Counterfactuals, Correlatives, and Disjunction. *

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Abstract. The natural interpretation of counterfactuals with disjunctive antecedents involves selecting from each of the disjuncts the worlds that come closest to the world of evaluation. It has been long noticed that capturing this interpretation poses a problem for a minimal change semantics for counterfactuals, because selecting the closest worlds from each disjunct requires accessing the denotation of the disjuncts from the denotation of the disjunctive antecedent, which the standard boolean analysis of *or* does not allow (Creary and Hill 1975, Nute 1975, Fine 1977, Ellis et al. 1977).

This paper argues that the failure to capture the natural interpretation of disjunctive counterfactuals provides no reason to abandon a minimal change semantics. It shows that the natural interpretation of disjunctive counterfactuals is expected once we refine our assumptions about the semantics of *or* and the logical form of conditionals, and (i) we assume that disjunctions introduce propositional alternatives in the semantic derivation, in line with independently motivated proposals about the semantics of *or* (Aloni 2002, Simons 2005, Alonso-Ovalle 2006); and (ii) we treat conditionals as correlative constructions, as advocated in von Fintel 1995, Izvorski 1996, Bhatt and Pancheva 2001, and Schlenker 2001.

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1. The Problem

Consider the following scenario: the summer is over and you and I are visiting a farm. The owner of the farm is complaining about last summer's weather. To give us an example of its devastating effects, he points to the site where he used to grow huge pumpkins: there is a bunch of immature pumpkins and many ruined pumpkin plants. He then utters the counterfactual in (1):

(1) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop.
(A variation on an example in Nute 1975.)

We conclude, right then, that there is something strange about this farmer. We have a strong intuition that the counterfactual in (1) is false: if we had had good weather this summer, he would have had a good crop, but we know for a fact — and we assume that the farmer does too — that if the sun had grown cold, the pumpkins, much as everything else, would have been ruined.

The problem that this article deals with is that a standard minimal change semantics for counterfactuals (Stalnaker, 1968; Stalnaker and Thomason, 1970; Lewis, 1973) fails to capture this intuition: if the usual boolean semantics for *or* is assumed, a standard minimal change semantics for counterfactuals predicts the counterfactual in (1) to be true.

To see why this is so, we need to adopt a simple minimal change semantics for counterfactuals.

In a minimal change semantics, evaluating whether a counterfactual is true involves checking whether the consequent is true in the world(s) in which the antecedent is true that are as close as possible to the actual world. We will assume here that *would* counterfactuals are true in the actual world if and only if the consequent is true in all the worlds where the antecedent is true that differ as little as possible from the actual world.[1]

To state these truth-conditions formally, we will take the interpretation of counterfactuals to be relative to a relation of comparative similarity defined for the set of accessible worlds W (which, we will assume, is the set of *all* possible worlds). Following Lewis (1973, p. 48), we will take any admissible relation of comparative similarity $\leq_w$ to be a weak ordering of W, with the world w alone at the bottom of the ordering (w is more similar to w than any other world w').[2] We will also make what Lewis calls 'the Limit Assumption': for any world w and set of worlds W we assume that there is always at least one world w' in W that come closest to w. Under these assumptions, the semantics of *would* counterfactuals can be formalized by means of a class selection function f that picks up for any world of evaluation w, any admissible relation of comparative similarity $\leq_w$, and any proposition p, the worlds where p is true that come closest to w.

(2) For any proposition p, worlds w, w', and any relation of relative similarity $\leq$,
$f_{\leq_w}(p)(w') \leftrightarrow [p(w') \; \& \; \forall w''[p(w'') \rightarrow w' \leq_w w'']]$

We can now state the truth-conditions of *would*-counterfactuals as follows: a *would* counterfactual is true in a world w (with respect to an admissible ordering) if and only if all worlds picked up by the class selection function

[1] For the differences between the minimal change semantics presented in Lewis 1973 and Stalnaker 1968, see Nute 1984, which provides an overview of the different flavors minimal change semantics come in.

[2] A weak ordering is a relation that is transitive (for any worlds w', w'', w''', whenever $w' \leq_w w''$ and $w'' \leq_w w'''$, then $w' \leq_w w'''$) and strongly connected (for any worlds w' and w'', either $w' \leq_w w''$ or $w'' \leq_w w'$). Unlike in a *strong* ordering, ties are permitted (two different elements can stand in the relation to each other). 'Being as old as', 'being at least as far from Boston as' are naturally interpreted as weak orderings. In our metalanguage,'$w' \leq_w w''$' is meant to convey that w' is at least as similar to w as w'' is.

(all the closest worlds to w in which the antecedent is true) are worlds in which the consequent is true.

(3) $[\![\text{If } \phi, \text{then would } \psi]\!]^{\leq}(w) \Leftrightarrow \forall w'[f_{\leq_w}([\![\phi]\!])(w') \rightarrow [\![\psi]\!](w')]$

Let us see now why, contrary to our intuitions, this semantics predicts the counterfactual in (1) (repeated in (4) below) to be true in the situation we started the discussion with.

(4) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop.
(A variation on an example in Nute 1975.)

The semantics in (3) predicts the counterfactual in (4) to be true in the actual world with respect to an admissible ordering if and only if the worlds in the proposition expressed by the antecedent of the conditional in (4) that come the closest to the actual world in the ordering are all worlds where we have a bumper crop. What is the proposition expressed by the antecedent of the conditional in (4)? The disjunction in the antecedent of the counterfactual in (4) operates over the propositions in (5a) and (5b).

(5) a. $[\![\text{we had had good weather this summer}]\!] = \lambda w.\mathbf{good\text{-}weather}_w$

b. $[\![\text{the sun had grown cold}]\!] = \lambda w.\mathbf{grow\text{-}cold}_w(\mathbf{s})$

Under the standard boolean semantics of *or*, the proposition expressed by the *if*-clause is the union of the set of worlds where the summer weather was good and the set of worlds where the sun grows cold:[3]

[3] In the metalanguage, I make use of a two-sorted language (Gallin, 1975). World arguments are subscripted. For the purposes of illustration, I take **good-weather** to be a predicate of worlds. The contribution of tense and mood is ignored. I will omit the superscript indicating that the interpretation function is relative to a relative similarity ordering when the ordering bears no effect on the interpretation.

(6) $[\![$If we had had good weather this summer or the sun had grown cold$]\!]$
$= \lambda w.\mathbf{good\text{-}weather}_w \vee \mathbf{grow\text{-}cold}_w(\mathbf{s})$

According to the semantics in (3), then, the counterfactual in (1) is predicted to be true in the actual world with respect to an admissible ordering of worlds if and only if the closest worlds where the proposition in (6) is true are all worlds where we have a bumper crop.

(7) $[\![(4)]\!]^{\leq}(w_0) \Leftrightarrow \forall w'[f_{\leq_{w_0}}([\![(6)]\!])(w') \rightarrow [\![\text{we have a bumper crop}]\!](w')]$

The problem is that the truth-conditions in (7) are too weak. In the scenario we started the discussion with, the counterfactual in (4) is evaluated with respect to an intuitive notion of relative similarity according to which the possible worlds where the sun grows cold are more remote from the actual world than the possible worlds where we have a good summer (more actual facts have to be false in a world where the sun grows cold than in a world where we have good summer weather). This similarity relation is represented in fig. 1 on page 6, where each circle represents a set of worlds that are equally close to the actual world, the dotted line surrounds the worlds where the sun gets cold, and the solid line the worlds where there is good weather this summer. With respect to this relation of comparative similarity, none of the worlds in which the proposition in (6) is true where the sun grows cold can count closer to the actual world than the worlds where we have a good summer. The selection function, therefore, only returns worlds where we have a good summer. Since in all the closest worlds where we have a good summer it is true that we have a bumper crop, the counterfactual in (4) is predicted to be true, contrary to our intuition.

When coupled with the standard boolean semantics for *or*, a minimal change semantics for counterfactuals does not capture by itself the natural

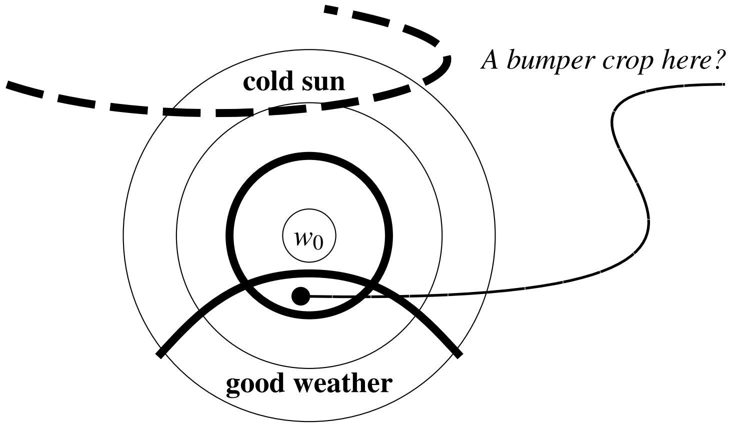


Figure 1. The problem of disjunctive antecedents.

interpretation of *would* counterfactuals with disjunctive antecedents: *would* disjunctive counterfactuals are naturally interpreted as claiming that the consequent is true in the closest worlds in *each* of the disjuncts; under a minimal change semantics, however — at least if the standard boolean semantics for *or* is assumed — they are predicted to claim that their consequent is true in the closest worlds in the union of the disjuncts.

The problem was first pointed out in the philosophical literature in the mid-seventies, and taken as an argument against Lewis' minimal change semantics for counterfactuals (Lewis, 1973).[4] There have been many reactions to it since then (see Nute 1984 and Nute and Cross 2001 for an overview.) For some researchers, the problem justifies abandoning a minimal change semantics for counterfactuals altogether: Ellis et al. (1977), for instance, proposed abandoning a possible world semantics for subjunctive conditionals, Warmbrōd (1981) advocates adopting a context-dependent downward monotonic semantics, and, most recently, Herburger and Mauck (2007) propose developing an event-based semantics. There might be reasons to abandon

[4] See, among others, Creary and Hill 1975, Nute 1975, Fine 1977, and Ellis et al. 1977.

a minimal change semantics for counterfactuals, but the goal of this article is to show, as van Rooij (2006) does, that the failure to capture the natural interpretation of disjunctive counterfactuals need not be one.

This article argues that the natural interpretation of disjunctive counterfactuals is in fact expected, even within a minimal change semantics, once we refine our assumptions about the semantics of *or* and the logical form of conditionals, and (i) we assume that disjunctions introduce propositional alternatives in the semantic derivation, in line with independently motivated recent proposals about the semantics of *or* (Aloni, 2003a; Simons, 2005; Alonso-Ovalle, 2006); and (ii) we treat conditionals as correlative constructions (as advocated in von Fintel 1995, Izvorski 1996, Bhatt and Pancheva 2001 and Schlenker 2001).

The article is organized as follows: section 2 presents the analysis, it shows that once counterfactuals are interpreted as correlatives, and a Hamblin-style semantics for *or* is adopted, the natural interpretation of *would* disjunctive counterfactuals is expected; section 3 shows that there are reasons to believe that the natural interpretation of disjunctive counterfactuals is not due to a downward entailing inference; section 4 discusses some problems for the derivation of their interpretation as a conversational implicature, section 5 discusses further two assumptions of the analysis, and section 6 concludes the discussion by introducing some issues for further research.

