the proposition expressed by the consequent. R is the accessibility relation. Now, according to the more conservative view of the inner structure of the accessibility relation, R is just a binary relation
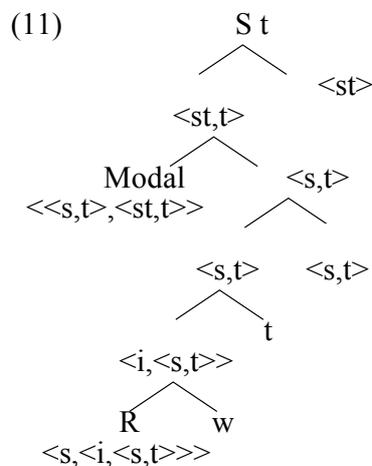
between worlds, so that the set of worlds that gets constructed is the set of worlds relevantly accessible from the evaluation world w.[6]

(9) $R = \lambda w.\ \lambda w'.\ w'$ is relevantly accessible from w.

My proposal is that the internal structure of accessibility relation is more complex: accessibility relations cannot simply be binary relations between worlds but must be ternary relations between worlds and *times*, as shown below.

(10) $R = \lambda w.\ \lambda t.\ \lambda w'.\ w'$ is relevantly accessible from w at t.

What counts as an accessible world now is not only relative to a world of evaluation but also to a time of evaluation. The accessible worlds are worlds accessible from a world and a time. The structure of a conditional sentence will then be as in (11).

(11)

```
                        S  t
                       /  \
                        <st>
               <st,t>
               /   \
          Modal      <s,t>
     <<s,t>,<st,t>>    /  \
                  <s,t>     <s,t>
                  /  \
             <i,<s,t>>  t
               /  \
              R    w
         <s,<i,<s,t>>>
```

Now that I have laid down my assumptions about the structure of a conditional sentence, I can go back to the selection problem we introduced above. The question that we raised above is: What is the set of worlds that the modal operator in a conditional sentence quantifies over? For indicative sentences it seems correct to say that the worlds that the modal operator quantifies over must be *epistemically accessible* worlds, that is to say, worlds compatible with the speaker's epistemic state. Restricting the quantification to epistemically accessible worlds accounts for why the antecedent itself has to be consistent with what the speaker knows. This is precisely the view advocated by Stalnaker, as we explained above. However, we will see below that the case of subjunctive conditionals is more complicated: it is not sufficient to say that the worlds that are selected may be outside the context set, i.e. outside the set of epistemically accessible worlds. Heim 1992 addresses this problem and offers a solution. In what follows I will present the puzzle and her solution.

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[6] What counts as relevantly accessible is a lexical matter. For example, the modal *must* can have both an epistemic and a deontic interpretation: in the former reading, the relevantly accessible worlds are epistemic worlds (worlds compatible with what the speaker knows); in the latter reading, the accessible worlds are worlds compatible with the actual laws.

2.1 How to revise the context set

In the case of subjunctive conditionals, we do not want the modal operator to quantify over epistemically accessible worlds because typically the antecedent of a subjunctive conditional is known to be inconsistent with the speaker's epistemic state, as the example below illustrates: that Jack is alive is inconsistent with what is being assumed (that is, that Jack is dead).

(12) Jack is dead. If he were alive, he would come to the ceremony.

However, as argued by Heim 1992, if we do not restrict the modal base to those worlds that are epistemically accessible, that is to say, if we take the modal base to be the set of all possible worlds (W), we cannot account for why conditionals whose antecedents have presuppositions are felicitous at all, and we predict that they should be infelicitous as the modal base does not have the right entailments. That Jack smokes tomorrow is presupposed by the antecedent of the next example, but the whole conditional is felicitous.

(13) Jack smokes. If he quit smoking tomorrow, which he won't, he would run the marathon.

In fact, not only *can* the presuppositions in the antecedent of a subjunctive conditional be entailed by the set of worlds we want to quantify over, they *must* be entailed. In the following example, the presupposition in the antecedent – that Jack smokes tomorrow – is inconsistent with the background assumption (that Jack no longer smokes), and as a result the subjunctive conditional is infelicitous.

(14) Jack quit smoking last year. #If he quit smoking tomorrow, he would not run the marathon.

The tension is between having a modal base large enough so as to allow the antecedent to be inconsistent with it, and having a modal base small enough so as to entail the presuppositions of the antecedent. The modal base must be larger than the context set so as to include some epistemically *in*accessible worlds, but clearly not any way to expand the context set will deliver the right result, as we must guarantee that some entailments are kept.

Heim 1992 proposed that the modal base – or, in the context change semantics in which she is framing her discussion, the context to which the antecedent is added – be neither the empty context (the set of all possible worlds, W) nor the main (utterance) context, but a *revised context*, that is to say a context where some assumptions have been suspended (in order for the antecedent to be consistent with it) but where the presuppositions in the antecedent have remained. Below in (a) is her definition: the outcome is the largest set such that the operation of adding (+) the antecedent φ to it is defined, i.e. such that the φ's presuppositions are entailed by it.[7] The context change potentials for subjunctive and indicative conditionals are given in (b) and (c) respectively.

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[7] In context change semantics, the meaning of a sentence is its *context change potential* (CCP), a CCP being a function from contexts to contexts. The presuppositions of a sentence are requirements on the context; that is to say, they determine which contexts its CCP can be applied to.

(15) a. For any context c, LF ϕ:
         rev (c), the revision of c for , is $\bigcup\{X \subseteq W: c \subseteq X$ and $\underline{X + \quad \text{is defined}}\}$

   b. CCP for Subjunctive Conditionals
       c + if p, *would* q = {w $\in$ c: $\text{Sim}_w(\text{rev}_p(c) + p) + q$ = same}

   c. CCP for Indicative Conditionals
       c + if p,q = {w $\in$ c: $\text{Sim}_w(c+p)+q$ = same}

The revision proposed by Heim guarantees that the right entailments are kept while allowing epistemically inaccessible antecedent-worlds to be included in the set. However, it does so by stipulating what the right constraint on the revision operation is, i.e. that the presuppositions in the antecedent stay. The stipulation that Heim made seemed inescapable because once you move outside the context set nothing guarantees that the modal base will have the right entailments.

   To recapitulate, Stalnaker 1975 proposed that the difference between indicative and subjunctive conditionals is that in the former but not in the latter case the selected antecedent-world must be an epistemically accessible world (i.e. a member of the context set). This accounts for the fact that a subjunctive conditional is felicitous when the antecedent is known by the speaker to be false. However, this does not account for why the presuppositions in the antecedent are required to be entailed by the context (Heim 1992). Why is the selected world a world where the antecedent's presuppositions are true? Heim 1992 stipulated that the revision process is such that any presupposition in the antecedent is kept in the revision set. However, even as it is Heim's revision process is not correct since it does not explain a further distinction that needs to be drawn among subjunctive conditionals. This is the content of the next section.

2.2 The puzzle of subjunctive conditionals revisited

Suppose Jack quit smoking three years ago, and never started smoking again. The subjunctive conditional in (a) – which from now on I will call *one-past subjunctive conditional* – is infelicitous, as we would expect given the generalization that the antecedent's presuppositions must hold in the context.

(16) *Jack quit smoking three years ago.*
     a. #If Jack quit smoking tomorrow, he could participate in the experiment.
     b. If Jack had quit smoking tomorrow, he would have participate in the experiment.

The antecedent of the conditional presupposes the proposition that Jack smokes tomorrow, and this proposition must be entailed by the set of worlds to which the antecedent is added (the revised context set). Because the revision of the context set suggested by Heim can entail the presuppositions required by the antecedent ϕ only if *c* itself entails them, it follows that the actual context set *c* must also entail the proposition that Jack smokes tomorrow. However, since it is not true in the actual context that Jack will smoke tomorrow, the sentence is correctly predicted to be infelicitous. What does not follow from Heim's theory of the revision process is the felicity of the conditional in (b): the proposition that Jack will smoke tomorrow is incorrectly predicted to be entailed by the main context and the whole conditional is

incorrectly predicted to be infelicitous. Here and throughout the discussion in this paper, I will call subjunctive conditionals like (b) *mismatched two-past subjunctive conditionals* (or simply, *two-past subjunctive conditionals*).[8]

To strengthen this point, consider another conditional statement with a presupposition-triggering item. Let us assume with Musan (1997) that most predicates trigger a presupposition that their subject be in existence or alive at the time at which the predicate is said to hold of it.[9] The predicate *to come* will then presuppose that its subject is alive at the time when she is said to come to the ceremony. Suppose that Jack died last year. Again, as in the case of the verb *to quit*, the mismatched two past subjunctive conditional in (b) is felicitous, contrary to the generalization that for any subjunctive conditionals the antecedent's presuppositions have to hold into the main context.

(17) *Jack died last year.*
   a. #If he came to the ceremony tomorrow, he would be proud of Sally.
   b. If he had come to the graduation tomorrow, he would have been proud of Sally.

Both the antecedent in (a) and the antecedent in (b) presuppose that Jack will be alive tomorrow, which is inconsistent with the common ground. However, only the conditional in (a) is infelicitous. Both the subjunctive conditional in (a) and the subjunctive conditional in (b) are future counterfactuals. Both antecedents express the same proposition, that is to say, that Jack will come to the ceremony tomorrow (or, in the case of the previous pair, that Jack will quit smoking tomorrow). Still they are different. The difference between the (a) and the (b) conditionals must lie in the number of *past* morphemes in both the antecedent and the consequent clauses. In (a), only one layer of past morphology occurs: the *–ed* on the main verb *to come* in the antecedent and the past incorporated into the modal *would* (which, as I said above, is analyzed as WOLL + past). In (b), two layers of past occur: in the antecedent, the *–ed* on the auxiliary and the auxiliary itself; in the consequent, the past on *would* and the auxiliary *have* itself. The generalization that the pairs above suggest is the following.

(18) **Generalization**:
   The restriction that the presuppositions in the antecedent of a subjunctive conditional must be entailed by the main context only holds for one-past subjunctive conditionals.

Our working hypothesis is that whether the presuppositions in the antecedent of a subjunctive conditional must be entailed by the main context or not depends on whether a second layer of past occurs or not. The examples discussed above show that it is not true that all subjunctive conditionals are subject to the same appropriateness condition.

Let me recapitulate what we have found out so far. We began with Stalnaker's idea that in the truth-conditions of subjunctive conditionals the world(s) selected may be outside the context set, possibility not available to indicative conditionals. We then saw that this is too simplistic for, although the antecedent of subjunctive conditionals

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[8] This kind of subjunctive conditionals has been discussed in Dudman 1983, 1984, and in more detail in Ogihara 2000 and Ippolito 2001. See Ippolito 2001 for a discussion of previous proposals.
[9] Exception to this generalization are the 'existence independence' predicates like *be famous*, which do not contain a lifetime presupposition (Musan 1997:283).

can fall outside the context set, the presuppositions in the antecedent must not. Heim's proposed revision of the context set was intended to solve this dilemma. However, we showed that even Heim's revision cannot be maintained because it does not account for the distinction between one- and two-past subjunctive conditionals. What is the correct theory of subjunctive conditionals, then?