2. The Analysis

The analysis of counterfactuals with disjunctive antecedents that we will entertain makes two novel assumptions: the first has to do with the semantics of disjunction, and the second with the logical form of conditionals. In the illustration of the problem in section 1, we have taken for granted the standard boolean semantics for *or*. In line with recent work on the semantics of natural language disjunction (Aloni, 2003a; Simons, 2005; Alonso-Ovalle, 2006), we will assume, instead, that *or* introduces into the semantic derivation a set of propositional alternatives. The proposal will be cast in section 2.1 within a Hamblin-style alternative semantics. We will then adopt in section 2.2 a compositional analysis of conditionals that assumes that they are correlative constructions. The natural interpretation of disjunctive counterfactuals is shown to follow from these two assumptions.

2.1. Disjunctive Antecedents in an Alternative Semantics

We start by laying out the Hamblin-style alternative semantics in which the analysis will be cast.[5]

In a Hamblin semantics, expressions of type τ are mapped to sets of objects in D_τ. Most lexical items denote singletons containing their standard denotations: the proper name in (8a) is mapped to a singleton containing an individual, and the verbs in (8b-8c) are mapped to a singleton containing a property.

(8) a. $[\![\text{Sandy}]\!] = \{\mathbf{s}\}$

b. $[\![\text{sleep}]\!] = \{\lambda x.\lambda w.\mathbf{sleep}_w(x)\}$

c. $[\![\text{see}]\!] = \{\lambda y.\lambda x.\lambda w.\mathbf{see}_w(x,y)\}$

[5] Charles Leonard Hamblin developed an alternative semantics in his analysis of questions (Hamblin, 1973). A Hamblin semantics has been invoked in the analysis of focus (Rooth, 1985; Rooth, 1992), and indeterminate pronouns (Ramchand, 1997; Hagstrom, 1998; Kratzer and Shimoyama, 2002; Alonso-Ovalle and Menéndez-Benito, 2003)

We will only be concerned for the most part with the way expressions combine by functional application. In an alternative semantics, functional application is defined pointwise, as in (9) below: to combine a pair of expressions denoting a set of objects of type $\langle \sigma, \tau \rangle$ and a set of objects of type σ, every object of type $\langle \sigma, \tau \rangle$ applies to every object of type σ, and the outputs are collected in a set.

(9) *The Hamblin Rule*
If $[\![\alpha]\!] \subseteq D_{\langle \sigma, \tau \rangle}$ and $[\![\beta]\!] \subseteq D_{\sigma}$, then
$[\![\alpha(\beta)]\!] = \{\ c \in D_{\tau} \mid \exists a \in [\![\alpha]\!] \exists b \in [\![\beta]\!] (c = a(b))\ \}$ (Hamblin, 1973)

Within this framework, it is natural to assume that *or* introduces into the semantic derivation the denotation of the disjuncts as alternatives:[6]

(10) *The* Or *Rule*
Where $[\![\mathrm{B}]\!], [\![\mathrm{C}]\!] \subseteq \mathrm{D}_{\tau}$, $\left[\!\!\left[\begin{array}{ccc} & \mathrm{A} & \\ \mathrm{B} & \mathrm{or} & \mathrm{C} \end{array} \right]\!\!\right] \subseteq \mathrm{D}_{\tau} = [\![\mathrm{B}]\!] \cup [\![\mathrm{C}]\!]$

With these assumptions in mind, let us consider again the disjunctive counterfactual in (1), repeated in (11) below:

(11) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop.

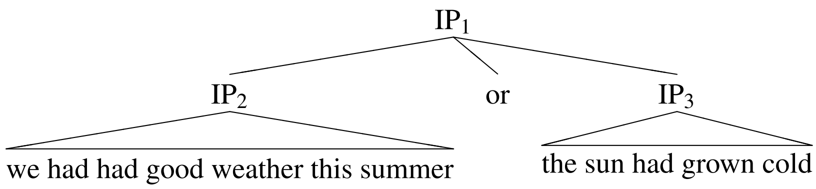
(A variation on an example in Nute 1975.)

[6] In what follows, we will represent the internal structure of disjunctions at LF as flat. It is inmaterial for the present analysis whether it is, but the reader is referred to Munn 1993 and den Dikken 2003, where the internal structure of disjunctive constituents is assumed *not* to be flat.

Although the rule in (10) associates *or* with set union, the role of *or* is different from the role of *or* under its standard boolean analysis. Notice that, in the rule in (10), B and C denote *sets* of semantics objects. *Or*, according to this rule, simply collects those semantics objects into a set, rather than mapping those objects into their boolean join.

We will assume, as we did when illustrating the problem in section 1, that the disjunction within the antecedent operates over two propositions. The relevant interpretable structure of the disjunction within the *if*-clause is the one in (12) below:

(12)



In the discussion of the example in section 1, we took for granted the textbook semantics for *or*, under which IP_1 denotes a proposition (the set of worlds in which at least one of the disjuncts is true). We will now drop that assumption. In the Hamblin-style semantics that we are assuming, IP_1 denotes a set of propositions. *Or* operates over the denotation of IP_2 and IP_3. IP_2 denotes the singleton containing the proposition that we have good weather this summer, and IP_3 the singleton containing the proposition that the sun grows cold. IP_1 denotes the union of these two sets: the set containing the proposition that we have good weather this summer and the proposition that the sun grows cold.

(13) a. $[\![$ We had had good weather this summer $]\!] =$
$\{\lambda w.\textbf{good-weather}_w\}$

b. $[\![$ The sun had grown cold $]\!] = \{\lambda w.\textbf{grow-cold}_w(\mathbf{s})\}$

c. $[\![\mathrm{IP}_1]\!] = \left\{ \begin{array}{c} \lambda w.\textbf{good-weather}_w, \\ \lambda w.\textbf{grows-cold}_w(\mathbf{s}) \end{array} \right\}$

The interpretation of disjunctive counterfactuals illustrated in section 1 involves checking whether the consequent holds in the closest worlds in each disjunct. For this interpretation to be captured in a standard minimal change semantics, the selection function needs to apply to each of the propositions that *or* operates over. Under the standard semantics for *or*, the selection function can only see the proposition that the whole disjunction denotes. That causes the problem. Under the present setup, however, the denotation of the disjuncts can be easily retrieved from the denotation of the whole disjunction. In principle, the semantic composition of conditionals can now access each disjunct on its own to select the worlds that come closest to the world of evaluation. How does the set of propositions in the antecedent contribute to the semantic composition of conditionals? To see how the semantics can select the closest worlds in each of the disjuncts we need to say something about the logical form of conditionals. We will see in the next section that a natural answer emerges once we assume that conditionals are correlative constructions.

2.2. Conditionals as Correlatives

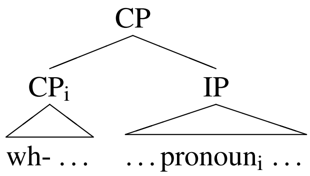
In line with much syntactic and semantic work on conditionals (von Fintel, 1994; Izvorski, 1996; Bhatt and Pancheva, 2006; Schlenker, 2004), we will assume that conditionals are correlative constructions.

The analysis that I present next builds on work on the semantics of correlatives by Veneeta Dayal (Srivastav, 1991b; Srivastav, 1991a; Dayal, 1995; Dayal, 1996). There are two main components to it: first, the consequent of a conditional is analyzed as denoting a property of propositions, much as the main clause of a correlative denotes a property of individuals (this is possible once *then* is analyzed as a propositional anaphor); and, second, *if*-clauses are analyzed as universal quantifiers ranging over propositions, much as antecedents of correlatives universally quantify over individuals.

2.2.1. Then *as a resumptive pronoun*

In correlatives, a relative clause adjoined to the matrix clause provides an anaphoric pronoun inside the main clause with an antecedent.

(14)



The construction is illustrated in (15) with a few examples from Hindi:

(15) a. [jo laRkii khaRii hai]$_i$ vo$_i$ lambii hai
which girl standing be-present she tall be-present
'Which girl is standing, that one is tall.' (Dayal 1996, p. 188).

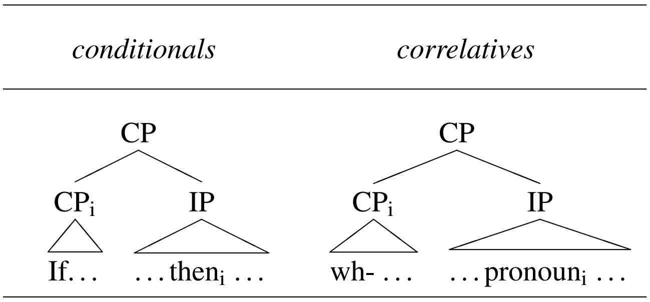
b. [jo laRkiyaaN khaRii haiN]$_i$ ve$_i$ lambii haiN
which girls standing be-present they tall be-present
'Which girls standing are, they are tall.' (Dayal 1996, p. 192).

c. [jo do laRkiyaaN khaRii haiN]$_i$ ve$_i$ lambii
which two girls standing be-present they tall
haiN
be-present
'Which two girls are standing, they are tall.'

(Dayal 1996, p. 192)

In conditionals, *then* has been analyzed as a resumptive pronoun that picks up the denotation of the *if*-clause as its antecedent, much as in other types of correlatives a pronoun ranging over individuals picks up the denotation of the relative clause that serves as its antecedent, as illustrated in (16) below (Iatridou, 1991b; Iatridou, 1991a; Iatridou, 1994; von Fintel, 1994; Hegarty, 1996). We will follow this analysis.

(16)



As other natural language quantifiers do, modals range over a contextually supplied domain. We will capture this contextual dependency by assuming that they take as an argument a pronoun ranging over propositions (von Fintel, 1994). *Then*, I want to assume, is one such pronoun, which is in complementary distribution with a covert counterpart.[7] Its interpretation, like the interpretation of other pronouns, is provided by the variable assignment. At LF, *then* bears an index. In the type of alternative semantics that I am assuming, *then* denotes a singleton containing the proposition that the variable assignment maps its index to:[8]

(17) $[\![\text{then}_{\langle 7,\langle s,t\rangle\rangle}]\!]^g = \{g(\langle 7,\langle s,t\rangle\rangle)\}$

What is the semantic import of the anaphoric link between the *if*-clause and the pronoun *then* in the main clause? Dayal (1996) assumes that the anaphoric relation between the relative and the pronoun in the main clause is a case of variable binding. The antecedent of a correlative is a generalized quantifier, which takes as an argument the property that results from abstract-

[7] This is a simplification. Schlenker (2004) argues that *then* is really doubling an implicit argument.