3. The Semantic Analysis of Subjunctive Conditionals

In answering the question of what the correct semantic analysis of subjunctive conditionals is we will raise and answer the following questions too: (1) What is the difference between indicative an subjunctive conditionals? (2) What is the role of the past morphology in the composition of the meaning of a subjunctive conditional? (3) What is the contribution of the second layer of past to the meaning of subjunctive conditionals? As Iatridou observes, the past morphology in subjunctive conditionals is not interpreted temporally, as the event of playing baseball in example (2) is supposed to take place in the future (tomorrow). What follows in this paper is inspired by her work and by the intuition behind it, i.e. that the temporal morphology we see in modal constructions actively contributes to the construction of the modal meaning. However, I depart from her idea that tense morphology has a "core meaning" that can apply to different kinds of entities (i.e. her idea that if it applies to times, it is interpreted temporally; if it applies to worlds, then it is interpreted modally). My claim is that tense (aspectual) morphology has a single, definite interpretation: the temporal (aspectual) one. The way tense morphology contributes to the composition of modal meaning is by being interpreted in *different positions* in the structure of a modal sentence, i.e. either in the restriction or in the nuclear scope of the modal operator. Recall that I am arguing that accessibility relations are of type $<s<i<st>>$ (where i is the type for times and s the type for worlds): the notion of *accessible world* is relative not only to a world but also to a time so that a world will be accessible if it satisfies certain conditions with respect to an evaluation world and an evaluation time. The past that we see in subjunctive conditionals such as *If Charlie played baseball tomorrow, we would lose the game* is the morphological realization of a *perfect* operator interpreted in the modal domain. I will develop an analysis of the meaning of subjunctive conditionals and show how it solves the puzzle of the presupposition projection for subjunctive conditionals discussed in Heim 1992; finally, I will answer the three questions I raised above.

3.1 Felicity Conditions for Conditionals

Recall what the puzzle was. The antecedent of a subjunctive conditional can be inconsistent with the common ground, and consequently, the set of worlds the modal operator quantifies over cannot be restricted to the worlds in the context set (the epistemically accessible worlds) (see (19) below). Furthermore, this set cannot be the empty context (W) either because, if it were, we would expect conditionals with antecedents with presuppositions to be infelicitous since the modal base does not have the right entailments. However, this is incorrect: subjunctive conditionals whose antecedents have presuppositions are felicitous, which means that the antecedent's presuppositions can be entailed by the modal base (cf. (20)). In fact, they must (cf. (21)).

(19) Jack is dead. If he were alive, he would come to the ceremony.

(20) Jack smokes. If he quit smoking tomorrow, which he won't, he would run the marathon.

(21) Jack quit smoking last year. If he quit smoking tomorrow, he would run the marathon.

Heim 1992 concluded that the only way to reconcile these two requirements of subjunctive conditionals is to stipulate that the modal base is neither the set of epistemically accessible worlds (the main context) nor the totally empty modal base W, but the (largest) set of worlds obtained by suspending all the speaker's assumptions except the presuppositions of the antecedent, which then remain entailed. However, I showed above that this stipulation does not work for all subjunctive conditionals: in particular, it does not account for the difference between one-past subjunctive conditionals and mismatched two-pasts subjunctive conditionals, as shown below.

(22) *Jack died last year.*
    a. #If he came to the ceremony tomorrow, he would be proud of Sally.
    b. If he had come to the graduation tomorrow, he would have been proud of Sally.

We are back where we were: how is the set of worlds to which modal operators apply selected? Clearly, the felicity conditions for indicative, one-past and two-pasts subjunctive conditionals are all different. But what is the difference and how is the difference determined?

It seems correct to hold that for a sentence ϕ to be felicitously uttered in the context c, c must entail the presuppositions of ϕ. In the common ground theory of presuppositions developed by Stalnaker (1973, 1974, 1975), the common ground is the set of all the propositions known or assumed to be true by all the participants in the conversation, and the context set is the set of worlds where all the propositions in the common ground are true. Assertions are meant to update the common ground. If the assertion is made and accepted, the common ground expands and the context set shrinks. Thus, if a sentence ϕ presupposes p, then asserting ϕ requires that the common ground entail p, i.e. it requires that the speaker assume that it is true in the common ground that p, modulo accommodation.[10] It is explicit in Heim's context change semantics (and implicit in Stalnaker's idea of a *derived context*) that a clause (that is to say, the structural description of a clause at the level of Logical Form) is not always evaluated with respect to the context of utterance: the context with respect to which a structure is evaluated depends on the level of embedding of the clause, the most unembedded clause being interpreted with respect to the main (utterance) context. We can then reformulate the principle above: what is responsible for the felicity of a sentence ϕ is not whether its presuppositions are entailed by the utterance context but whether they are entailed by the *evaluation context* (which may be identical to the utterance time in some cases). Call this principle PREP.

---

[10] Stalnaker (1972, 1973, 1974, 1978, 1988, 1998). Kartunnen (1974), Lewis (1979), Heim (1982, 1983, 1992), Thomason (1990) and von Fintel (2000) also contributed important work in the tradition of the common ground theory of presuppositions.

(23)   **Presupposition Principle (PREP)**
　　　　For a sentence ϕ to be uttered felicitously, the presuppositions of ϕ have to be entailed by the context of evaluation.

Because PREP is true of any sentence ϕ, it will be true of the antecedent of a conditional too.[11] Because this is true of the antecedent of *any* conditional, the difference between the felicity of an indicative conditional and that of a subjunctive conditional must be accounted for in some other way. My proposal is that the skeleton of the felicity conditions for the three kinds of conditionals we are considering is the same, but what changes is the context set. In all the three cases, the antecedent ϕ is required to be compatible with *some* set of worlds. The felicity condition for indicative conditionals is easy: it requires that the antecedent ϕ be compatible with the main context (i.e. the context at the utterance time). The felicity condition for non-past subjunctive conditionals (which from now on I will call one-past subjunctive conditionals) requires that the antecedent be compatible with *some* context, call it c_3. Finally, the felicity condition for mismatched two-pasts subjunctive conditionals requires that the antecedent be compatible with *some other* context c_4. Both c_3 and c_4 are different from c_u.

　　　　(24) Felicity Conditions
　　　　　　(A) <u>Indicative conditionals</u>
　　　　　　　　　ϕ c_u
　　　　　　(B) <u>1-past-subjunctive conditionals</u>
　　　　　　　　　ϕ c_3
　　　　　　(C) <u>2-past-subjunctive conditionals</u>
　　　　　　　　　ϕ c_4

In this picture, the context of evaluation of a subjunctive conditional is never the main (utterance) context. Furthermore, whether a subjunctive conditional has one layer of past morphology or two layers of past morphology correlates with the selection of the context of evaluation. It is therefore a pressing question what exactly these contexts are, and how their selection is determined by the layers of past morphology. The point of the following discussion is to show that once we replace the context of utterance with the context of evaluation, and once we have a theory of *what* the context of evaluation is in each case, we come to realize that there is no conflict between the fact that the antecedent of a subjunctive conditional can be counterfactual and the fact that its presuppositions have to hold in the main context.

3.2 What Looks Like Past is Perfect
I propose that the past morphology we see in subjunctive conditionals in English is the morphological realization of a perfect operator. The English perfect, and especially the present perfect, has raised a lot of interest in the linguistic literature because of the properties that distinguish it from both the present and the simple past tense. McCoard (1978) offers a survey of possible theories of the perfect: the current relevance theory, the indefinite past theory, the embedded past theory and, finally, the theory that he argues to be the best, the Extended Now theory. Very briefly, according

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[11] The claim that the presuppositions of the antecedent of a conditional have to be entailed by the context is a standard claim of a dynamic approach to meaning (Heim 1992). However, we will see later that the issue is more intricate and I will have more to say on this topic later on in the paper.

to the extended now theory, the perfect is the marker of prior events which are nevertheless included within the overall period of the present, the "extended now".
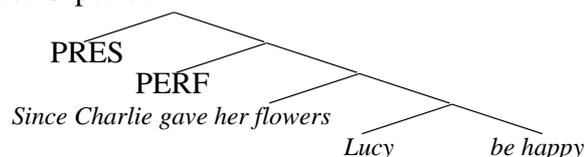
The analysis of the perfect that I will assume here is a version of the Extended Now theory (McCoard 1978, Dowty 1979, among others) suggested in Iatridou, Anagnostopoulou and Izvorski (2001) and implemented and extended in von Fintel and Iatridou (2002), and Iatridou (2002). According to this theory, the perfect sets up a time span (the *perfect-time span*, their version of the extended now), whose left boundary (LB) is generally determined by an adverbial, and whose right boundary (RB) is determined by the tense of the perfect (the utterance time for the *present* perfect, a past time for the *past* perfect, a future time for the *future* perfect). Consider the two examples below, Existential and Universal perfect respectively.

> (25) Since 1997, Lucy has been to Boston once.   (E)
> (26) Lucy has been happy since Charlie gave her flowers.   (U)

The universal interpretation of the perfect requires a predicate of which the subinterval property holds (these could be stative predicates, or predicates that have been turned into predicates with the subinterval property by operators like the progressive). The LF for the universal sentence above will look as follows.

> (27) LF for U-perfect

The universal sentence will be true just in case there is an interval whose right boundary is the utterance time and whose left boundary is the time at which Charlie gave Lucy flowers, and Lucy is happy throughout that interval. The perfect operator, the left boundary (LB) and the right boundary (RB) are defined as follows (von Fintel and Iatridou 2002, Iatridou 2002). The *o* symbol in the entry of the present tense means 'overlap'.

> (28) $[[\textbf{PERF}]]^{g,c} = \lambda P_{<i,t>}.\ \lambda t.\ \exists t':\ RB(t, t')\ \&\ P(t')=1$
>
> (29) $LB(t,t')$ iff $t \subseteq t'\ \&\ \neg \exists t'': t'' < (t \subseteq t')\ \&\ t'' \subseteq t'$
>
> (30) $RB(t,t')$ iff $t \subseteq t'\ \&\ \neg \exists t'': (t \subseteq t') > t''\ \&\ t'' \subseteq t'$
>
> (31) $[[\textbf{PRES}_2]]^{g,c} = g(2)$, defined only if $g(2)\ o\ t_c$

As in the case of the universal perfect, in the existential present perfect, the right boundary of the time span will be the utterance time, since the tense is present. The *since*-adverbial determines the left boundary of this interval. Informally, the sentence is true if there is a time during this interval at which Lucy was in Boston. The LF for *Since 1997, Lucy has been in Boston once* will be the following.

(32) LF for E-perfect

PRES
    PERF
     Since 1997

               Lucy   *be in Boston*

The ∃ operator will have the entry below, so that informally (25) is true just in case there is an interval (*the perfect-time span*) *t* whose left boundary is some time within 1997 and whose right boundary is the utterance time, and there is a subinterval of *t* at which Lucy went to Boston.
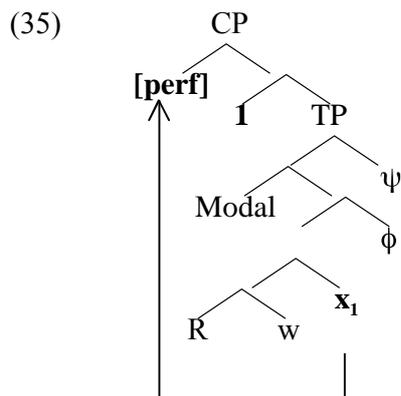
(33) $[[\exists_{\supseteq}]]^t = \lambda p_{<st>}. \exists t': t \supseteq t' \& p(t')=1$

My proposal is that the past morphology that we see in both the antecedent and the consequent clause of a subjunctive conditional is the morphological realization of the perfect operator introduced above. Temporal elements can be interpreted in the restriction of a modal operator or in its nuclear scope: the perfect that occurs in subjunctive conditionals is an instance of the former case.

      What does it mean to say that a perfect is interpreted in the restrictor of a modal operator? Recall that I have proposed that the notion of accessible world is relative not only to a world but also to a time. This is accomplished by having a time argument in the argument structure of the accessibility relation (cf. section 2).

(34) $R = \lambda w. \lambda t. \lambda w'. w'$ is relevantly accessible from w at t.

Now, my proposal is that the perfect operator is not interpreted within the proposition expressed by the consequent clause but it provides the time argument of the accessibility relation. We could implement this proposal by generating the perfect operator inside the accessibility relation (where *x* occurs in the structure above), and then adjoining it to the top of the structure for reason of interpretation (the perfect operator being a quantifier cannot saturate the time argument of R). The after-movement structure would look as follows.

(35)
CP

  [perf]

      1   TP

                ψ

      Modal

              φ

              x₁

    R   w

However, this does not seem a very attractive operation, as the nature of this movement is syntactically obscure. Instead, I will choose a second option in which the perfect operator is base-generated at the top of the structure, while still being interpreted as the argument of the accessibility relation. The structure and the

semantic computation is shown in the tree below. I will explain the structure in more detail below. Here, I would like to draw the reader's attention to the close parallelism between the structure of a subjunctive conditional below and the structure of the Existential-perfect we gave above. In both structures, a perfect operator occurs below the tense, and the existential quantifier   occurs lower in the structure taking the relevant proposition as it argument (in the case of the E-perfect, this proposition was that one expressed by the tenseless sentence; in the case of the subjunctive conditional, the proposition is more complex as it includes accessible worlds where ϕ is true). The bound variable x argument of the accessibility relation R ranges over times. The world argument of R is the actual world (w_c) by default.[12]

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[12] As the tree in (36) shows, we need both a time-sensitive accessibility relation and a time-independent similarity relation, *Sim*. I will justify the need for having both a time-sensitive accessibility relation and a time-independent similarity relation in section V, V.1, V.2, V.3.

(36)

$t_3: RB(t_c,t_3)$ & w[$t_1: t_3$ t_1 & w is accessible from w_c at t_1 and   is true in w
and w resembles w_c no less than any other world   is true in w]

t_c t_6. $t_3: RB(t_6,t_3)$ &   w[$t_1:t_3$ t_1 & w is accessible from w_c at t_1 and   is true
                         in w and w resembles w_c no less than any other world   is true in w]

[[**Perf**]]^{g,c} =
  P. t_6. $t_3: RB(t_6,t_3)$ & $P(t_3)=1$

                         t_2.   w[$t_1: t_2$ t_1 & w is accessible from w_c at t_1 and   is true in w
                         and w resembles w_c no less than any other world   is true in w
                         ]

                    t_2. […]   w[$t_1:t_2$ t_1 & w is accessible from w_c at t_1 and
                                                is true in w and w resembles w_c no less than
                                                any other world   is true in w]

  q. w[$t_1:t_2$ t_1 & w is accessible from w_c at t_1 [[ψ]]^{g,c} = w_6. w_6
and   is true in w and w resembles w_c no less
than any other world   q(w)]

                    [[**Modal**]]^{g,c} =
                     p. q. w[p(w)   q(w)]

                              w_5. $t_1:t_2$ t_1 & w_5 is accessible from w_c at t_1 and   is true in
                              w_5 and w_5 resembles w_c no less than any other world
                              accessible from w_c at some subinterval of t_2 and in which
                              is true.

                         [[**Sim**]]^{g,c} =
                    p. w_5. w_5 p and w_5 resembles w_c no
                         less than any other world in p w_4. $t_1: t_2$ t_1 & [t_5. w_2. w_2 is
                                                                 accessible from w_c at t_5 and   is
                                                                 true in w_2]$(t_1)(w_4)$ =
                                                                 = w_4. $t_1:t_2$ t_1 & w_4 is
                                                                 accessible from w_c at t_1 and   is
                                                                 true in w_4

  [[∃⊇]]^{g,c} = $P_{<i<st>>}$. w_4. $t_1: t_2$ t_1 & $P(t_1)(w_4)$ t_5. w_2. w_2 is accessible from
                                                                                w_c at t_5 and   is true in w_2.
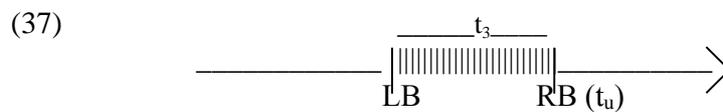
                                                  t_5.[…] $w_2.w_2$ is acc. from w_c at x_5
                                                                        and   is true in w_2

                         w_2. w_2 is accessible from w_c at x_5 [[ϕ]]^{g,c} = w_3. w_3

                    t_4. w_2. w_2 is accessible from w_c at t_4 x_5

                    [[**R**]]^{g,c} = w_c
  w_1. t_4. w_2. w_2 is accessible from w_1 at t_4

The kind of accessibility relation that we are interested here is time-dependent. Given an evaluation world w and time t, the relevantly accessible worlds are those worlds that are compatible with w at t. As time goes by and as the set of propositions true in the actual world expands, possibilities get foreclosed, which means that the set of worlds compatible with the actual world (i.e. compatible with what is possible in the actual world) shrinks over time. Now, let us go over the structure on the previous page in more details. Since the variable which saturates the time argument of the accessibility relation R is bound by the ___ operator and because of the definition of the ___, which worlds are accessible is evaluated not with respect to the whole interval (introduced by the perfect operator) but with respect to each subinterval of this interval, so that for each subinterval we consider the worlds that are accessible at that subinterval. As for the perfect operator, it builds an interval whose right boundary is determined by the c-commanding tense, which in the structure above is the utterance time.

(37)

The truth-conditions of a one-past subjunctive conditional will require that it be true just in case there is a subinterval t_3 whose right boundary is the utterance time and such that in all the possible worlds w such that there is a subinterval of this interval at which w is accessible and such that the antecedent ϕ is true in w and w is maximally similar to the actual world, the consequent is true in w.

(38) $[[\textbf{\textit{If }} \phi \textbf{\textit{, would }} \psi]]^c = 1$ iff ___ t_3: $RB(t_c, t_3)$ & ___$w[$ ___ t_1: t_3 ___ t_1 & w is accessible from w_c at t_1 and ___ is true in w and w resembles w_c no less than any other world ___ is true in w]

We are now in a position to spell out the felicity conditions we gave above, which I repeat below. Here I will focus on indicative and one-past subjunctive conditionals and I will postpone the discussion of two-past subjunctive conditionals to a later section.

(39) Felicity Conditions (presuppositions)
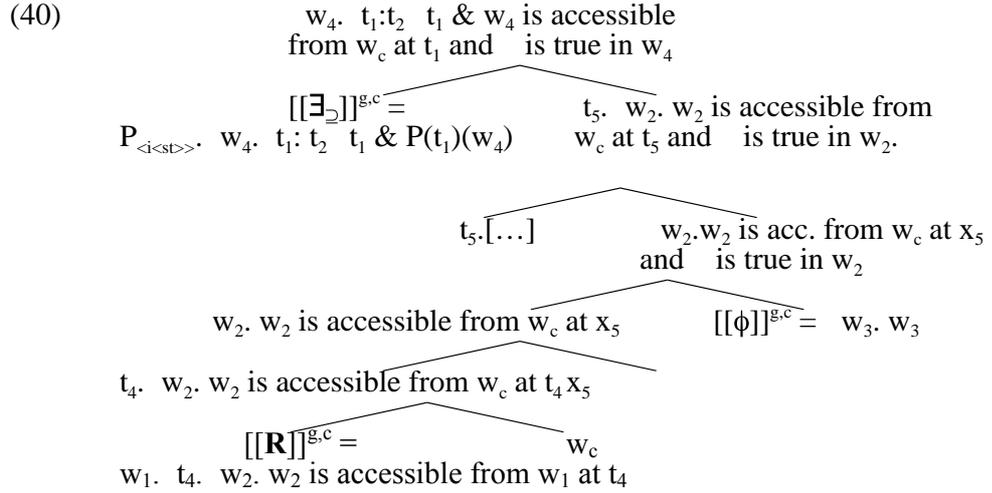   (A) <u>Indicative conditionals</u>
        ϕ ___ c_u
    (B) <u>1-past-subjunctive conditionals</u>
        ϕ ___ c_3
    (C) <u>2-past-subjunctive conditionals</u>
        ϕ ___ c_4

As I already said, the difference between the felicity conditions of indicative and subjunctive conditionals lies entirely in the context set that is selected (c_u versus c_3). I use the expression *context set* to refer to the set of worlds selected by the accessibility relation (the modal base) to which the antecedent is added. The piece of structure that corresponds to these sets is the following.

(40)

$$w_4. \; t_1{:}t_2 \; t_1 \; \& \; w_4 \text{ is accessible from } w_c \text{ at } t_1 \text{ and ... is true in } w_4$$

$[[\exists_{\supseteq}]]^{g,c} =$ $t_5. \; w_2. \; w_2 \text{ is accessible from } w_c \text{ at } t_5 \text{ and ... is true in } w_2.$

$P_{<i<st>>}. \; w_4. \; t_1{:}\,t_2 \; t_1 \; \& \; P(t_1)(w_4)$

$t_5.[\ldots]$ $w_2. w_2 \text{ is acc. from } w_c \text{ at } x_5 \text{ and ... is true in } w_2$

$w_2. \; w_2 \text{ is accessible from } w_c \text{ at } x_5$ $[[\phi]]^{g,c} = \; w_3. \; w_3$

$t_4. \; w_2. \; w_2 \text{ is accessible from } w_c \text{ at } t_4 \, x_5$

$[[R]]^{g,c} =$ w_c

$w_1. \; t_4. \; w_2. \; w_2 \text{ is accessible from } w_1 \text{ at } t_4$

When no perfect and ... operators occur, the time argument of the accessibility relation is the utterance time by default. If the time argument of the accessibility relation is the utterance time, the context set is the set of worlds compatible with what is possible at the utterance time, i.e. c_u. If we assume that the morphological realization of the perfect operator in English conditionals is the past, the kind of conditionals where no perfect operator occurs is indicative conditionals. Thus, in indicative conditionals the context set is the context set at the utterance time (i.e. the main context set), as shown below. In one-past subjunctive conditionals, the perfect operator is interpreted as the time argument of the accessibility relation: hence, c_3 must be the set of worlds compatible with what is possible at any time during the interval t_3 built by the perfect operator, whose right boundary is the utterance time.

(41) Context of evaluation
  $c_u = \{w \; W{:} \; w \text{ is compatible with } w \text{ at } t_u\}$
  $c_3 = \{w \; W{:} \; t_1{:}t_1 \; t_3 \; \& \; w \text{ is compatible with } w \text{ at } t_1\}$

Given the structure of a conditional sentence that I am assuming, the felicity requirement that the antecedent be compatible with the relevant context set is the requirement that the restriction of the modal operator not be empty, which is just an instantiation of the general prohibition against quantifiers having empty domains.[13] We can now account for the following two facts: (1) the difference between indicative and subjunctive conditionals; (2) the puzzle of subjunctive conditionals.