[8] A variable assignment is assumed to be a function from pairs of natural numbers and type specifications to entities of the right type. In what follows, I will use a slightly different notation: instead of writing ‘$\text{then}_{\langle 7,\langle s,t\rangle\rangle}$’, I will write ‘$\text{then}_{7_{\langle s,t\rangle}}$.’

ing over the pronoun in the main clause, as illustrated below with a plural correlative.[9]

(18) jo laRkiyaaN khaRii haiN ve lambii haiN
which girls standing be-PR they tall be-PR
'Which girls are standing, they are tall.' Dayal (1996, p. 192)

(19) IP : $\forall x[(\mathbf{girl}(x)\ \&\ \mathbf{stand}(x)) \rightarrow \mathbf{tall}(x)]$

CP$_{\mathrm{i}}$: $\lambda P_{\langle e,t\rangle}.\forall x[(\mathbf{girl}(x)\ \&\ \mathbf{stand}(x)) \rightarrow P(x)]$ IP : $\mathbf{tall}(x)$

which girls standing be they$_i$ tall be

Once *then* is analyzed as a propositional anaphor, we can analyze the consequent of a conditional as denoting a property of propositions, much as the consequent of a correlative denotes a property of individuals.

Consider again, for instance, the counterfactual that we opened this article with, repeated in (20) below:

(20) If we had had good weather this summer or the sun had grown cold, (then) we would have had a bumper crop.

(A variation on an example in Nute 1975.)

We will assume that the interpretable structure of its consequent is as in (21).

(21) IP

$\oplus$ $\otimes$

would then$_{5_{\langle s,t\rangle}}$ we have had a bumper crop

[9] In the illustration in (19), I simplify a bit for expository reasons. Srivastav (1991, p.668) assumes that the domain of individuals is closed under sum formation and treats the antecedent of a plural correlative as a universal quantifier whose domain of quantification is the supremum of the set of girls who are standing, as in (i) below. If the predicate abstract with which this quantifier combines is distributive, as in the example in (19), the resulting truth conditions are equivalent.

(i) $\lambda P_{\langle e,t\rangle}.\forall x[(x = \iota x.(^*\mathbf{girl}(x)\ \&\ \mathbf{stand}(x)) \rightarrow P(x)]$ (see Srivastav 1991)

Would is assumed to be a function that takes two propositions p and q as arguments and returns (the singleton) containing the proposition that is true in a world w if and only if the closest worlds to w where p is true are all worlds where q is true.

(22) $[\![\text{would}]\!]^{\leq,g} = \{\lambda p_{\langle s,t\rangle}.\lambda q_{\langle s,t\rangle}.\lambda w.\forall w'[f_{\leq_w}(p)(w') \rightarrow q(w')]\}$

With respect to any admissible similarity relation $\leq$, the LF in (21) denotes the singleton containing the proposition that is true in a world w if and only if the worlds in the proposition that *then* takes as its antecedent that come closest to w in the relevant ordering are all worlds where we have a bumper crop.

(23) $$[\![(21)]\!]^{\leq,g} = \left\{ \lambda w.\forall w' \left[\begin{array}{c} f_{\leq_w}(\mathrm{g}(5_{\langle s,t\rangle}))(w') \\ \rightarrow \\ \textbf{have-a-bumper-crop}_{w'}(\textbf{we}) \end{array} \right] \right\}$$

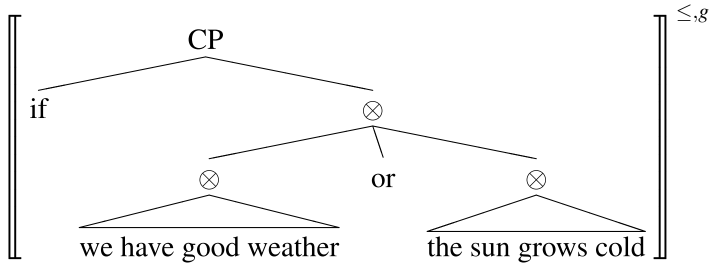
By abstracting over *then* in (21), we end up with (a set containing) a function from propositions to propositions that maps any proposition p into the proposition that is true in a world w if and only if the p-worlds that come closest to w are all worlds where we have a bumper crop.[10]

(24) $$\left[\!\!\left[\; [_{\odot}\ 5_{\langle s,t\rangle}\ [_{\mathrm{IP}}\ [_{\oplus}\ \text{would}\ \ \text{then}_{5_{\langle s,t\rangle}}]\ [_{\otimes}\ \text{we have had a bumper crop}]]] \; \right]\!\!\right]^{\leq,g} =$$
$$\{\lambda p_{\langle s,t\rangle}.q_{\langle s,t\rangle} \mid q \in [\![(21)]\!]^{\leq,g[p/5_{\langle s,t\rangle}]}\}$$

[10] For ease of exposition, I assume that the lambda abstraction is represented at LF by means of an index, as in Heim and Kratzer 1998. From now on, I will use the expression 'the p-worlds' to refer to the worlds where a certain proposition p is true.

2.2.2. If-*clauses as quantifiers over propositions*

What is the denotation of the *if*-clause? The antecedent of a correlative denotes, under Dayal's analysis, a generalized quantifier: a property of properties of individuals. The relative in the example in (19) denotes a property of properties of individuals that holds of any property P if and only if P holds of every individual which is a girl and is standing. Under the Hamblin-style analysis of disjunction that we are assuming, we can treat the *if*-clause in parallel to Dayal's analysis as denoting a property of properties of propositions which holds of any property of propositions $P_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}$ if and only if $P_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}$ holds of every proposition in the set of propositional alternatives denoted by the antecedent (a singleton, in the case of non disjunctive antecedents; a set that contains all the atomic propositional disjuncts in the case of disjunctive antecedents.) The *if*-clause in (25) denotes, under this analysis, a property of properties of propositions that holds of any property of propositions $P_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}$ in a world w if and only if $P_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}$ holds in w of the proposition that we have good weather this summer and of the proposition that the sun grows cold.

(25) 

$$= \left\{ \lambda f_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}.\lambda w.\forall p \left[p \in \left\{ \begin{array}{c} \lambda w.\textbf{good-w}_w, \\ \lambda w.\textbf{cold}_w(\textbf{s}) \end{array} \right\} \rightarrow f(p)(w) \right] \right\}$$

The denotation of the whole conditional can be now calculated by applying the denotation of the *if*-clause to the denotation of the consequent.

(26) $[\![(20)]\!]^{\leq,g} = [\![(25)]\!]^{\leq,g}([\![(24)]\!]^{\leq,g})$

Under the present analysis, the sentence in (20) denotes, for any admissible ordering, the singleton containing the proposition that is true in a world *w* if and only if all the closest worlds to *w* in which we have good weather are worlds where we have a bumper crop, and all the closest worlds to *w* in which the sun grows cold are worlds where we have a bumper crop.[11] With respect to an ordering that makes every world where the sun grows cold less similar to the actual world than any world where we had good weather this summer, the sentence in (20) expresses a proposition that is false in the actual world, because none of the closest worlds to the actual world where the sun grows cold are worlds where we have a good crop. The intuition reported in section 1 is then captured.[12]

2.2.3. *The universal force*

The analysis of disjunctive counterfactuals that we have entertained has two main components: the assumption that *or* introduces a set of alternatives into the semantic derivation allows for the selection function to have access to each of the disjuncts; the assumption that conditionals, much like other correlatives, convey universal quantification over the type of entities described by the antecedent captures the intuition that a disjunctive counterfactual of the form of (27a) is equivalent to the conjunction of counterfactuals of the type of (27b) and (27c).

[11] Notice that, in the present analysis, the non-monotonicity of questions is due to the semantics of the modal in the consequent.

[12] In the analysis that we have just presented, *then* is a bound variable pronouns ranging over the propositions in the domain set up by the *if*-clause. An anonymous reviewer points out that the alternatives introduced by a disjunction in a modal context can also be suitable antecedents for *then* in intersentential anaphora cases such as (i) below (example due to the reviewer):

(i) Let us suppose that John Kerry or Hillary Clinton became president. Then Bill Clinton would / might become ambassador to the United Nations.

(27) a. If ϕ or ψ, then would ξ.

b. If ϕ, then would ξ.

c. If ψ, then would ξ.

Before concluding this section, I would like to address the source of this second meaning component.

We have treated *if*-clauses as universal quantifiers ranging over propositions. Dayal (1996) treats the antecedent of correlatives as definite descriptions: the antecedent of the plural correlative in (28) below denotes the maximal sum of girls that are standing. Since the main clause is associated with a distributive property, the whole correlative is predicted to be true if and only if every girl is tall.

(28) a. jo laRkiyaaN khaRii haiN ve lambii haiN
which girls standing be-PR they tall be-PR
'Which girls are standing, they are tall.' (Dayal 1996, p. 192)

b. IP : $\mathbf{tall}(\iota x[^*\mathbf{girl}(x)\ \&\ \mathbf{stand}(x)])$

CP$_\mathrm{i}$: $\lambda P_{\langle e,t\rangle}.P(\iota x[^*\mathbf{girl}(x)\ \&\ \mathbf{stand}(x)])$ IP : $\mathbf{tall}(x)$

which girls standing be-PR they$_i$ tall be-PR

If the predicate abstract that *if*-clauses combine with is always distributive (if it is true of a sum of propositions if and only if it is true of all the atomic parts of the sum), we get, in the end, the same truth-conditions that we got by assuming a universal quantifier over propositions. Should we assume that *if*-clauses denote sums of propositions, then? To finish, I would like to consider a potential argument against doing so and conclude, tentatively, that it is not a knock-down one.

Consider what happens when we embed a *would* counterfactual under what is presumably a wide scope negation:

(29) It is plain false that Hitler would have been pleased if Spain had joined Germany or the U.S.
(Kratzer, p.c., a variation on an example in Nute 1980 (p. 157))

If the *if*-clause is a universal quantifier over propositions, the sentence in (29) is predicted to be true if and only if it is false that *both* counterfactuals below are true:

(30) a. Hitler would have been pleased if Spain had joined Germany.
b. Hitler would have been pleased if Spain had joined the U.S.

This is, of course, compatible with one of them being true. The possibility of continuing (29) as in (31) shows that this is the case.

(31) ... There is enough evidence showing that he might have objected to Spain joining the U.S. If she had joined Germany, he would have been pleased, of course. (Kratzer, p.c.)

If *if*-clauses denoted sums of propositions, and the predicate abstracts associated with the consequents were distributive, the disjunctive counterfactual in (29) could also in principle be true if the predicate abstract is not true of all the propositional alternatives introduced by *or* (but just of one of them.) However, plural definite descriptions are known to interact with negation in a peculiar way: the sentence in (32) conveys that Sandy saw none of the cats, not just that Sandy didn't see every cat.

(32) Sandy didn't see the cats.

To capture this, a 'homogeneity' presupposition is usually invoked (Loebner, 1998; Schwarzschild, 1994). Beck (2001) formulates homogeneity as follows (where P is a predicate of atomic individuals, ${}^{*}P$ a pluralized distributive predicate, and A a plurality):

(33) $^{*}P(A) = 1$ iff $\forall x[x \in A \rightarrow P(x)]$

$^{*}P(A) = 0$ iff $\forall x[x \in A \rightarrow \neg P(x)]$

(undefined otherwise)

One could argue that disjunctive counterfactuals do not seem to behave like plural definite descriptions, after all, by pointing out that the sentence in (29) does not convey an homogeneity presupposition. Yet, for the argument to go through, one would have to show, as an anonymous reviewer points out, that the homogeneity presupposition of definite descriptions is present even with the type of wide scope negation in (29). This is not that clear, since the sentence in (34) does not seem to convey that Sandy saw none of the cats.