IV. The Puzzle of Subjunctive Conditionals solved

The first fact we want to account for is the following generalization: (A) differently from indicative conditionals, subjunctive conditionals *can* be uttered in contexts where it is known that the antecedent is false; (B) differently from indicative conditionals, when a subjunctive conditional is uttered, the antecedent is understood to be false or unlikely. The pair below exemplified the contrast in (A).

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[13] Thanks to Irene Heim for suggesting this point.

(42) *Jack is dead.*
     a. If he were alive, he would come to the ceremony.
     b. #If he is alive, he will come to the graduation.

Let us start with (A). The set of worlds that we will consider are all the worlds accessible at any time during an interval whose right boundary is the utterance time, and for the conditional to be felicitous it is only required that there be some ϕ-world accessible at some time during this interval. It is not required that that world be accessible at the utterance time. Thus, the conditional can be felicitously uttered if the possibility that Jack is alive now is inconsistent with the current state of affairs. This is not true for indicative conditionals: as the absence of the past morphology indicates, there is no perfect operator to interpret as the time argument of the accessibility relation and, consequently, the accessibility relation will be relative to the utterance time by default. It follows that the set of accessible worlds will only include worlds that are accessible *now* and, consequently, the conditional will be felicitous only if some ϕ-world is accessible now. Because there is now no accessible world where Jack is alive (i.e. it is not consistent with what is possible now that Jack is alive), the indicative conditional in (b) above is deviant.

     This explains only part (A) of the generalization above. To illustrate part B, consider the following example.

(43)   *Sally needs some help moving out of her apartment. Who could she ask for help? Lucy is there to advice Sally.*
    Sally: Charlie is a nice guy.
    a. Lucy: You should definitely ask him, then. If he is nice, he will help you.
    b. Lucy: You should definitely ask him, then. #If he were nice, he would help you.

The (b) sentence above suggests that Lucy is not accepting Sally's statement that Charlie is a nice guy (reason why it is odd after the advice of asking him for help). What this example shows is that, while it is possible to utter an indicative conditional when the speaker accepts the truth of the proposition expressed by the antecedent, it is impossible to utter a subjunctive conditional in these very same circumstances. In order to explain this fact, I suggest that we view the fact that subjunctive conditionals cannot be uttered in contexts where the speaker believes the antecedent to be true or likely as a *scalar implicature* derived from the competition between the presupposition (felicity condition) of indicative conditionals and the presupposition (felicity condition) of subjunctive conditionals. This idea is an extension of the classical theory of implicatures stemming from Grice (1975): not only can two assertions in a relation of asymmetric entailment compete, but so can two presuppositions. There must be a principle requiring that speakers maximize their presuppositions, i.e. that they presuppose as much as it is allowed by the context. Heim (1991) has suggested similar arguments in her discussion of the meaning and use of indefinites. She considers the *unexpected* deviance of the sentence with the indefinite article below.

(44)   a. #I interviewed a father of the victim.
       b. I interviewed the father of the victim.

If we assume the ⟨⟩-analysis of the indefinite article, the definite and indefinite articles stand in an asymmetric entailment relation – [*a* ζ]ξ is entailed by [*the* ζ]ξ, under the Fregean analysis – and, consequently, we expect a scalar implicature to be generated: the use of [*a* ζ]ξ will conversationally implicate that the speaker is not in a position to utter the stronger [*the* ζ]ξ. But since it is known that each person has one and only one father, the sentence with the indefinite article conveys as much information as the sentence with the definite article: why is the former infelicitous then? Heim suggests that we could hypothesize the existence of a principle requiring the speakers to presuppose as much as possible with their utterances: if you can presuppose that *p*, then you must. If such a principle is at work, then the use of the definite article to refer to the father of the victim is required. Further evidence in favor of the "Maximize Presupposition" principle is again due to Heim. Suppose a man is sitting in a restaurant having coffee. If the waiter who served him before were to go to him and were to ask "Would you like a coffee?", his utterance would be infelicitous, for the man is already having *a* coffee. What the waiter should say is "Would you like *another* coffee?". As in the father of the victim's example, there is apparently no reason to rule out the use of the indefinite article given that both the waiter and the customer share the knowledge that the latter has already had a coffee, unless we postulate the existence of some principle requiring the use of the presuppositional item *another* instead of the presupposition-neutral item *a*, if the relevant information is being presupposed. I believe that the infelicity of a subjunctive conditional uttered in a context where the antecedent is known to be likely is parallel to the infelicity of the sentence with the indefinite article uttered in a context where it is known that there is unique individual satisfying the description.

Now we can derive the implicature that the antecedent of a subjunctive conditional is false in detail. The set of worlds quantified over by the modal operator in indicative conditionals, c_u, is the set of worlds accessible at the utterance time; on the other hand, the set of worlds quantified by the modal operator in a one-past subjunctive conditional is the set of worlds accessible at any time during an interval which crucially included the utterance time: thus, the worlds accessible now will be among the worlds accessible during the perfect-time span. In other words, c_u is a subset of c_3. Consequently, being compatible with c_u entails being compatible with c_3, but not vice versa: for any proposition *p*, if *p* is possible at the utterance time, then *p* is also possible in an interval of time which includes the utterance time, but if *p* was possible at some time during an interval which includes the utterance time, it does not follow that *p* is possible at the utterance time (for example, *p* might have been possible at some time in the interval but may be no longer possible now). Thus, the felicity condition for one-past subjunctive conditional asymmetrically entails (are "weaker" than) the felicity condition for indicative conditionals.

(45) Felicity Conditions
    (A) <u>Indicative conditionals</u>
        φ ⊆ c_u
    (B) <u>1-past-subjunctive conditionals</u>
        φ ⊆ c_3

Since the necessary asymmetric entailment holds, the implicature can be derived: if the speaker utters a subjunctive conditional, she is presupposing something weaker than what she would have been presupposing had she uttered an indicative conditional. Her interlocutor will implicate that she was not in a position to make the

stronger presupposition, i.e. to presuppose that the antecedent is compatible with the current context. For a speaker not to even be in a position to presuppose that the antecedent ϕ is compatible with what is currently the case, it means that she must have some reason to doubt that ϕ.

The second fact that we want to account for is what we called the dilemma of one-past subjunctive conditionals: while the antecedent can be inconsistent with what is possible at the utterance time (that is to say, can be impossible), the antecedent's presuppositions cannot. The set of worlds we need seems to have two irreconcilable properties: (i) it must be a set of world such that the possibly epistemically inaccessible antecedent can be consistent with it, and (ii) it must be a set of worlds such that the presuppositions of the antecedent must be entailed by it. In the first example below, that Jack is alive is known to be false, but the subjunctive conditional is felicitous. However, the fact that is known that Charlie does not smoke (and will not smoke tomorrow) causes the infelicity of the second example.

> (46) Jack is dead. If he were alive, he would come to the ceremony.
> (47) Jack quit smoking last year. #If he quit smoking tomorrow, he would not run the marathon.

Above, we accounted for why the antecedent can be inconsistent with the current context (the context at the utterance time). The set of worlds quantified over by the modal operator in a one-past subjunctive conditional is the set of all the worlds w such that there is a time during the perfect-time span at which w is accessible. Because the set of possibility cannot expand over time (i.e. possibilities get either foreclosed or actualized), it is always possible to consider an interval long enough so as to include some time at which the antecedent was still possible. Therefore, the restriction of the modal operator is guaranteed not to be empty and the conditional felicitous. The restriction on the presuppositions of the antecedent, however, must be stronger: PREP requires that the presuppositions of a sentence be entailed by the context of evaluation, and because in one-past subjunctive conditionals the context of evaluation is c_3, the presuppositions of the antecedent must be entailed by c_3. What does it mean to be entailed by c_3? I wish to suggest that to be entailed by c_3 means to be entailed *throughout* the interval t_3, i.e. at each of its subintervals (I will go back to this point below). The conditional in (47) is infelicitous because the antecedent's presupposition – that Jack will smoke tomorrow – is not entailed at every subinterval of the perfect-time span (i.e. by the sets of worlds accessible at each subinterval) for it is not entailed by the set of worlds accessible at the utterance time. The conditional in (46), instead, does not violate PREP because its antecedent does not contain any presupposition at all.

Let me spend a few words on the requirement that the antecedent's presuppositions be entailed throughout the interval. One question that this hypothesis immediately raises is where the universal force of this requirement comes from, given that the quantifier that actually occurs above the antecedent is the existential quantifier. We expect the presuppositions of the proposition under an existential quantifier not to be universal: in the sentence *A woman was talking to her sister*, the presupposition is that *a* woman has a sister, not that every woman has a sister. [14] However, in the conditional cases that we are considering, the presupposition seems to have a universal force. I do not know why this is so, but notice that a similar fact

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[14] Thanks to Kai von Fintel for raising this point.

can be observed in standard uses of the perfect. For instance, consider the perfect sentence *Since 1990 Lucy has been to Boston*: this sentence requires that Lucy be alive throughout the interval, and not just at the time she went to Boston, differently from the sentence *In 1990 Lucy went to Boston*, where the only requirement is that she was alive at some point in 1990, and not that she was alive throughout the whole year. Consider the sentence below, where no temporal adverb occurs to set up the right boundary of the perfect-time span.

(48) Lucy has visited Boston once.

As observed by IAI (2000), this sentence means that during *her lifetime*, Lucy was once in Boston. Thus, the left boundary of the interval is Lucy's birth. Because the right boundary of the interval is set by the present tense, the sentence requires that Lucy's lifetime include the utterance time, i.e. that Lucy be still alive now. We can put this differently. Recall that, following Musan (1997), I assume that most predicates carry the presupposition that their subject is alive or in existence at the time at which they are said to satisfy the predicate. We may think of the interval created by the perfect operator as the interval throughout which the presupposition of the sentence in question holds, and whose left boundary cannot precede the time at which the presupposition held for the first time. In *Lucy has visited Boston*, this gives us an interval such that it is true throughout it that Lucy is alive (Lucy's life). In a sentence like *The meteor has hit the earth once*, the interval will be determined by the meteor's existence. The contrast below (Chomsky 1970) also follows.

(49) #Einstein has visited Princeton.
(50) Princeton has been visited by Einstein.

Consider the infelicitous sentence first. The presupposition of this sentence is that Einstein is alive and this presupposition must be true throughout the interval created by the perfect. Because the interval includes the utterance time (its right boundary is the utterance time), it follows that the presupposition has to be true now too, which is inconsistent with what we know, i.e. that Einstein is dead now. As in the case of subjunctive conditionals the presuppositions of the antecedent must hold throughout the interval whose left boundary is the time at which they were first entailed by the context, in standard perfect sentences the existence presupposition of the sentence must hold throughout the interval introduced by the perfect operator whose left boundary is the time at which these presuppositions first held. We do not have an answer to why this is the case, but the fact that there exists this parallelism between subjunctive conditionals and perfect sentences consolidates the claim that a perfect operator occurs in the structure of subjunctive conditionals.[15,16]

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[15] One note of caution: it may be that different presuppositions behave in different ways. Whether this is so is at this point still an open question.