(34) It is plain false that Sandy saw the cats.

I will assume in the rest of the paper that *if*-clauses contribute the universal quantification over propositions, and remain agnostic as to whether this force is best captured by means of a universal propositional quantifier or a sum operator.

3. Downward Entailingness

To capture the intuition reported in section 1, the analysis presented in section 2 moves beyond the standard boolean semantics of *or*. This move allows us not to give up on a minimal change semantics for counterfactuals. However, it is easy to see that the intuition reported in section 1 is in fact expected under the standard boolean analysis of *or* if a material conditional analysis for conditionals is assumed. For suppose, for the sake of the argument, that *would* counterfactuals were to be analyzed as strict conditionals (material conditionals under the scope of a necessity operator (Lewis, 1973, p.4)), as in (35) below, where the domain of quantification of *would* is fixed with the help of a variable C ranging over functions of type $\langle s, \langle s,t\rangle\rangle$:

(35) $$[\![\text{If } \phi, \text{would } (C)\ \psi]\!]^g = \lambda w.\forall w' \begin{bmatrix} ([\![\phi]\!](w') \ \&\ g(C)(w)(w')) \\ \rightarrow \\ [\![\psi]\!](w') \end{bmatrix}$$

If *would* counterfactuals were *strict* conditionals, the counterfactual in (36), for instance, would express the proposition p that is true in a world w if and only if *all* accessible worlds from w (say, all worlds w' in which the laws of nature of w hold) in which kangaroos have no tails are worlds where they topple over.

(36) If kangaroos had no tails, they would topple over (Lewis 1973, p.1).

Consider now what the truth-conditions of a *would* disjunctive counterfactual would be like under the standard boolean analysis of *or*. With respect to the assignment of a domain of accessible worlds A, a disjunctive counterfactual would be true in a world w if and only if *all* worlds that are in at least one of the disjuncts and that are also in A are worlds where the consequent is true — if and only if the proposition expressed by the consequent is a subset of the set of worlds that belong to the union of the propositions expressed by the disjuncts and to A.

(37) $[\![\text{If } \phi \text{ or } \psi, \text{ would } (C)\ \xi]\!]^g =$

$$\lambda w.\forall w' \left[\left[\begin{pmatrix} [\![\phi]\!](w') \\ \vee \\ [\![\psi]\!](w') \end{pmatrix} \ \&\ \ g(C)(w)(w') \right] \rightarrow [\![\xi]\!](w') \right]$$

Under these truth-conditions, if a disjunctive counterfactual of the form in (37) is true in a world w with respect to a domain of accessible worlds A, both counterfactuals of the form in (38) must be true in w — assuming that they are evaluated with respect to the same set of accessible worlds, that is — because, in virtue of the transitivity of the subsethood relation, if a set X is a subset of a set Y, *any* subset of X must also be a subset of Y.[13]

(38) a. If ϕ then would ξ.

b. If ψ then would ξ.

Under the strict conditional analysis, substituting a certain proposition p in the antecedent with any of the subsets of p preserves truth: the antecedent of counterfactuals is a downward entailing environment. The interpretation of *would* counterfactuals illustrated in section 1 can be then captured as a downward entailing inference. But then, wouldn't the problem of capturing the natural interpretation of disjunctive counterfactuals be solved by adopting a strict conditional analysis? This section argues that it would not be.

The discussion is organized as follows. We will first consider the status of the inference reported in section 1 in the close-to-downward entailing semantics for counterfactuals presented in von Fintel 1999. We will see that the inference is predicted to be as context dependent as other monotonic inferences, for which well known counterexamples exist, contrary to intuitions. We will then look at the interpretation of *might* counterfactuals. If *might* counterfactuals are the duals of *would* counterfactuals, they are not downward entailing. However, a *might* counterfactual of the form of (39a) can be naturally understood as equivalent to the conjunction of counterfactuals of the type in (39b) and (39c).

(39) a. If ϕ or ψ, then might ξ.

[13] This is independent, of course, of whether the set of accessible worlds A contains both ϕ and ψ worlds. If there are no ϕ-worlds in the set of accessible worlds A, the strict conditional analysis makes a counterfactual of the type in (38a) trivially true.

b. If ϕ, then might ξ.

c. If ψ, then might ξ.

We will conclude by showing that the inference from (39a) to both (39b) and (39c), which is not licensed under a monotone semantics, is expected under the analysis presented in section 2.

3.1. Strawson Downward Entailingness

One important advantage of the strict conditional analysis over the minimal change semantics analysis is that, under the strict conditional analysis, the fact that negative polarity items are licensed in the antecedent of counterfactuals, as illustrated in (40), does not come out as a surprise: under the strict conditional analysis, the antecedent of counterfactuals is a downward entailing environment, and, according to the received view, negative polarity items are licensed in downward entailing environments (Ladusaw, 1980).

(40) a. If you had left any earlier, you would have missed the plane. (von Fintel 1999, p. 33)

b. If you had ever heard my album, you would know that I could never consider the music business. (www.brainyquote.com/quotes/quotes/d/dwaynehick217577.html)

But before solving the problem presented in section 1 by endorsing a strict conditional analysis of counterfactuals, we have to address the classic counterexamples to the monotonicity of counterfactuals that Lewis (1973) brought into play to justify his minimal change semantics. The inference from (41a) to (41b), for example, (an instance of the pattern known as 'Strengthening the Antecedent') is not valid, although it should be, under the strict conditional analysis — if all the accessible worlds where kangaroos have no tails are worlds where they topple over, all worlds where kangaroos have no tails but use crutches (a subset of the worlds where kangaroos have no tails) must be worlds where they topple over.

(41) a. If kangaroos had no tails, they would topple over. (Lewis, 1973, p.1)

b. If kangaroos had no tails but used crutches, they would topple over. (Lewis, 1973, p.9)

Or take the argument that has (42b) and (42a) as premises and (42c) as a conclusion (an instance of the pattern known as 'Hypothetical Syllogism'): intuitively, it is not valid; and, yet, under the strict conditional analysis, it should be, given the transitivity of subsethood.

(42) a. If Hoover had been born in Russia, he would have been a Communist.

b. If Hoover had been a Communist, he would have been a traitor.

c. If Hoover had been born in Russia, he would have been a traitor. (Lewis (1973, p. 33) attributed to (Stalnaker, 1968))

Likewise for the pattern illustrated in (43) (known as 'Contraposition'): suppose the set of accessible worlds where Goethe does not die in 1832 is a subset of the worlds where he is dead now; it must then follow that the set of accessible worlds where he is alive by now is a subset of the set of worlds where he dies in 1832. Yet the inference from (43a) to (43b) does not seem to be valid.

(43) a. If Goethe had survived the year 1832, he would nevertheless be dead by now. (Kratzer 1979, p. 128)

b. If Goethe were alive now, he would have died in 1832.

Lewis' counterexamples to the monotonicity of *would* counterfactuals pose a problem to the strategy of deriving the interpretation of *would* counterfactuals with disjunctive antecedents as a downward monotone inference. If the intuition reported in section 1 is to be captured by adopting a downward entailing semantics for *would* counterfactuals, Lewis' counterexamples must be accounted for.

Kai von Fintel (2001) presents an analysis of counterfactuals that addresses Lewis' counterexamples. He has convincingly argued that counterfactuals are *close* to downward entailing. They are not downward entailing in the strict sense (thus accounting for Lewis' counterexamples) but they show limited downward entailingness — what he dubbed 'Strawson downward entailingness' — and it is this property, he argues, that licenses negative polarity items. The question, then, is whether the assumption that counterfactuals are Strawson downward monotonic solves the problem illustrated in section 1. We will conclude that it does not.[14] To see why, we need to bring into the discussion the analysis presented in von Fintel 2001.

Under von Fintel's analysis, counterfactuals are evaluated with respect to a contextually fixed accessibility function f, which changes as discourse evolves. The accessibility function, which he calls the 'modal horizon', assigns to any world of evaluation w a set of worlds that come closest to w (with respect to an admissible ordering of relative similarity). Counterfactuals carry the presupposition that the modal horizon assigns to the world of evaluation worlds where the antecedent is true. Accommodating that presupposition is what makes the modal horizon evolve. In the initial context the modal horizon

[14] Kai von Fintel himself discussed the problem in some unpublished notes (von Fintel, 1997) and reached the same conclusion.

assigns to any world w the singleton that contains w. If, by the time a counterfactual is asserted, the modal horizon f does not assign to the world of evaluation w any worlds where the antecedent is true — as typically happens with respect to an initial context — those worlds that are at least as close to w as the closest antecedent worlds are added to the worlds that f assigns to w.[15]

(44) Where f is an accessibility function and $\leq$ a relation of relative similarity,

$$f\,|\text{If } \phi, \text{then would } \psi|^{\leq} = \lambda w. f(w) \cup \{w' \mid \forall w'' \in [\![\phi]\!]^{f,\leq} : w' \leq_w w''\}$$

(von Fintel, 2001)

The proposition expressed by the conditional is then computed with respect to the updated modal horizon. With respect to a modal horizon f (and ordering $\leq$) that assigns to any world w some worlds where its antecedent is true, a *would* counterfactual expresses the proposition that is true in w if and only if all worlds in $f(w)$ where the antecedent is true are worlds where the consequent is true.

(45) $[\![\text{If } \phi, \text{then would } \psi]\!]^{f,\leq}(w) \Leftrightarrow$

$$\forall w' \in f|\text{If } \phi, \text{then would } \psi|^{\leq}(w) \begin{bmatrix} [\![\phi]\!]^{f,\leq}(w') \\ \rightarrow \\ [\![\psi]\!]^{f|\text{If } \phi, \text{then } \psi|^{\leq},\leq}(w') \end{bmatrix}$$

(von Fintel, 2001)

[15] Notation: '$f|$If ϕ, then would $\psi|^{\leq}$' is the modal horizon that results from accommodating the presupposition that f assigns to any world w the closest worlds to w (with respect to $\leq$) where ϕ is true. Kai von Fintel notes in his paper that the context change potential that I am reporting here has no provision for embedded conditionals. He offers a more complex one that does (von Fintel (2001, p.21)). The context change potential that we are using here will do for our purposes of illustrating that this analysis of counterfactuals does not solve the problem of disjunctive counterfactuals.

Most of the monotonic inferences are invalid in this system. Strengthening the Antecedent is. Consider as illustration the inference from (46a) to (46b):

(46) a. If kangaroos had no tails, they would topple over. (Lewis , 1973, p.9)

b. If kangaroos had no tails but used crutches, they would topple over.

(Lewis, 1973, p.9)

Is the inference from (46a) to (46b) valid? In classic logic, shifting the context is considered a fallacy: when assessing the validity of arguments the context should not shift. We are now assuming that conterfactuals can shift the context. We then need to take this fact into account when assessing the validity of arguments. To assess the validity of the inference from (46a) to (46b) we will consider the following *dynamic* notion of entailment:[16]

(47) *Dynamic entailment*

$\phi_1, \ldots \phi_n \models_{\text{dynamic}} \psi$ iff for all contexts c, $[\![\phi_1]\!]^c \cap \ldots [\![\phi_n]\!]^{c|\phi_1|\ldots|\phi_{n-1}|} \subseteq [\![\psi]\!]^{c|\phi_1|\ldots|\phi_n|}$ (von Fintel, 2001, p.24)

Strengthening the Antecedent is not dynamically valid. Take an arbitrary context c and an arbitrary world w. Assume the counterfactual in (46a) is true with respect to c in w. For that to be the case, the modal horizon in that context must assign to w worlds where kangaroos have no tails. The counterfactual in (46b) can be undefined in w if $f(w)$ contains no worlds where kangaroos have no tails but use crutches.

Let us now consider the case of counterfactuals with disjunctive antecedents:

(48) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. (Nute, 1975)

[16] '$c|\phi|$' names the result of updating c with ϕ.

The inference from (48) to (49a) and (49b) below is not dynamically valid either: the counterfactual in (48) could be true in a world w with respect to a modal horizon f and yet (49b) could be undefined for w. That would be the case if, for instance, none of the closest worlds to w where the antecedent of (48) is true are worlds where the sun grows cold.

(49) a. If we had had good weather this summer, we would have had a bumper crop.

b. If the sun had grown cold, we would have had a bumper crop.

For the inference to go through, there must be worlds in the modal horizon of the type described by each disjunct. To enforce this condition, we need, again, to assume that the interpretive system has access to each of the propositions that *or* operates over. The problem persists.

There is, however, a weaker notion of validity that can be formulated in the system. We can check whether the propositions expressed by the premises of an argument with respect to a context that satisfies the presuppositions of both the premises *and* the conclusion entail the conclusion. This is the notion of entailment that is claimed to be the one that NPIs are sensitive to (von Fintel, 1999).

(50) *Strawson entailment*

$\phi_1, \ldots \phi_n \models_{\text{Strawson}} \psi$ iff for all contexts c such that $c = c|\phi_1|\ldots|\phi_n||\psi|$,
$[\![\phi_1]\!]^c \cap \ldots [\![\phi_n]\!]^{c|\phi_1|\ldots|\phi_{n-1}|} \subseteq [\![\psi]\!]^{c|\phi_1|\ldots|\phi_n|}$ (von Fintel (2001, p.26))

Strengthening the Antecedent *is* Strawson-valid. Take any arbitrary context c whose modal horizon f is already such that (46a) and (46b) will not expand it anymore. For any world w, $f(w)$ will include worlds where kangaroos have no tails but use crutches. Assume that (46a) is true in a world w

with respect to f. All the worlds in $f(w)$ where kangaroos have no tails are worlds where they topple over. Since $f(w)$ includes worlds where kangaroos do not have tails, but use crutches, the counterfactual in (46b) must be true in w with respect to f.

Consider now the inference from (48) to (49b). Take a context c whose modal horizon f is such that (48) and (49b) will not expand it. Such a modal horizon will already include worlds where the sun grows cold. Assume that the proposition expressed by (48) with respect to f is true in a world w. All worlds in $f(w)$ where the antecedent of (48) is true will be worlds where we have a bumper crop. That means that all worlds in $f(w)$ where we have good weather this summer are worlds where we have a good crop and all worlds in $f(w)$ where the sun grows cold are worlds where we have a bumper crop. The counterfactual in (49b) must be true in w with respect to f. We can reason likewise to show that the inference from (48) to (49b) is Strawson-valid.

The analysis of counterfactuals presented in von Fintel 2001 treats the inference from (48) to both (49a) and (49b) on a par with Strengthening the Antecedent: neither is dynamically valid, but both are Strawson-valid. Yet there seems to be a difference between these two inference patterns: the pattern in the interpretation of disjunctive counterfactuals we are trying to capture seems to be reliable and stable, it does not depend on any contextual shift; Strengthening the Antecedent is not.[17] But even if the inference illustrated in section 1 were shown to be as shifty as Strengthening the Antecedent, there are reasons to believe that the inference does not have to do with the monotonicity of counterfactuals, since the problem illustrated in section 1 has a parallel in the case of *might* counterfactuals, which, if they

[17] For the context dependence of Strengthening the Antecendent, see the discussion in Kratzer 1979.

are the duals of *would* counterfactuals, are not downward entailing. We turn to this issue next.

3.2. Might Counterfactuals

3.2.1. *As duals of* would *counterfactuals*

Consider the following scenario. Suppose that we are watching a magic show. The magician mysteriously bends a fork with the power of his mind. We are shocked. To remedy the shock, I utter the counterfactual in (51) after the show:

(51) If you had had a good magic book or you had been a newborn baby, you might have bent that fork too.

What would be your reaction? I think you would disagree with me: perhaps you think one could learn to bend forks from magic books (you certainly can), but if you were a newborn baby, you know you would not have bent that fork.

The problem, again, is that a minimal change semantics for *might* counterfactuals predicts the counterfactual in (51) to be true if the standard boolean semantics for *or* is assumed.

To see why, we will assume, with Lewis (1973), that *might* counterfactuals are the duals of *would* counterfactuals: a *might* counterfactual is true in a world w (with respect to an admissible ordering) if and only if the proposition expressed by the consequent is compatible with the worlds in the proposition expressed by the antecedent that come the closest to w in the relevant ordering (but see section 3.2.2 below).

(52) $[\![\text{If } \phi, \text{then might } \psi]\!]^{\leq} = \lambda w.\exists w'[f_{\leq_w}([\![\phi]\!])(w')\ \&\ [\![\psi]\!](w')]$

According to the standard boolean analysis of *or*, the antecedent of the counterfactual in (51) denotes the union of the set of possible worlds where you have a good magic book and the set of worlds where you are a newborn baby.

(53) $[\![$If you had had a magic book or you had been a newborn baby$]\!]$
$= \lambda w.\exists x[(\mathbf{book}_w(x)\ \&\ \mathbf{have}_w(\mathbf{you}, x)) \vee \mathbf{child}_w(\mathbf{you})]$

The counterfactual in (51) is then predicted to be true in the actual world (with respect to an admissible ordering) if and only if the consequent is true in at least one of the worlds where (53) is true that come closest to the actual world in the relevant ordering.

These truth-conditions are, again, too weak. Take the picture in fig. 2 on page 32 as illustration. The picture in fig. 2 represents a relative similarity relation according to which the worlds where you are a newborn baby are more remote than the worlds where you have a good book on magic. The counterfactual in (51) is likely to be evaluated with respect to this type of relative similarity relation (more actual facts have to be false in a world where you are a newborn baby than in the worlds where you have a good book on magic), but that means that the closest worlds where the antecedent of (51) is true are all worlds where you have a magic book, and, since, presumably, there are worlds among the closest worlds where you have a good magic book in which you do in fact bend the fork, the counterfactual is predicted with respect to this similarity relation, contrary to our intuitions.

The intuition that we are reporting shows that a *might* counterfactual of the the type in (54a) can be naturally understood as conveying that both counterfactuals of the type in (54b) and (54c) are true.

(54) a. If ϕ or ψ, then might ξ.
b. If ϕ, then might ξ.

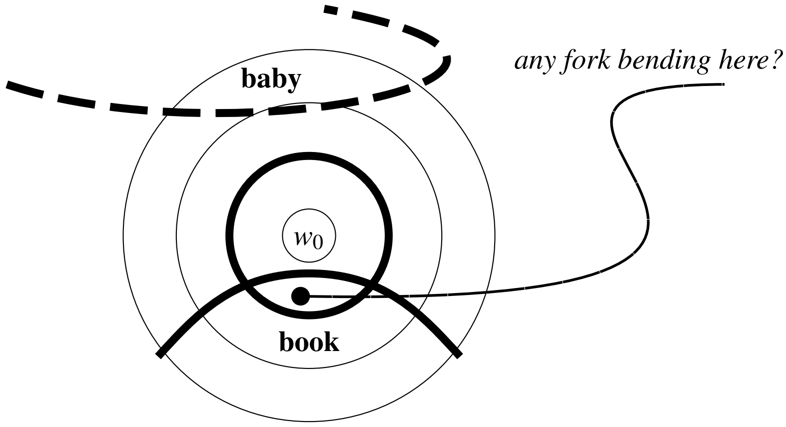


Figure 2. The problem of disjunctive antecedents: *might* counterfactuals.

c. If ψ, then might ξ.

The difference with respect to the case of *would* counterfactuals is that the strict conditional analysis fails to predict the validity of the inference from (54a) to (54b) and (54c). For suppose we adopt a strict conditional analysis of *might* counterfactuals. If they are the duals of *would* counterfactuals, they would claim that the proposition expressed by the consequent is compatible with the set of accessible worlds in the proposition expressed by the antecedent:

(55) $[\![\text{If } \phi, \text{ might } (C)\ \xi]\!]^g = \lambda w.\exists w'[[\![\phi]\!](w')\ \&\ g(C)(w)(w')\ \&\ [\![\xi]\!](w')]$

Consider now a disjunctive counterfactual, like the one in (51), repeated in (56) below.

(56) If you had had a good magic book or you had been a newborn baby, you might have bent that fork too.

Under the strict conditional analysis, the counterfactual in (56) conveys that the proposition that you bend that fork is compatible with the accessible worlds that are either worlds where you have a good magic book or worlds where you are a newborn baby, as captured below.

(57) $[\![(56)]\!]^g =$

$$\lambda w.\exists w' \left[\begin{pmatrix} \exists x[\mathbf{book}_{w'}(x) \;\&\; \mathbf{have}_{w'}(\mathbf{you},x)] \\ \vee \\ \mathbf{baby}_{w'}(\mathbf{you}) \end{pmatrix} \begin{matrix} \&\; g(C)(w)(w') \\ \& \\ \mathbf{bend}_{w'}(\mathbf{you},\mathbf{f}) \end{matrix} \right]$$

But then, according to the truth-conditions in (63), for the counterfactual in (56) to be true, the proposition expressed by the consequent need not be compatible with each disjunct: the truth conditions in (63) will be satisfied in a world w in case none of the accessible worlds where you are a newborn baby are worlds where you bend that fork.

The inference from (54a) to (54b) and (54c) is not Strawson-valid either, of course. Take an arbitrary context c and an arbitrary world w. Assume that the counterfactual in (56) is true with respect to c in w. For that to be the case, the proposition expressed by its antecedent must be compatible with the accessible worlds in the modal horizon $f(w)$. We now assume that the propositions expressed by the antecedents of both (58a) and (58b) are compatible with $f(w)$. That means that the modal horizon $f(w)$ contains worlds where you have a good magic book, and worlds where you are a newborn baby. Now suppose that the proposition that you bent that fork is compatible with the closest worlds where you have a good magic book, but that it is incompatible with the closest worlds where you are a newborn baby. The counterfactuals in (56) and (58a) will be both true in w with respect to context c, but the counterfactual in (58b) will be false.

(58) a. If you had had a good magic book, you might have bent that fork.

b. If you had been a newborn baby, you might have bent that fork.

Assuming that *might* counterfactuals are the duals of *would* counterfactuals doesn't help capturing their natural interpretation.