[16] The essential part of my proposal is that subjunctive conditionals have a hidden temporal structure that contributes to the definition of the accessibility relation, and I have argued that their necessary component is a perfect operator. However, it may be that what we have in the structure of a subjunctive conditional is not an existential perfect (as I proposed above) but a *universal perfect*, i.e. the modal counterpart of *Lucy has been happy since Charlie gave her flowers*. If this were the case, we could explain the requirement that the presuppositions of the antecedent hold throughout the perfect-time span as a consequence of a hidden *universal quantifier* quantifying over subintervals of the perfect-time span. I have not worked out this possibility in detail, but notice that this could also provide an

To sum up, the proposal that I have presented accounts for the properties of indicative and subjunctive conditionals and for their differences. I have proposed a theory that accounts for the puzzle of one-past subjunctive conditionals. The set of worlds we needed seemed to be epistemically accessible worlds since the presuppositions of the antecedent of a subjunctive conditional had to be entailed by it. However, the set of worlds we needed could not possibly be the set of epistemically accessible worlds since often the antecedent itself is known to be false. The theory that I have argued for here solves this dilemma by appealing to the work of a perfect operator interpreted as part of the definition of an accessible world. The perfect operator builds an interval of time whose right boundary is the utterance time. Thus, quantification will be restricted to ϕ-worlds accessible from the actual world at any time during the interval. Crucially, ϕ's presuppositions must be entailed by each set of worlds epistemically accessible at some time during the interval: because the set of worlds accessible at the utterance time is one of them, it follows that ϕ's presuppositions must hold at the utterance time as well. On the other hand, ϕ itself only has to be compatible with this big set of worlds: it is sufficient that there be some world accessible at some time during the interval, for the conditional to be felicitous; it is not required that that time be the utterance time, though, which accounts for the fact that ϕ could be known to be false by the speaker, while the subjunctive conditional is still felicitous.

IV.1 Entailment and Accommodation: What you can and cannot accommodate
Consider again our familiar subjunctive conditional. As we said before, the presuppositions need to be checked at each point during the interval, i.e. they are required to be entailed by each set of worlds accessible at some time during the interval. The right boundary of this interval is the utterance time. Thus, at each time during the interval, Jack smokes.

(51) If Jack quit smoking next summer, he would please his grandmother.

However, there is problem. Although at each point in the interval Jack smokes, it is still not *entailed* by the set of accessible worlds at each time during the interval that

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answer to why in so many languages subjunctive conditionals are marked by *imperfective* morphology for – as shown in Iatridou and al. 2000 – in many languages standard occurrences of the universal perfect are marked by imperfective morphology. The expected correlation is that in languages that mark standard occurrences of universal perfect with imperfective morphology, subjunctive conditionals will also be marked by imperfective morphology. I have not yet done a cross-linguistic survey, but let me mention that Italian does indeed behave in this expected way. In Italian, the universal perfect is expressed by the present tense (indicative), as shown in (i). Notice that the present tense is imperfective and, as (ii) illustrates, it can be used to talk about ongoing eventualities. If you compare (i) with the subjunctive conditional given in (5), you will see that in both the imperfective component appears, which corroborates the correlation sketched above.

(i)   Lucia ama Carlo da tre anni.
         Lucia love-PRES/IND Carlo from three years
         'Lucia has loved Carlo for three years'
(ii)   Cosa fa Lucia? Guarda il telegiornale.
         What do-PERS/IND Lucia? (She) watch-PRES/IND the news
         What is Lucia doing? She is watching the news.

Future research will hopefully establish whether it is in fact a universal perfect that occurs in the LF-structure of a subjunctive conditional.

Jack will be smoking next summer, for at each subinterval of the perfect-time span, there are accessible worlds where, for example, Jack quits smoking next week and in these worlds it is not true that he will smoke next summer and, consequently, the antecedent is undefined. In *some* of the accessible worlds Jack smokes next summer. Does this force us to abandon the entailment requirement? Are we going to replace it with the weaker compatibility requirement? I will first give an argument that we *may* keep the entailment requirement. Then, I will give an argument that we *must*.

Let us begin with the 'may' argument. What we need is accommodation. Remember that each time during the interval is an evaluation point: the presuppositions of the antecedent must be checked then. However, as we said out above, each set of accessible worlds will also include worlds where Jack quits smoking after the evaluation time (the subinterval) but before next summer (e.g. this Christmas). These are the worlds that need to be eliminated if we want to keep the entailment requirement. Once we eliminate them, what we are left with are worlds where Jack smokes at the evaluation time and still smokes next summer. If accommodation takes place, the set of accessible worlds will shrink in the desired way. Accommodation also accounts for why the following conditional is infelicitous. Among the worlds accessible at any time during the interval (the utterance time – being its RB – is included), there are worlds where, for example, Jack will start smoking this Christmas, i.e. worlds where the presupposition of the antecedent (that Jack will smoke next summer) is true. However, the conditional is infelicitous.

> (52) Jack quit smoking last year. #If he quit smoking next summer, he would not run the marathon.

Its infelicity tells us that all those worlds where he starts smoking between now and Christmas are eliminated, something that we can account for by assuming that accommodation has taken place.

I believe that accommodation is in fact what goes on and that we must keep the entailment requirement, instead of the weaker compatibility requirement. The reason is the following. Suppose that Charlie does not smoke now, and that I do not know enough about him to have an opinion about whether he will or will not start smoking at some point in the future. Even though it is compatible with what I know that there is future time between now and next summer when he will start smoking, if I do not *know* (or assume) that he *will* start smoking, I cannot appropriately say *If he quit smoking next summer, he would please his grandmother*. Hence, a mere compatibility relation is not enough.

Furthermore, notice that it is necessary that accommodation is performed at the subinterval level, i.e. that at each subinterval there are worlds in which the relevant presupposition is true. As pointed out to me by Irene Heim, if accommodation where allowed to be performed globally over the whole set of worlds *w* accessible at some time in the interval, it would also take place in one-past subjunctive conditionals whose presuppositions are inconsistent with the current context and, as a result, the unwanted worlds would be eliminated and the one-past subjunctive conditional would be predicted to be felicitous, contrary to fact. To see this point, let us go back to our familiar example repeated below.

> (53) Jack quit smoking last year. #If he quit smoking next summer, he would not run the marathon.

We argued that the problem with it is that the worlds accessible now are worlds in which Jack does not smoke next summer (and therefore cannot quit), even though t_3 (the perfect-time span) can be long enough so as to include some antecedent-worlds (i.e. some worlds where Jack will quit smoking next summer). Consequently, c_3 can contain (epistemically inaccessible) worlds where the antecedent ϕ and its presupposition are true. Now, if it was possible to have global accommodation, it would apply here, it would eliminate all the accessible worlds where Jack does not smoke next summer, and it would leave in the context set only worlds where he does smoke next summer. So, given the way c_3 is constructed, if global accommodation occurred, the one-past subjunctive conditional would be felicitous. But it is not. Hence, global accommodation cannot apply. However, for accommodation to apply at each subinterval, there must be worlds where Jack will smoke next summer which are accessible at each subinterval: since in the example above, there are no worlds accessible now where he smokes next summer, accommodation cannot take place and the presupposition that Jack will smoke next summer will not be entailed at the utterance time and, *a fortiori*, throughout the interval.

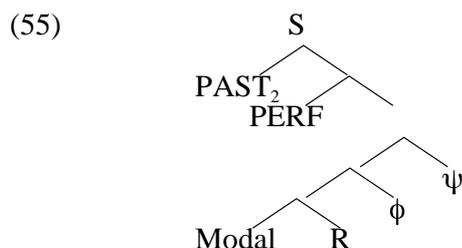**IV.2 Mismatched two-past Subjunctive Conditionals**
I proposed that the one layer of past that we see in English subjunctive conditionals is the morphological realization of a 'high' perfect operator, that is to say, a perfect that is interpreted in the modal domain, more specifically as contributing to the definition of the accessibility relation. The questions that we will ask in this section are the following: (1) What is the role of the second layer of past that we see in mismatched two-past subjunctive conditionals? (2) What accounts for the meaning contrast between one-past and two-past subjunctive conditionals? Let us begin with question (1).

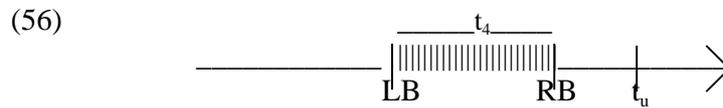Consider again our example of a two-pasts subjunctive conditional.

(54) *Jack quit smoking last year.*
     If he had quit smoking tomorrow, he would have run the marathon.

As I explained above, here we have two layers of past to account for, because neither of them is about when Jack's quitting is supposed to take place (the supposition is about the future). As for the layer of past that obligatorily occurs in subjunctive conditionals, I proposed that is a perfect operator in disguise. But here we have two layers of past. What does the second layer of past contributes? Recall that we want to account for the difference in meaning between a one-past subjunctive conditional and a two-pasts subjunctive conditional (cf. (16) and (17) above), and we want to relate this difference to the different temporal morphology we see. My proposal is that the skeletal structure of a mismatched two-past subjunctive conditional is as follows. As above, ϕ is the antecedent and ψ is the consequent.

(55)

25

The second layer of past is a real past tense and modifies a time, but this time cannot be the time at which the eventuality described in the antecedent is said to take place (since that eventuality is said to occur in the future). As the structure above illustrates, I take the second layer of past that occurs in mismatched two-past subjunctive conditionals to provide the value for the right boundary of the perfect-time span. Because the right boundary of the perfect-time span is a past time, the whole interval will be past with respect to the utterance time, as shown in the picture below.

(56)

Therefore, what we have in the modal domain of a mismatched two-past subjunctive conditional is a real *past perfect*, like in the sentence *Last Monday, Jack had already quit smoking*, where the right boundary of the interval is (some time) last Monday. The truth-conditions for a two-past subjunctive conditional will be as follows. The more detailed structure is given in (58).[17]

(57) $[[\textbf{\textit{If}}\ \phi,\ \textbf{\textit{would have}}\ \psi]]^c = 1$ iff t_4: $RB(t_2,t_4)$ &   w[t_1: t_4 t_1 &   w is accessible from w_c at t_1 and   is true in w and w resembles w_c no less than any other world   is true in w] *defined if $t_2 < t_c$.*

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(58)

t_4: RB(t_2,t_4) & w[t_1: t_4 t_1 & w is accessible from w_c at t_1 and is true in w
and w resembles w_c no less than any other world is true in w], *defined only if g(2)<t_c.*

[[**PAST₂**]]^{g,c} t_6. t_4: RB(t_6,t_3) & w[t_1:t_4 t_1 & w is accessible from w_c at t_1 and is true
in w and w resembles w_c no less than any other world is true in w]

[[**Perf**]]^{g,c} =
  P. t_6. t_4: RB(t_6,t_4) & P(t_4)=1

t_2. w[t_1: t_2 t_1 & w is accessible from w_c at t_1 and is true in w
and w resembles w_c no less than any other world is true in w
]

t_2. […]   w[t_1:t_2 t_1 & w is accessible from w_c at t_1 and
is true in w and w resembles w_c no less than
any other world is true in w]

q. w[t_1:t_2 t_1 & w is accessible from w_c at t_1 [[ψ]]^{g,c} = w_6. w_6
and is true in w and w resembles w_c no less
than any other world q(w)]

[[**Modal**]]^{g,c} =
  p. q. w[p(w) q(w)]

w_5. t_1:t_2 t_1 & w_5 is accessible from w_c at t_1 and is true in
w_5 and w_5 resembles w_c no less than any other world
accessible from w_c at some subinterval of t_2 and in which
is true.