One could argue, however, that the assumption that *might* counterfactuals are the duals of *would* counterfactuals should not be taken for granted. There is a debate in the literature on minimal change semantics for conditionals between Lewis (1973) and Stalnaker (1984) that focuses on the duality of *would* and *might* counterfactuals. Lewis sticks to the assumption that *would* and *might* counterfactuals are duals of each other. Stalnaker doesn't. Stalnaker's semantics for *would* conditionals makes use of a selection function that picks up for any world of evaluation w, *the* closest world to w in which the antecedent is true. A *would* conditional says that *the* closest world where the antecedent is true is one where the consequent is. Since *would* counterfactuals are not universal quantifiers, they do not have duals. In Stalnaker's system *might* counterfactuals are epistemically qualified versions of *would* counterfactuals (Stalnaker 1984, p.144).[18] To conclude, I want to show that adopting Stalnaker's analysis does not solve the problem of capturing the natural interpretation of disjunctive antecedent, because the problem arises with conditionals containing other possibility modals for which a Stalnaker-type analysis is not plausible

[18] The main motivation for Stalnaker's analysis is that it is hard to follow the denial of a *would* counterfactual with a *might* counterfactual, as the following example illustrates:

(i) a. Would President Carter have appointed a woman to the Supreme Court last year if a vacancy had occurred?

b. # No, certainly not, although he might have appointed a woman.
(Stalnaker (1984, p. 144))

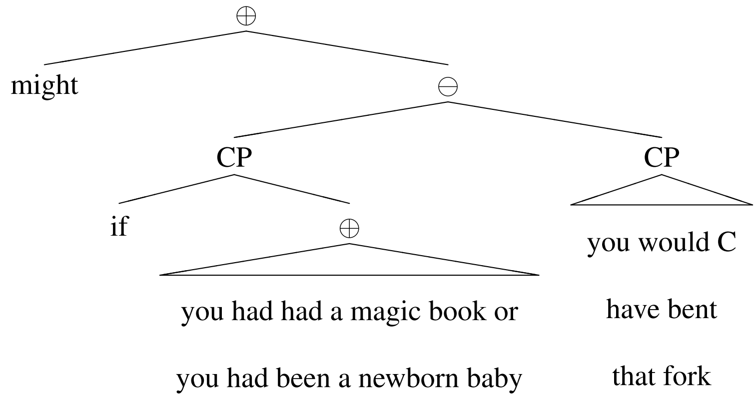
This is unexpected under Lewis' analysis: it could very well be that not all closest worlds of the antecedent type are worlds of the consequent type, while some of them are.

3.2.2. *Stalnaker on* might *counterfactuals*

Under Stalnaker's analysis, the example in (56), repeated in (59), receives the LF in (60):

(59) If you had had a good magic book or you had been a newborn baby, you might have bent that fork too.

(60)



If *might* counterfactuals are analyzed as *would* counterfactuals embedded under epistemic *might*, and *would* counterfactuals are analyzed as strict conditionals, the sentence in (59) will entail both (61a) and (61b). Let us see why.

(61) a. If you had had a good book on magic, you might have bent that fork.

b. If you had been a newborn baby, you might have bent that fork.

Might denotes the function from propositions to propositions that maps any proposition p into the proposition that is true in any world w if and only if p is consistent with the set of worlds epistemically accessible in w.

(62) Where $\mathscr{E}_w$ is the set worlds epistemically accessible from w,
$[\![\text{might}]\!] = \lambda p.\lambda w.\exists w'[w' \in \mathscr{E}_w \;\&\; p(w')]$

The LF in (60) denotes the proposition that is true in any world w if and only if there is at least one world epistemically accessible from w in which the embedded *would* counterfactual is true. Under the strict conditional analysis, the counterfactual embedded under *might* in (60) denotes the proposition p that is true in a world w if and only if all accessible worlds in the union of the set of worlds where you have a good magic book and the set of worlds where you are a newborn baby are worlds where you bend that fork, as illustrated below.

(63) $$[\![\ominus]\!]^g = \lambda w.\forall w' \left[\begin{array}{c} \left(\left(\begin{array}{c} \exists x[\mathbf{book}_{w'}(x) \;\&\; \mathbf{have}_{w'}(\mathbf{you}, x)] \\ \vee\; \mathbf{baby}_{w'}(\mathbf{you}) \end{array} \right) \\ \&\; g(C)(w)(w') \right) \\ \rightarrow \mathbf{bend}_{w'}(\mathbf{you}, \mathbf{f}) \end{array} \right]$$

Suppose now that the proposition denoted by the LF in (60) is true in a world w, but that the proposition expressed by (61a) is false (under Stalnaker's analysis, the proposition expressed by (61a) is the proposition p that is true in a world w if and only if there is at least one epistemically accessible world where the proposition expressed by (64) is true.)

(64) If you had had a good magic book, you would have bent that fork.

There must then be at least one world w' epistemically accessible from w such that the set of worlds accessible from w' where you have a good book on magic is a subset of the worlds where you bend that fork. Call that world w_1. If the sentence in (61a) is false in w, there should not be any world w' epistemically accessible from w such that the set of accessible worlds from w' where you have a good magic book is a subset of the worlds where you bend that fork. That contradicts the conclusion that w_1 is one such world. Reasoning likewise, we conclude that (60) also entails (61b). Stalnaker's analysis of *might* counterfactuals could then capture the desired entailments.

The problematic entailments do not only arise with *might* counterfactuals, though: they also arise with other types of conditionals with possibility modals. Take, for instance deontic *may*:

(65) Mom, to Dad: "If Sandy does her homework or yours, she may eat this ice cream."

It seems natural to conclude from (65) that both sentences below are true:

(66) a. If Sandy does her homework, she may eat this ice cream.
b. If Sandy does your homework, she may eat this ice cream.

In fact, the discourse in (67) sounds contradictory:

(67) # If Sandy does her homework or her sister's, she may eat this ice cream, but if she does her homework, she may not eat it.

If we where to adopt Stalnaker's strategy to account for the interpretation of disjunctive counterfactuals, we would also have to adopt it to account for the interpretation of disjunctive deontic conditionals. It is far from clear how Stalnaker's strategy might be applied to disjunctive deontic conditionals, though: embedding the corresponding universal *must* conditional would not help, since the conditional in (66b) is definitely not equivalent to the one in (68b).[19]

[19] An anonymous reviewer points out that we could get the desired entailments if we embed the conditional under a restricted universal modal:

(i) $\lambda w \forall w'[(w' \in [A \vee B] \ \&\ g(C)(w)(w') \rightarrow$
$\exists w''[w''$ is deontically accessible from w' & $w'' \in D]$

To get the desired entailments, we would need to make sure that C selects both A and B worlds, of course.

(68) a. If Sandy does her homework, she may eat this ice cream.

b. It might be the case that if Sandy does her homework, she must eat this ice cream.

3.3. Conclusion

Appealing to a strict conditional analysis of counterfactuals while keeping the standard boolean semantics for *or* does not help much, then, because a strict conditional analysis does not capture by itself the natural interpretation of *might* counterfactuals.

The analysis that we presented in section 2, however, naturally extends to the case of disjunctive *might* counterfactuals: it treats them in completely parallel fashion to *would* counterfactuals. Take, as illustration, the *might* counterfactual in (59), repeated in (69) below.

(69) If you had had a good magic book or you had been a newborn baby, you might have bent that fork too.

In the consequent of the conditional in (69), *might* combines with *then* and with the proposition that you have bent that fork to yield a (singleton containing the) proposition that is true in a world w if and only if the set of worlds in the denotation of the antecedent of *then* that come closest to w is compatible with the proposition that you have bent that fork.

This move, as the reviewer points out, would mean giving up on a unified analysis of epistemic and deontic modals. The analysis I presented in the previous sections is consistent with the type of unified analysis of conditionals pursued over the years by Angelika Kratzer (see a. o. Kratzer 1991), see discussion of (72) below.

(70)
$$\left[\!\left[\ [_{\text{IP}}\ [_{\oplus}\ \text{might}\ \ \text{then}_{7_{\langle s,t\rangle}}]\ [_{\otimes}\ \text{you have bent that fork}]]\ \right]\!\right]^{\leq,g} =$$
$$\{\lambda w.\exists w'[f_{\leq_w}(g(7_{\langle s,t\rangle}))(w')\ \&\ \textbf{bend}_{w'}(\textbf{you},\textbf{that-fork})]\}$$

Abstracting over the denotation of *then*, we get a singleton containing a function from propositions to propositions that maps any proposition p into the proposition that is true in a world w if and only if the set of p-worlds that come closest to w is compatible with the set of worlds where you bend that fork.

(71)
$$\left[\!\left[\ [_{\otimes}\ 7_{\langle s,t\rangle}\ [_{\text{IP}}\ [_{\oplus}\ \text{might}\ \ \text{then}_{7_{\langle s,t\rangle}}]\ [_{\otimes}\ \text{you have bent that fork}]]]\ \right]\!\right]^{\leq,g} =$$
$$\{\lambda p_{\langle s,t\rangle}.q_{\langle s,t\rangle} \mid q \in [\![(70)]\!]^{\leq,g[p/7_{\langle s,t\rangle}]}\}$$

Under this analysis, the *if*-clause denotes a set containing a function of type $\langle\langle\langle s,t\rangle,\langle s,t\rangle\rangle,\langle s,t\rangle\rangle$ that maps the function in the set in (71) to the proposition that is true in any world w if and only if the set of worlds where you have a good magic book that come closest to w is compatible with the proposition that you bend that fork, and the set of worlds where you are a newborn child that come the closest to w is also compatible with the proposition that you bend that fork. The analysis predicts the sentence in (20) to be false in the context presented in section 2, because, under the relevant ordering, none of the closest worlds to the actual world where you are a newborn child are worlds where you bend the fork.

The reader can probably see how the analysis can extend to other types of disjunctive conditionals. Take, for instance, the deontic conditional in (65), repeated in (72) below:

(72) Mom, to Dad: “If Sandy does her homework or yours, she may eat this ice cream.”

The analysis presented in section 2 would claim that the consequent of this conditional expresses the property of propositions P that is true of any proposition p in a world w if and only if in some of the closest worlds to a deontic ideal in w in which p is true are worlds in which she eats ice cream. The whole conditional would claim that in the world of evaluation w, the property P is true of the proposition that Sandy does her homework and of the proposition that she does her sister’s homework.

4. An Implicature?

To conclude, I would like to address a different potential derivation of the natural interpretation of disjunctive counterfactuals. The idea is to derive the interpretation of disjunctive counterfactuals, while keeping the standard boolean analysis of *or*, by resorting to a conversational implicature. The following quote illustrates the spirit of the proposal:[20]

> There is certainly evidence for SDA. From the statement
>
> D: If there had been rain or frost, the game would have been called off.

[20] In the quote below, ‘SDA’ stands for the ‘simplification of disjunctive antecedents’ inference pattern, the name used in the philosophical literature to refer to the interpretation of disjunctive counterfactuals illustrated in section 2.

one naturally infers both of these:

D_r: If it had rained, the game would have been called off.

D_f: If there had been frost, the game would have been called off.

What validates those inferences if SDA is not valid? [. . .]