[[**Sim**]]^{g,c} =
  p. w_5. w_5 p and w_5 resembles w_c no
less than any other world in p

w_4. t_1: t_2 t_1 & [t_5. w_2. w_2 is
accessible from w_c at t_5 and is
true in w_2](t_1)(w_4) =
= w_4. t_1:t_2 t_1 & w_4 is
accessible from w_c at t_1 and is
true in w_4

[[∃⊇]]^{g,c} = P$_{<i<st>>}$. w_4. t_1: t_2 t_1 & P(t_1)(w_4) t_5. w_2. w_2 is accessible from
w_c at t_5 and is true in w_2.

t_5.[…] w_2.w_2 is acc. from w_c at x_5
and is true in w_2

w_2. w_2 is accessible from w_c at x_5 [[φ]]^{g,c} = w_3. w_3

t_4. w_2. w_2 is accessible from w_c at t_4 x_5

[[**R**]]^{g,c} = w_c
w_1. t_4. w_2. w_2 is accessible from w_1 at t_4

27

The essential component of subjunctive conditionals is a perfect operator interpreted at the top of the modal structure and contributing to the interpretation of the accessibility relation. In one-past subjunctive conditional, where the only past you see is in fact the perfect in disguise, the right boundary of the interval is set to the utterance time by default. However, in two-pasts subjunctive conditionals, what you see is in fact a past perfect, where the second layer of past sets the right boundary to a time before the utterance time.

IV.2.1 The Felicity Puzzle: one versus two layers of past

What we need to do now is to account for the semantic properties of these conditionals, in particular the contrast between one-past and two-past subjunctive conditionals that we discussed in section 3.1.[18] The felicity conditions for subjunctive conditionals are repeated below.

(59) <u>1-past-subjunctive conditionals</u>
      ϕ c_3
<u>2-past-subjunctive conditionals</u>
      ϕ c_4

Recall the examples we used above to illustrate the contrast. Suppose Jack quit smoking last year. An utterance of a one-past subjunctive conditional is infelicitous, whereas an utterance of a two-past subjunctive conditional making exactly the same supposition is felicitous.

(60) Jack quit smoking last year. #If he quit smoking tomorrow, he would not run the marathon.
(61) Jack quit smoking last year. If he had quit smoking tomorrow, he would not have run the marathon.

As it should be by now familiar, the presuppositions of the antecedent have to be checked at each subinterval in the perfect-time span, i.e. they are required to be entailed by each set of worlds accessible at a subinterval in the perfect-time span. If a second layer of past occurs, we have the structure of a past perfect, where the past is higher than the perfect operator and provides the value for the right boundary of the interval. More precisely, the right boundary will be the contextually salient past time, i.e. the time immediately before which Charlie quit smoking last year. Because the right boundary is a past time, the whole interval lies in the past. It follows that the presuppositions of the antecedent do not have to be entailed by the set of worlds accessible at the utterance time, since the utterance time is not a subinterval of c_4. In our example, what is required is that the presupposition that Charlie will smoke tomorrow is entailed by the set of worlds accessible throughout the interval whose right boundary precedes the time when he quit smoking; it is not required that it be entailed by the set of worlds accessible now. This explains why the mismatched past subjunctive conditional is appropriate even if the speaker knows that the presupposition in the antecedent is false.

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[18] What follows is taken from Ippolito 2001 where I discuss mismatched two-past subjunctive conditionals in greater detail. I refer the reader to that article for a more thorough presentation of the puzzle and the solution. See also Ippolito 2002a and 2002b.

However, the pairs below show that not only can a mismatched two-pasts subjunctive conditional be felicitously uttered when the speaker knows that the antecedent is false or impossible, but it must. One-past and two-past subjunctive conditionals are in complementary distribution.

(62) *Jack still smokes.*
 If he quit next summer, he would win the Boston marathon.
 #If he had quit next summer, he would have won the Boston marathon.

(63) *Jack quit smoking last year.*
 #If he quit next summer, he would not win the Boston marathon.
 If he had quit next summer, he would not have won the Boston marathon.

Why is a two-past subjunctive conditional appropriate *only* if the speaker knows that the presupposition is false? The evaluation context for a mismatched two-past subjunctive conditional is c_4. What is c_4? Analogously to c_3 (the evaluation context of a one-past subjunctive conditional), c_4 is the set of worlds w such that there is a subinterval of the perfect-time span at which w is accessible.

(64) $c_4 = \{w \quad W: \quad t_1 : t_1 \quad t_4 \ \& \ w$ is compatible with the speaker's knowledge at $t_1\}$

In Ippolito 2001, I propose to derive the impossibility of the antecedent in mismatched two-past subjunctive conditionals as a scalar implicature, in the same way in which we derived the difference between indicative and one-past subjunctive conditionals. As in that case, I assume a "Maximize presuppositions" principle: the competition occurs between the presupposition (felicity condition) of one-past and two-past subjunctive conditionals (in (55) above). Because the set of possibilities shrinks over time, given two times t_1 and t_2 where $t_1 < t_2$, the set of worlds compatible with what is possible at t_1 (what we called the context set at t_1) is either as big as or bigger than the set of worlds compatible with what is possible at t_2 (what we called the context set at t_2). It follows that for a proposition to be compatible with the context set at t_2 entails for that proposition to be compatible with the context set at t_1, but not vice versa. Therefore, when the speaker chooses to utter a mismatched two-past subjunctive conditional, she chooses to presuppose something weaker than what she would have presupposed had she uttered a one-past subjunctive conditional. Hence, the competition takes place.

(65) **Competition:**
 a. You presupposed: $\quad$ $\phi \quad c_4$ $\qquad\qquad$ where $c_3 \quad c_4$
 b. You didn't presuppose: $\quad$ $\phi \quad c_3$
 c. Hence: $\qquad\qquad\quad$ $\neg(\phi \quad c_3 \quad)$ $\quad \equiv \quad$ $\phi \cap c_3 = \varnothing$

The implicature is that the antecedent is incompatible with c_3, which includes the set of worlds accessible at the utterance time; that is to say, the antecedent is either false or impossible.

4.2.2 Cancelability

I have argued that the implicature that the antecedent of mismatched past subjunctive conditionals is not true is drawn because the speaker chose to make reference to what

was possible at some past time rather than referring to what is possible at the time of the utterance, which would have been more informative. What distinguishes implicatures from both assertions and presuppositions is that they can be canceled, that is to say, that there may be contexts where the conditions that force the implicature to be drawn are missing, and, consequently, the implicature is suspended. In this section, I will show that this is in fact the case for the implicature that the antecedent of mismatched two-past subjunctive conditionals is not true. In particular, I will show that the implicature will not be drawn in cases where it would not have been *relevant* to talk about what is currently possible.

Suppose Jack is a subject in an experiment on the psychological consequences of quitting to smoke. The experiment pays according to how long the subject has been a smoker during the experiment. Jack had to decide when to quit smoking. The last time I saw him was a few days ago, and I am now reporting to you bits of the conversation we had, and the thoughts that went through Jack's mind before he decided to quit in six months: "He was really torn: true, if he had quit in three months, he would have made $1000. But <u>if he had quit in six months, he would have made $2000 but would have been worse for his health</u>. In the end, he decided that it would be safest for him to quit in three months". The point of this example is that I am reporting Jack's words and thoughts at *the moment of his decision*. What is the case at the time of the utterance is irrelevant, and consequently, there is no competition the one-past subjunctive counterpart, the implicature of falsity is not drawn, and the mismatched past subjunctive conditional can be uttered in a context where the speaker believes that the antecedent (that Jack will quit smoking in three months) is true.

V. The Content of Accessibility Relations

Above I proposed that accessibility relations are not just binary relations between worlds but that they need to be thought of as ternary relations where the third element is a time. The notion of accessibility we used was time-sensitive. In this section, I wish to argue that this notion of accessibility is necessary and that theories that appeal (only) to time-independent notions fail to account for the facts that we discussed above. More specifically, I will show that Lewis 1979's analysis of counterfactuals in terms of *overall similarity* cannot be maintained.

V.1 Worlds and the Direction of Time: Lewis 1979

Lewis 1979 is concerned with the question of how the asymmetry of counterfactual dependence can be explained by a semantics analysis of counterfactual conditionals. By the expression "the asymmetry of counterfactual dependence", Lewis refers to the claim that there is a counterfactual dependence in one direction of time (from the past to the future) and counterfactual independence in the other direction (from the future to the past). In other words, whereas it is reasonable to imagine that if the present were different, the future would be different too, it is not as reasonable to suppose that if the present were different, then the past would be different too. The objective of a good semantic analysis of subjunctive conditionals must account for this asymmetry. The first semantic analysis that Lewis considers builds this asymmetry into the analysis itself.

(66) ANALYSIS 1. Consider a counterfactual "If it were that A, then it would be that C" where A is entirely about affairs in stretch of time t_A. Consider all those possible worlds w such that:

(1) A is true at w;

(2) w is exactly like our actual world at all times before a transition period beginning shortly before t_A;

(3) w conforms to the actual laws of nature at all times after t_A;

(4) during t_A and the preceding transition period, w differs no more from our actual world than it must to permit A to hold.

The counterfactual is true if and only if C holds at every such world w.

Analysis 1 guarantees that the worlds you will consider are worlds maximally similar to the actual world up to (shortly before) t_A, t_A being the time at which the situation described in the antecedent is supposed to take place. If t_C follows t_A, then C may be false in our world, since the actual world is like the possible worlds in which A is true only up to t_A. However, if t_C precedes t_A, then because of point (2) of Analysis 1, C will have to be true in the actual world too. Thus, the counterfactual asymmetry is guaranteed.

Lewis has some arguments against Analysis 1. For example, he claims that Analysis 1 is built for a special case, that is to say, for cases where the hypothetical situation is about a particular time. However, there are suppositions that are not about particular times, as in the examples below. I will not discuss here these cases.[19]

(67) If kangaroos had no tails …

(68) If gravity went by the inverse cube of distance …

The semantic analysis that Lewis considers to be correct purports to *derive* the asymmetry of counterfactual dependence rather than to build it into the truth-conditions of the counterfactual, and it is based on the notion of *comparative similarity of possible worlds*.

(69) ANALYSIS 2. A counterfactual "If it were that A, then it would be that C" is (non-vacuously) true if and only if some (accessible) world where both A and C are true is more similar to our actual world, overall, than is any world where A is true but C is false.

Overall similarity among worlds is clearly a vague notion. And in fact Lewis takes this to be a good aspect of the theory since counterfactuals are vague. However, something has to be said about what sort of similarity relation can be combined with Analysis 2 to obtain what Lewis calls he standard resolution of vagueness: "one that invalidates back-tracking arguments, one that yields an asymmetry of counterfactual dependence except perhaps under special circumstances, one that agrees with Analysis 1, our asymmetry-by-fiat analysis, whenever it ought to" [Lewis 1986: 42-43].

"If kangaroos had no tails, they would topple over" seems true. Still, if kangaroos had no tails but used crutches, they would *not* topple over. "If Nixon had

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[19] In fact, these examples may follow from the notion of accessibility relation that I have been assuming, whereby a world is accessible from an evaluation world at a certain time if it is compatible with what is possible in the evaluation world at that time. In the first of the two examples above, we can take the relevant evaluation time to be the time at which it was still possible for kangaroos to have no tail, i.e. the time that immediately preceded the creation of that species. Similarly, in the second example the relevant evaluation time will be the time at which gravity began (before which, for example, the universe was different and obeyed different laws).

pressed the button there would have been a nuclear holocaust" also seems true. But, again, if Nixon had pressed the button but the fatal signal had vanished on its way from the button to the rockets, there would *not* have been a nuclear holocaust (Lewis 1979:45). Which worlds are to count as the most similar worlds to the actual world in order for the conditionals above to come out true? Lewis' recipe comes in four points, in order of priority.

> (70) SIMILARITY FUNCTION.
>> (1) It is of the first importance to avoid big, widespread, diverse violations of law.
>> (2) It is of the second importance to maximize the spatio-temporal region throughout which perfect match of particular fact prevails.
>> (3) It is of the third importance to avoid even small, localized, simple violations of law.
>> (4) It is of little or no importance to secure approximate similarity of particular fact, even in matters that concern us greatly.

The claim that I would like to argue for here is that neither Analysis 1 nor Analysis 2 can be maintained. First, I will show that Lewis' Analysis 2 cannot account for the meaning of mismatched two-pasts subjunctive conditionals; more generally, it cannot account for the difference between non-past subjunctive conditionals and mismatched past subjunctive conditionals. Secondly, I will show that Analysis 1 cannot either, unless it is modified precisely along the lines that I have suggested in this paper.

V.2 Overall Similarity is not enough

In the actual world, Jack quit smoking last year and never started again. Imagine a world w_1 in which Jack quits smoking tomorrow. We don't want w_1 to be a world where the actual laws are violated: for example, we do not want w_1 to be a world in which the *same* quitting can occur twice. Thus, w_1 had better be a world in which Jack did not quit smoking last year. This world will be the closest possible world to the actual world that meets the priorities listed in (70).

> (71) *Jack quit smoking last year.*
>> If Jack had quit smoking tomorrow, he would have run the Boston marathon.

Analysis 2 seems correct for the mismatched past subjunctive conditional above: the conditional is true just in case Jack does not run the Boston marathon in the world w_1 most similar to the actual world where he quits smoking tomorrow. The definition of the similarity function guarantees that the conditional above comes out true by excluding worlds where he quit last year (worlds where you can do the *same* action twice are worlds that do not obey the actual laws), as well as worlds where he quits smoking tomorrow but – say – he breaks his leg and cannot run.

The problem is that the existence of this world w_1 which is the world closest to the actual world according to the right weighs and priorities, does not account for the felicity difference between the two types of subjunctive conditionals we have been investigating in this paper, i.e. mismatched two-pasts subjunctive conditionals and one-past subjunctive conditionals. Below is the one-past version of the subjunctive conditional above: as we are familiar from the previous discussion, in the scenario described above, the one-past subjunctive conditional is infelicitous.

(72) *Jack quit smoking last year.*
　　　#If Jack quit smoking tomorrow, he would not run the Boston marathon.

Lewis' Analysis 2 does not account for the difference in appropriateness. It predicts that the two subjunctive conditionals should pattern alike. After all, what is the difference if all there is to consider is overall similarity between worlds?

V.3 The Time of the Divergence

Analysis 1 fails too. Consider the two subjunctive conditionals discussed above. Recall that the problem Analysis 2 faces is that it does not seem to be able to distinguish between the two types of subjunctive conditionals below. Consequently, it does not seem to be able to account for why one but not the other is infelicitous, let alone correlate this difference with the different tense morphology that they employ.

(73) If Jack had quit smoking tomorrow, he would not have run the Boston marathon.
(74) #If Jack quit smoking tomorrow, he would not run the Boston marathon.

As it stands, Analysis 1 does not do much better: if we keep Lewis' definition – which I repeat below – both conditionals are predicted to pattern alike. This is because the time of the divergence between the actual world and the possible worlds being considered is the time at which the situation described in the antecedent is supposed to take place. In both conditionals, this time is tomorrow. Thus, in both cases the possible worlds most similar to the actual world are identical to the actual world up to (some time) tomorrow, when they diverge from the actual course of events. But, then, again we predict both types (two-pasts and one-past subjunctive conditionals) to be true and felicitous.

(75) ANALYSIS 1. Consider a counterfactual "If it were that A, then it would be that C" where A is entirely about affairs in stretch of time t_A. Consider all those possible worlds w such that:
　(1) A is true at w;
　(2) w is exactly like our actual world at all times before a transition period beginning shortly before t_A;
　(3) w conforms to the actual laws of nature at all times after t_A;
　(4) during t_A and the preceding transition period, w differs no more from our actual world that it must to permit A to hold.
The counterfactual is true if and only if C holds at every such world w.

However, there is a way to amend Analysis 1 that does account for the contrast above: the time of the divergence should not be the time that the supposition is about (i.e. the time at which the hypothetical situation is supposed to hold or take place) but the time argument of the accessibility relation. In turn, the time argument of the accessibility relation is determined by the tense of the subjunctive conditional, as I proposed in the preceding sections of this paper. In two-pasts subjunctive conditionals (below), the second layer of past is interpreted as the right boundary of the perfect-time span.

(76) If Jack had quit smoking tomorrow, he would not have run the Boston marathon.

The past time in the accessibility relation (the right boundary of *R*) will be the contextually salient past time at which something happened that foreclosed the possibility that he would quit smoking tomorrow: this time is (some time during) last year, when he actually quit smoking. This is the time at which the possible worlds that we are quantifying over in the truth-conditions of the two-pasts subjunctive conditional diverge from the actual world. At some point during the perfect-time span and before its right boundary, it was possible that Jack would quit smoking tomorrow. What we need are the worlds accessible then.

As for one-past subjunctive conditionals, we want to account for both the deviance of (77) and the felicity of (78). Let us start with the latter.

(77) #If Jack quit smoking tomorrow, he would not run the Boston marathon.
(78) Zack is dead. If he were alive, he would be hundred years old.

The right boundary of the perfect-time span is the utterance time. What we want are those possible worlds accessible at some time during the perfect-time span but before its right boundary: because we can go back in time before some possibility was foreclosed in the actual world, there will be a time in the perfect-time span at which it was still possible that Zack would be alive now. The worlds over which we want to quantify are worlds accessible then. This explains the felicity of the example. As for the infelicitous (77), the fact that we can find a time during the perfect-time span at which it was possible that Jack would quit smoking tomorrow (i.e. a time before the time at which he actually quit) does not rescue the conditional because of the requirement that we discussed above that the presuppositions of the antecedent be entailed throughout the interval. Because the perfect interval includes the utterance time, the presupposition that Jack will smoke tomorrow must hold now, contrary to fact. Thus, the sentence is infelicitous.

To sum up, I have shown that we need a time-dependent notion of accessibility relation and that simply having a timeless notion of similarity will not account for the differences between one-past and two-past subjunctive conditionals. Before I conclude, let me spend a few words on the fact that we need both a time-sensitive accessibility relation and an overall similarity relation (see (58)). Suppose the speaker utters the conditional below, and suppose that Jack died six months ago and that Zack decided to attend the ceremony only a week ago.

(79) If Jack had come to the ceremony tomorrow, he would have met Zack.

According to the analysis that I have argued for above, the conditional above is felicitous if Jack's coming to the ceremony tomorrow was compatible with what was possible in the actual worlds at some past time. The contextually salient past time is the time at (or immediately before) which Jack died. In other words, all the worlds we are quantifying over are worlds compatible with what was possible *then*. However, at that past time, many possibilities were open and not all entailing the truth of the consequent: for example, although it was possible that Zack would come and that Jack would meet Zack, it was also possible that Zack would not come and that Jack would not meet Zack. The problem is that it is not true that Jack will meet Zack in all the worlds that were compatible with what was possible in the actual world last year. The reason why the speaker seems to be allowed to say that Jack *would* have met Zack had he come to the ceremony tomorrow, is that the speaker *now* knows that Zack is one of the invitees, i.e. that the actual world is such that Zack will come to the

ceremony tomorrow. Therefore, what we want is not just the set of worlds accessible at a certain past time such that the antecedent is true. What we want is the set of worlds compatible with what was possible at some past time and such that they are *maximally similar* to the actual world. To illustrate this point, reconsider the ceremony example. Call the proposition that Zack comes to the graduation *p*, and the proposition that Zack does not come to the ceremony ¬*p*: last year, the actual world was compatible with both *p* and ¬*p*. Thus, the set of worlds accessible at that time included both *p*-worlds and ¬*p*-worlds. However, in the actual world, only *p* is true, i.e. the actual world is a *p*-world. By requiring that the worlds selected be maximally similar to the actual world, we actually eliminate all the ¬*p*-worlds, and are left only with *p*-worlds in which the antecedent is true (i.e. in which Jack comes to the ceremony tomorrow). And in these worlds, it is true that Jack meets Zack.

In order to restrict the modal operator to antecedent-worlds maximally similar to the actual world, we need a similarity function. Which worlds are to be regarded as the most similar to the actual world is relative to some proposition: thus, we will say that a world *w* is maximally similar to the actual world with respect to a proposition *p* just in case there is no *p*-world more similar to the actual world than *w*. In our case, we need the set of worlds maximally similar to the actual world among those worlds that are accessible at some past time and where the antecedent is true.

(80) $[[\textbf{Sim}]]^w = \lambda p_{<st>}. \lambda w'. w' \in p$ and w' resembles w no less than any other world in p.

Sim is the function that takes a proposition – i.e. the set of worlds that are accessible at some past time and such that the antecedent is true – and gives in return the set of worlds among them such that they are maximally similar to the actual world.

To conclude, I have proposed a solution to the puzzle of mismatched past subjunctive conditionals: the second layer of past morphology that clashes with the future temporal adverb in the antecedent is interpreted in the "modal domain", where by "modal domain" I mean that it contributes to the internal composition of the accessibility relation. More specifically, I have shown that once we have a general theory of subjunctive conditionals (i.e. a theory of the role of the first layer of past morphology), the role of the second past in mismatched past subjunctive conditionals follows. What we see is a real past perfect, and the second layer of past sets the right boundary of the perfect time span, exactly what happens in non-modal occurrences of the past perfect. Furthermore, I have argued that neither Lewis' Analysis 1 nor Lewis' Analysis 2 can account for the contrast between a one-past subjunctive conditional and a two-pasts subjunctive conditional. I suggested that only a modification of Analysis 1 can: such a modified analysis is what I have proposed in this paper and it crucially employs a time-dependent notion of accessibility.

VI. Conclusion and remaining issues

The question that has driven my investigation is "Why is a past tense the hallmark of subjunctive conditionals?". This was a very puzzling fact: what is the relation between temporal morphology and modal interpretation? In this paper I have suggested an answer: the past morphology that we see in subjunctive conditionals like *If Jack played tomorrow, he would win* is in fact the morphological realization of a 'high' perfect operator, i.e. a perfect operator interpreted in the "modal domain". Therefore, the occurrence of temporal morphology in subjunctive conditionals is no

longer puzzling: the temporal morphology receives a temporal interpretation, as it would in its 'low' uses. One question remains: if the hallmark of subjunctive conditionals is a perfect operator, why do we see a past tense? We seem to have a case where what looks like a past is in fact semantically a perfect. Interestingly, we do know that the reverse occurs: some occurrences of the perfect are interpreted as past. For example, in the sentence (a) below the past perfect *had left* must be interpreted as two pasts, one "agreeing" with the matrix past *told* and one part of the original utterance ("Zack left on Monday"). The past perfect could not be interpreted as both a past (required by the matrix past) and a present perfect as part of Jack's original utterance because the present perfect is incompatible with the adverb *on Monday* and could not have been part of Jack's utterance. Similarly for the sentence in (b), where what Jack confessed is "I left at 3pm'.