The explanation is Gricean. D would be a sensible, decent, verbally economical thing to say *only* [emphasis added] for someone who did think that D_r and D_f are both true. Consider a person who asserts D because he is confident of D_r, he regards the closest Freeze-worlds as remote, and does not believe D_f. What this person asserts is true if he is right about D_r; but asserting it on this basis is bad behaviour. It is of the same general kind — though perhaps not so bad in degree — as your saying ‘If there had been rain or 90 per cent of the world’s Buddhist priests had converted to Catholicism overnight, the game would have been called off.’ The second disjunct is pointless in this case. There would be a point in including it only if it too had some bearing on the consequent.

(Bennett 2003, pp. 168-170)

How should this type of argument be spelled out? Consider again, as illustration, the disjunctive *might* counterfactual that we discussed in section 3.2, together with the simpler counterfactuals in (74a) and (74b).

(73) If you had had a good magic book or you had been a newborn child, you might have bent that fork.

(74) a. If you had had a good magic book, you might have bent that fork.

b. If you had been a newborn child, you might have bent that fork.

The starting point for this line of reasoning is the observation that it does not seem cooperative for a speaker to utter the disjunctive counterfactual in (73) if, for any world *w* compatible with what the speaker believes, the closest worlds to *w* where you have a good magic book are closer to *w* than the closest worlds where you are a newborn child. Why? If for any world *w* compatible with what the speaker believes, the closest worlds to *w* where you have a magic book are closer to *w* than the closest worlds where you are a newborn baby, the disjunctive counterfactual in (73) will be true in a world *w* compatible with what the speaker believes if and only if the simpler counterfactual in (74b) is. But the disjunctive counterfactual in (73) is a more complex (longer) expression than the counterfactual in (74a). Some kind of economy principle should rule out uttering (74b) instead of the simpler (74b) in this situation. What kind of economy principle can we appeal to? Grice's maxim of manner seems to be a possibility. Let's see what it takes to appeal to the maxim of manner.

The sentences in (73) and (74a) are not logically equivalent, so the manner reasoning cannot rely on comparing two expressions that share the same meaning, but maybe it is enough to assume that what is being compared here are two sentences — one of which is more complex than the other — that are truth-conditionally equivalent throughout the speaker's belief state. Let us then assume tentatively the following principle:

(75) Suppose the sentence S contains a proper subset of the lexical items (subtrees . . .) of the sentence S′. If S and S′ have identical semantic interpretation in the speaker's belief state, then S′ cannot be uttered felicitously.

By assuming that the speaker is obeying the principle in (75), the hearer could reason as follows:

(76) The speaker is obeying the principle in (75). Thus, if the speaker uses a complex form S′, then no simpler sentence S has identical semantic interpretation in the speaker's belief state.

The principle in (76) does not justify concluding from an utterance of (73) that both (74a) and (74b) are true. What the hearer can conclude from (76) is that there must be at least one world compatible with what the speaker believes where (73) is true, but (74a) isn't; and that there must be a world compatible with what the speaker believes where (73) is true, but (74b) isn't. That cannot be the case if in all worlds *w* compatible with what the speaker believes, the closest worlds to *w* where the antecedent of (73) is true are all worlds where you have a good magic book (because in that case the sentence in (74a) would have to be true in all worlds *w* compatible with what the speaker believes), but we cannot yet conclude that for any world *w* compatible with what the speaker believes, both (74a) and (74b) must be true in *w*: for let us suppose that the worlds where you have a good magic book and the worlds where you are a newborn child are equally close to any world *w* compatible with what the speaker believes; and let us also suppose that there are only two types of worlds compatible with what the speaker believes: worlds *w* in which the closest worlds where you have a magic book are compatible with your bending that fork, but in which you don't bend that fork in any of the closest worlds where you are a newborn child (as illustrated in figure 4, page 44); and worlds *w* where the closest worlds where you are a newborn child are compatible with your bending that fork, but in which none of the closest worlds where you have a good magic book are (as illustrated in figure

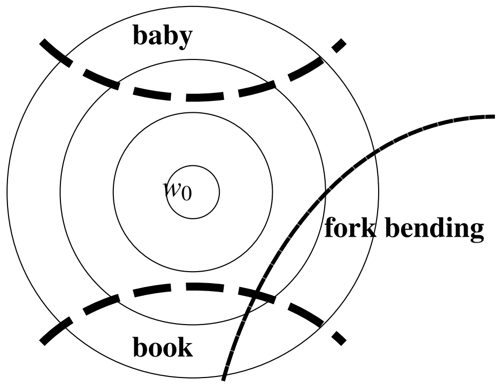


Figure 3. If you had had a good magic book, you might have bent that fork.

4, page 46). In all worlds *w* compatible with what the speaker believes, the sentence in (73) is true, but neither (74a) or (74b) is true in all those worlds. The discourse below is not predicted to be deviant.

(77) # If you had a good magic book or you were a newborn child, you might have bent that fork; but, for all I know, it is possible that if you have a good magic book you might not have bent that fork.

Appealing to the principle in (76) alone does not seem to be enough.

What other principle could be ruling out uttering the disjunctive conditional in the scenarios where it quantifies over worlds that are only in one of the two disjuncts? The reasoning that Bennett entertains is slightly different from the one illustrated above. What Bennett seems to be assuming is that the hearer can conclude from an utterance of (73) that the speaker is not in a belief state in all whose worlds (74a) is true, *but* (74b) is false. Why is that so? The idea seems to be that when (73) is true in any world *w* compatible with what the speaker believes if and only if (74a) is, the second disjunct seems to have no role whatsoever. But even if the selection function were to pick up some worlds where the second disjunct is true, what makes sure that both (74a) and (74b) are true? The counterfactual in (73) can be true in a world *w*, whose closest counterparts include worlds where you have a magic book and worlds where you are a newborn child, in case none of the worlds where you are a newborn baby are worlds where you bend that fork.

If the natural interpretation of disjunctive counterfactuals is indeed an implicature, a different pragmatic principle should be at work.[21]

[21] In van Rooij and Schulz (2007) one finds the sketch of an elegant pragmatic account of the natural interpretation of disjunctive counterfactuals. The account defines an ordering of the possible belief states of the speaker in which (i) below is true. The belief states in which (i) is true are ranked with respect to how many of the alternatives in (ii) are true in them.

(i) If A or B, would C.

(ii) a. If A, would C.

b. If B, would C.

Assuming that the speaker is competent about both (iia) and (iib) (that for either of those alternatives, it holds that they are true either in all worlds compatible with what the speaker believes or in none of them), there are two minimal states in the ordering: one in which (iia) is true, but (iib) is false; and another in which (iib) is true and (iia) is false. An optimal interpretation for (i) is defined on the basis of these minimal belief states. The interpretation maps a sentence like (i) into the set of belief states *s* in which all the alternatives that are true in a minimal belief state are true. An optimal interpretation of (i) is then one in which the speaker believes (ii) and also (iii).

It would be interesting to see what the system predicts for the interpretation of disjunctive counterfactuals embedded under negation (see discussion on page 19). Are the alternatives to a sentence like (iii) the ones in (iv)? In view of the discussion on page 19, should we define the optimal belief state for (iii) as one in which both alternatives in (iv) are true?

(iii) It's false that if A or B, would C.

(iv) a. It's false that if A, would C.

b. It's false that if B, would C.

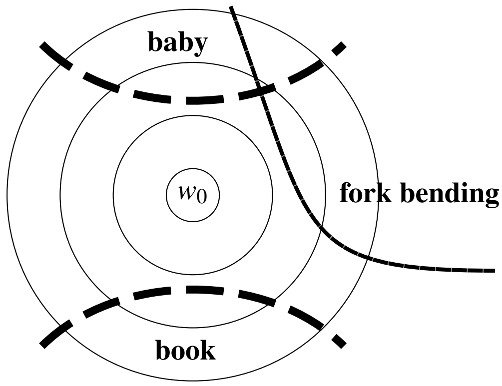


Figure 4. *If you had been a newborn child, you might have bent that fork.*

5. On the universal force and the visibility of the disjuncts

According to the analysis presented in section 2, the interpretation of disjunctive counterfactuals involves universal quantification over antecedents: a counterfactual of the form "If A or B, then C" conveys that for all propositions *p* in the set containing the propositions expressed by A and B, it is true that if *p*, then C.

The analysis has two components: (i) adopting a Hamblin semantics for *or* allows for the semantic composition of counterfactuals to make reference to each disjunct on its own, and (ii) assuming that they are correlatives justifies their universal force.

Before concluding, I would like to address two issues concerning these two components: in the next subsection I discuss the assumption that source of the universal force is external to the consequent, and, in the last subsection, I discuss the assumption that the disjuncts are *always* visible to the interpretation component.

5.1. IS THE UNIVERSAL FORCE EXTERNAL TO THE CONSEQUENT?

In the analyses presented in Alonso-Ovalle 2004 and van Rooij 2006, the disjuncts are made visible to the interpretation function via the variable assignment, by assuming that disjunctions impose a condition on a variable, as first proposed in Rooth and Partee 1982, following the Heimian analysis of indefinites (Heim, 1982). The disjunctive counterfactual of the sentence in (1), repeated in (78a) below, would be analyzed, according to this analysis, as in (78b), where p is a free variable of type $\langle s,t \rangle$.

(78) a. If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop.
(A variation on an example in Nute 1975.)

b. $p \mathbin{\&} p = \lambda w.\mathbf{good\text{-}summer}_w \vee p = \lambda w.\mathbf{cold}_w(\mathbf{s})$

The effect of quantifying over the disjuncts is derived from the universal force of *would* counterfactuals. These analyses account for the natural interpretation of *would* counterfactuals by assuming that *would* counterfactuals quantify over pairs $\langle w,g \rangle$ of worlds w and variable assignments g such that g is a variable assignment that maps the variable introduced by *or* to one of its possible values (determined, as in (78b), by the disjuncts), and w is a world (i) in which the proposition expressed by the antecedent under g is true, and (ii) that gets as close to the world of evaluation as any other world w' in which the proposition expressed by the antecedent under g is true. *Would* counterfactuals claim that *all* those pairs are pairs that satisfy the consequent. The universal force is built into the semantics of *would* counterfactuals.

This type of analysis, however, does not cover the case of *might* counterfactuals. If *might* counterfactuals are duals of *would* counterfactuals, they would say that at least one of the pairs $\langle w, g \rangle$ contributed by the antecedent satisfy the consequent, not that all do. To cover the case of *might* counterfactuals, we need to resort to an external force of universal quantification, as the analysis presented in section 2 does. Take for instance the *might* counterpart of the example in (78a).

(79) If we had had good weather this summer or the sun had grown cold, we might have had a bumper crop.

According to the analysis presented in section 2, this counterfactual claims that we might have had a good crop if we had had good weather this summer, and also if the sun had grown cold. To capture this interpretation, we need to move beyond quantifying over pairs of worlds and assignment and mimic the effects of quantifying over the disjuncts in the antecedent. One possibility, suggested in van Rooij 2006 (fn. 26), is this: the semantic interpretation can collect in one set the pairs $\langle w, g \rangle$ such that g maps p to the proposition that we have a good summer and w is one of the closest worlds where we have a good summer, and in another set the pairs $\langle w, g \rangle$ such that g maps p to the proposition that the sun grows cold. We can then say that the antecedent of the counterfactual contributes a set containing these two sets, and that both *would* and *might* counterfactuals claim that the consequent follows from *any* of those sets. We would end up with an analysis similar to the one proposed in section 2, but in which the source of the universal quantification is left unexplained. The analysis presented in section 2 justifies the source of the universal quantification by assuming that counterfactuals are correlatives.