(81) a. On Saturday Jack told me that Zack had left on Monday.
　　　 Jack: "Zack left on Monday"
　　　 Jack: # "Zack has left on Monday"

　　 b. Yesterday, Jack confessed to having left at 3pm.
　　　 Jack: "I left at 3pm"
　　　 Jack: # "I had left at 3pm"

What I am suggesting is that in the semantics there are two objects, the past and the perfect, and that their morphological realization is not always transparent in either way: as there are occurrences of the perfect interpreted as past, there are occurrences of past interpreted as perfect. In the reported speech examples above, the past perfect is the only possible morphological realization of two pasts in the same clause. For lack of space I cannot go into the details of why English (and other languages) cannot realize the perfect operator at work in subjunctive conditionals as a perfect (Ippolito 2002b). However, if this hypothesis is correct, we expect to find some language whose morphology can and does realize the perfect in subjunctive conditionals.[20]

To conclude, I have argued that accessibility relations are complex relations involving not only a world but also a time of evaluation. The truth-conditions and felicity-conditions of modal sentences depend on the time of the accessibility relation. In indicative conditionals and indicative modal sentences, the time of the accessibility relation is the utterance time, in that no temporal element occurs above the modal at logical form. However, in subjunctive conditionals and non-indicative modal sentences where a past tense obligatorily occurs, a perfect operator occurs above the modal operator at logical form: the perfect creates an interval of time such that the modal operator quantifies over worlds accessible at some time during the interval.[21] In subjunctive conditional and modal sentences where only one layer of past occurs, the right boundary of this interval is the utterance time, by default. However, in subjunctive conditionals and non-indicative modal sentences with two layers of past morphology, the role of the second layer of past is to shift the right boundary of the interval to some time earlier than the utterance time, so that the whole interval is past relative to the utterance time. Thus, temporal and aspectual operators can occur *low* or *high* in a structure. *Low* occurrences of the perfect and the past are interpreted at LF

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[20] I have argued in Ippolito 2002b that Bulgarian seems to be this language.
[21] When I say that a past tense occurs, I mean that some tense occurs that has a past component or expresses a past meaning.

where they are spelled out, i.e. in the Tense Phrase. These are the standard uses of perfect and past like in the sentences *Jack has been to Boston once* and *Jack came to Boston once*, respectively. *High* occurrences of perfect and past are what we sometimes called "modal" occurrences: although they are spelled out 'low' (i.e. in the TP), they are interpreted at LF in the restriction of a (possibly covert) modal operator. Temporal mismatches force these temporal elements to be interpreted high at LF so as not to clash with the temporal adverb that occurs inside the relevant proposition (syntactically, within the TP).

This proposal offered an account of the systematic difference between indicative and subjunctive conditionals, as well as of the difference between indicative and non-indicative modal sentences. While explaining what is the common element to all "subjunctive" conditionals, it also allowed us to account for the difference among subjunctive conditionals, i.e. between one-past subjunctive conditionals and two-pasts subjunctive conditionals with respect to their felicity conditions.

Finally, in my analysis of conditionals I have followed the spirit of Stalnaker (1975)'s and Heim (1992)'s analyses, even though I departed from their views in substantial ways. Furthermore, the notion of accessibility that I showed to be necessary is *time-dependent*, and I argued that Lewis' notion of *overall similarity* alone does not account for the cases studied in this dissertation. I discussed both analyses discussed in Lewis (1979) – Analysis 1 and Analysis 2 – and I argued that neither of them is able to account for the differences in truth and felicity conditions between one-past subjunctive conditional and mismatched two-pasts subjunctive conditional. However, our analysis, which employs a time-dependent notion of accessibility, can.

References

Bonomi, A.: 1997, "Aspect, Quantification and *when*-clauses in Italian", *Linguistics and Philosophy* **20**: 469-514.

Chomsky, N.: "Deep Structure, Surface Structure, and Semantic Interpretation", in R. Jakobson and S. Kawamoto (eds.), *Studies in General and Oriental Linguistics*.

Dowty, D.: 1979, *Word Meaning and Montague Grammar*. Reidel, Dordrecht.

Dudman, V. H.: 1983, "Tense and Time in English Verb Clusters of the Primary Pattern", *Australian Journal of Linguistics*, **3**, 25-44.

Dudman, V. H.: 1984, "Conditional Interpretations of *if*-sentences", *Australian Journal of Linguistics*, **4**, 143-204.

Von Fintel, K.: 2001 "Counterfactuals in a Dynamic Context", in M. Kenstowicz(ed.) *Ken Hale. A life in Language*, MIT Press: Cambridge, Massachusetts.

von Fintel, K.: 2000, "What is Presupposition Accommodation?", manuscript, MIT.

von Fintel, K.: 1998, "The Presupposition of Subjunctive Conditionals", in U. Sauerland and O. Percus (eds.) *The Interpretive Tract*, MITWPL volume 25.

von Fintel, K.: 1994, *Restrictions on Quantifier Domains*, GLSA, Amherst, Massachusetts.

von Fintel, K. and S. Iatridou: 2002, "Since ~~since~~", manuscript, MIT.

Giorgi, A. and F. Pianesi: 1997, *Tense and Aspect. From Semantics to Morphosyntax.* Oxford University Press, Oxford.

Goodman, N.: 1947 "The Problem of Counterfactual Conditionals", *Journal of Philosophy*, XLIV, 113-128. Reprinted in N. Goodman (1983) *Facts, Fiction and Forecast*, Harvard University Press, Cambridge, Massachusetts.

Grice, H.P.: 1975, "Logic and Conversation", in P. Cole & J. Morgan (eds.), *Syntax and Semantics 3: Speech acts*, 41-58, New York: Academic Press.

Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, University of Massachusetts at Amherst.

Heim, I.: 1983, "On the Projection problem for Presuppositions", *WCCFL* **2**: 114-125.

Heim, I.: 1991, "Articles and Definiteness", in A. v. Stechow & D. Wunderlich (eds.), *Semantics. An international Handbook of Contemporary Research*, Berlin: de Gruyter.

Heim, I.: 1992, "Presuppositions Projection and the Semantics of Attitude Verbs", *Journal of Semantics* **9**, 183-221.

Heim, I.: 1994, "Comments on Abusch's theory of tense", in H. Kamp (ed.) *Ellipsis, Tense and Questions*. University of Amsterdam.

Iatridou, S.: 2002, "More Perfect Constructions", manuscript, MIT.

Iatridou, S.: 2000, "The Grammatical Ingredients of Counterfactuality", *Linguistic Inquiry*, Volume 31, Number 2 231-270

Iatridou, S., E. Anagnostopoulou, R. Izvorski: 2000, "Observations About the Form and Meaning of the Perfect", in M. Kenstowicz (ed.), *Ken Hale: A Life in Language*, MIT Press, Cambridge, Massachusetts.

Ippolito, M.: 2001, "Presuppositions and Implicatures in Counterfactuals", forthcoming in *Natural Language Semantics*.

Ippolito, M.: 2002a, "The Contribution of Tense to Modality", in Mako Hirotani (ed.) *NELS 32*, GLSA, Amherst, Massachusetts.

Ippolito, M.: 2002b, *The Time of Possibilities. Truth and Felicity of Subjunctive Conditionals*. MIT Dissertation.

Ippolito, M.: 2002b, "A pragmatic analysis of Imperfect Conditionals" (2002), forthcoming in R. Cameron, L. Lopez and R. Nunez (eds.) *Selected papers from the LRSL XXXI*. John Benjamins Publishing Company.

Kartunnen, L.: 1974, "Presupposition and linguistic context", *Theoretical Linguistics*, **I**, 181-94.

Kartunnen, L. and S. Peters: 1979, "Conventional Implicature", in C.-K. Oh and D. A. Dinneen (eds.), *Syntax and Semantics 11: Presupposition*, Academic Press, New York, 1-56.

Kratzer, A.: 1998, "More Structural Analogies Between Pronouns and Tenses", in *Proceedings of SALT VIII*.

Kratzer, A.: 1991, "Modality", in A. von Stechow and D. Wunderlich (eds.), *An International Handbook of Contemporary Research*, 639-650. Berlin: de Gruyter.

Kratzer, A.: 1986, "Conditionals", CLS 22.

Kratzer, A.: 1981a, "Revision and Partition: The Semantics of Counterfactuals", *Journal of Philosophical Logic*, 10, 201-216.

Kratzer, A.: 1981b, "The Notional Category of Modality", in H-J. Eikmeyer and H. Rieser (eds.), *Words, Worlds, and Contexts*, 38-74. Berlin: de Gruyter.

Lewis, D.: 1968, *On the Plurality of Worlds*, Basil Blackwell, Oxford.

Lewis, D.: 1973, *Counterfactuals*, Harvard University Press, Cambridge, MA.

Lewis, D.: 1975, "Adverbs of Quantification", in E. Keenan (ed.), *Formal Semantics of Natural Language*, 3-15, Cambridge University Press, Cambridge, MA.

Lewis, D.: 1979, "Counterfactual Dependence and Time's Arrow", *Noûs* 13, 455-76. Reprinted in D. Lewis (1986) *Philosophical Papers*. Volume II, Oxford University Press, Oxford.

McCoard, J.: 1978, *The English Present Perfect: Tense-Choice and the Pragmatic Inferences*, Amsterdam: North-Holland Press.

Ogihara, T.: 2000, "Counterfactuals, Temporal Adverbs, and Association with Focus", in *SALT 10*, CLS Publications, Cornell University.

Portner, P.: 1992, *Situation Theory and the Semantics of Propositional Expressions*. Unpublished Ph.D. Dissertation, University of Massachusetts at Amherst.

Stalnaker, R.: 1968, "A Theory of Conditionals". *Studies in Logical Theory. American Philosophical Quarterly*.

Stalnaker, R.: 1973, "Presuppositions", *Journal of Philosophical Logic* **2**: 447-457.

Stalnaker, R.: 1974, "Pragmatic Presuppositions", in M. Munitz and P. Unger (eds.) *Semantics and Philosophy*, New York University Press, New York.

Stalnaker, R.: 1975, "Indicative Conditionals", in *Philosophia*. 5, 269-286. Monograph: 2 (Blackwell). Reprinted in Stalnaker 1999, *Context and Content*, Oxford University Press, Oxford.

Stalnaker, R.: 1978, "Assertion". In P. Cole (ed.), *Syntax and Semantics: 9*, 315-322.

Stalnaker, R.: 1988, "Belief Attribution and Context", in R. Grimm and D. Merrill (eds.), *Contents of Thoughts*, 140-156, University of Arizona Press, Tucson.

Stalnaker, R.: 1998, "On the Representation of Context", *Journal of Logic, Language and Information* **7**: 3-19.

Thomason, R.: 1990, "Accommodation, Meaning, and Implicature: Interdisciplinary Foundations for Pragmatics", in P. Cohen, J. Morgan and M. Pollack (eds.), *Intentions in Communication*, 325-363, MIT Press, Cambridge, Massachusetts.