5.2. ON THE VISIBILITY OF THE DISJUNCTS

To conclude, I would like to mention that there is a known recipe to construct counterexamples to the interpretation by the analysis presented in section 2: make up a disjunctive counterfactual of the type we have been looking at (the type where one of the disjuncts is more remote than the other), and be sure that the consequent denotes the proposition expressed by one of the disjuncts. Here's a famous case:

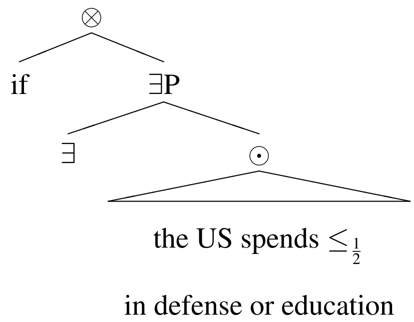
(80) If the U.S. devoted more than half of its budget to defense or to education, it would devote more than half of its budget to defense. (Nute 1984)

According to the analysis presented in section 2, this counterfactual denotes (a singleton containing) the proposition p that is true in a world w if and only if the closest worlds to w where the U.S. spends more than half of its budget in defense are all worlds where the U.S. spends more than half of its budget in defense, and the closest worlds to w where the U.S. spends more than half of its budget in education are all worlds where it spends more than half of its budget to defense. The sentence seems to be intuitively true, but this proposition is a contradiction.

The standard theory of *or* fares better here. Under the standard analysis of *or*, the antecedent expresses the proposition that at least one of the disjuncts is true (the union of the set of worlds where the U.S. devotes more than half of its budget to defense and the set of worlds where it devotes more than half of its budget to education). Under the plausible relative similarity relation that ranks the worlds where the U.S. spends more in defense than in education as closer to the actual world than the worlds where the U.S. spends more in education than in defense, the selection function will only pick up worlds where the U.S. devotes more than half of its budget to defense. The counterfactual is then predicted to be true.

The analysis presented in section 2 can still capture the interpretation that we want by letting an Existential Closure operation range over the set of propositional alternatives introduced by *or*, as illustrated below, in which case the proposition expressed by the antecedent would be the same as in the standard analysis of *or*.[22]

(82)



a. $[\![\otimes]\!]^{\leq,g} = \{\lambda f_{\langle\langle s,t\rangle,\langle s,t\rangle\rangle}.\lambda w.\forall p[p \in [\![\exists \mathrm{P}]\!]^{\leq,g} \rightarrow f(p)(w)]\}$

b. $[\![\exists \mathrm{P}]\!]^{\leq,g} = \left\{ \lambda w'.\exists p \in \left\{ \begin{array}{c} \lambda w.\textbf{spend-}_w \leq_{\frac{1}{2}} (\textbf{us, ed}), \\ \lambda w.\textbf{spend-}_w \leq_{\frac{1}{2}} (\textbf{us, df}) \end{array} \right\} \ \& \ p(w') \right\}$

---

[22] Similarly, an anonymous reviewer offers the following context:

(81) John is playing a game of luck with white, black, and red balls. We know (but he doesn't) that none of the white balls has a winning number, but that taken together 30% of the black and red balls have a winning number (but we don't know the proportion of winning numbers among the black balls, nor among the read balls.) John picked a ball, and lost.

The reviewer points out that, in this context, (i) can be read as (ii), as if Existential Closure was triggered within the scope of the *if*-clause.

(i) If John had picked a black ball or a red ball, he would have had 30% chances of winning.

(ii) If John had picked a ball that wasn't white, he would have had 30% chances of winning.

c. $$[\![\odot]\!]^{\leq,g} = \left\{ \begin{array}{c} \lambda w.\mathbf{spend\text{-}}_w \leq_{\frac{1}{2}} (\mathbf{us, ed}), \\ \lambda w.\mathbf{spend\text{-}}_w \leq_{\frac{1}{2}} (\mathbf{us, df}) \end{array} \right\}$$

But we are left with an important question: why is Existential Closure triggered in this example, but not in the ones we discussed before? If disjunctive counterfactuals were ambiguous and their LFs could optionally include an Existential Closure operator under the scope of *if*, the counterfactuals we discussed in the previous sections should have the reading predicted by the standard analysis of *or*, but they don't seem to. If we want to capture the interpretation of examples like (80) by resorting to an operation of Existential Closure, we seem to be forced to conclude that the operation is a last resort strategy to avoid interpreting examples like (80) as contradictions. Maybe one could reason as follows: the analysis predicts that the example in (80) can only be true if the proposition that the U.S. devoted more than half of its budget to education were the impossible proposition (the proposition that is true in no world). Here's why: the analysis predicts the sentence to be true if and only if the closest worlds where the U.S. spends more than half of its budget in education are all worlds where it spends more than half of its budget in defense *and* the closest worlds where the U.S. spends more than half of its budget in defense are all worlds where it spends more than half of its budget in education. As long as there are worlds where the U.S. spends more than half of its budget in education, these truth-conditions will not be satisfied in any world, because, given our assumptions about the selection function, if there are worlds where the U.S. spends more than half of its budget in education, when applied to the proposition that the U.S. spends more than half of its budget in education, the selection function will return no world where the U.S. spends more than half of its budget in defense. If there were no possible worlds where the U.S. spends more than half of its budget to education, the selection function will return the empty set, and since the empty set is a subset of any set, it will be a subset of the set of worlds where the U.S. devotes more than half of its budget to defense. The sentence could then be true. Now, since the proposition that the U.S. devotes more than half of its budget to education is not the impossible proposition, the hearer knows that the sentence in (80) is a contradiction. For (80) to be contingent, Existential Closure should be triggered.

However, I am not fully convinced that this is all there is to be said about the pattern that (80) illustrates. Consider for instance the following example, with exactly the same characteristics:

(83) If I earned at most $30,000 or more than a billion, I would surely earn at most $30,000.

The example sounds contradictory to me, unless it is forced to be interpreted as the following more verbose examples:

(84) a. If I *were to* earn at most $30,000 or more than a billion, I *would* earn at most $30,000.

b. If I *might* earn at most $30,000 or more than a billion, I *would* earn at most $30,000.

c. (Even) if it were possible that I earned at most $30,000 and it were also possible that I earned more than a billion, I would nevertheless earn at most $30, 000.

Similarly, I think Nute's example accepts the following paraphrases:

(85) a. If the U.S. *were to* devote more than half of its budget to defense or education, it would devote more than half of its budget to defense.

b. If it were the case that the U.S. *might* devote more than half of its budget to defense or to education, it *would* devote more than half of its budget to defense.

c. (Even) if it were possible that the U.S. devoted more than half of its budget to defense and it were possible that the U.S. devoted more than half of its budget to education, the U.S. would nevertheless devote more than half of its budget to defense.

These paraphrases reveal some implicit modality. The disjunctions in the antecedent could be under the scope of a modal. There is then much more to say about these examples. We need to know where the implicit modality comes from, and we need to know how the propositional alternatives introduced by disjunction interact with modals. These two questions go beyond the scope of this article.

6. To Conclude

We have seen that the failure to capture the natural interpretation of disjunctive counterfactuals provides no reason to abandon a minimal change semantics for counterfactuals.

The analysis of disjunctive counterfactuals that we have presented, however, does not come for free. To be sure that the interpretation has access to each disjunct on its own, we have moved beyond the textbook analysis and embrace a Hamblin semantics for disjunction. Isn't this a costly move? I will like to let David Lewis answer the question.

In a short reply to his critics (Lewis 1973), Lewis suggested in passing moving beyond the standard analysis of *or* to capture the natural interpretation of disjunctive counterfactuals, and justifies the move as follows:

> Isn't it badly *ad hoc* to solve a problem in counterfactual logic by complicating our treatment of 'or'? When we have a simple, familiar, unified treatment (marred only by the irrelevant question of exclusivity) wouldn't it be more sensible to cherish it? I reply that if I considered our present problem in isolation, I would share these misgivings. But parallel problems arise from other constructions, so our nice uncomplicated treatment of 'or' is done for in any case. Consider:
>
> (4) I can lick any man in the house, or drink the lot of you under the table.
>
> (5) It is legal for you to report this as taxable income or for me to claim you nas a dependent.
>
> (6) Holmes now knows whether the butler did it or the gardener did.
>
> Take the standard treatment of 'or'. Try wide or narrow scope; try inclusive or exclusive. (4-6) will prove as bad as (1).
>
> (1) If either Oswald had not fired or Kennedy had been in a bullet-proof car, then Kennedy would be alive today.
>
> (Lewis 1977, 360-361)

Thirty odd years after it was written, Lewis' answer sounds premonitory. A number of recent works have resorted to an Alternative Semantics to solve several long-standing problems that have to do with the interpretation of disjunction: Alonso-Ovalle (2008), for instance, shows the advantages of adopting an Alternative Semantics to capture the exclusive interpretation of disjunctions with more than two disjuncts, and Aloni (2003a), Simons (2005) and Alonso-Ovalle (2006) pursue the hypothesis that disjunctions denote sets of propositional alternatives to account for its behavior in modal contexts, like the ones that Lewis considers.[23] Capturing the interpretation of disjunctive counterfactuals is not the only reason to embrace an Alternative Semantics for disjunctions, then.

To conclude, I would like to point out two issues for further research. The first one is the analysis of the behavior of indefinites and Free Choice items in the antecedent of counterfactual conditionals. A number of recent works (see Kratzer and Shimoyama 2002, Alonso-Ovalle and Menéndez-Benito 2003, Menéndez-Benito 2005) have offered reasons to analyze within an Alternative Semantics both existential (German *irgendein*, Spanish *algún*) and universal (Spanish *cualquiera*) Free Choice items. Alonso-Ovalle and Menéndez-Benito (in preparation) explain the scope behavior of Spanish *algún* in conditionals by adopting the analysis of conditionals presented above. It would be interesting to investigate whether the analysis presented here can also say something about the interpretation of other Free Choice items in the antecedent of counterfactuals.

The second issue for further research is the analysis of *and*. Under the set-up that we have presented, *or* does not have any existential force of its own. Its only role is to introduce a set of propositional alternatives into the semantic derivation. An external Existential Closure operator is responsible for

[23] See Alonso-Ovalle 2006 for extensive discussion of the literature. In the analysis that we have presented, and in these more recent works, it is assumed that disjunctions do not have quantificational force of its own. This is an assumption that was first made in Rooth and Partee 1982.

the existential force traditionally associated with *or*. Are there are reasons to believe that the universal force of *and* is also external? Kratzer (1977) points out that examples like (86) are ambiguous between giving a single conjoined recommendation (that students engaged in doing two things) and giving a pair of recommendations (recommending students to practice striding and also recommending them to practice flying.) It remains to be seen whether the fact that each term of the conjunction can have an equal status in the recommendation is connected to the phenomenon discussed in this paper.[24]

(86) Te Miti recommended that students practice striding and flying.
(Kratzer, 1977)

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[24] Thanks to Angelika Kratzer for pointing out this potential connection.

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