Alternatives and Truthmakers in Conditional Semantics

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1 Introduction: a trilemma

My starting point is a classical puzzle about counterfactuals in natural language. Counterfactuals seem to satisfy three logical constraints that are individually plausible, but jointly inconsistent.

Constraint #1. Counterfactuals invalidate Antecedent Strengthening. I.e., one cannot replace the clause appearing in a counterfactual antecedent with a stronger one and preserve truth value.

Failure of Antecedent Strenghtening $\varphi \mathbin{\Box\!\!\rightarrow} \psi \not\models \varphi^{+} \mathbin{\Box\!\!\rightarrow} \psi$
(with $\varphi^{+} \models \varphi$, $\varphi \not\models \varphi^{+}$)

The argument for this constraint (Stalnaker 1968, Lewis 1973a, 1973b) is that discourses that exemplify violations of Antecedent Strengthening—so-called Sobel sequences—can be heard as consistent.

(1) If the US threw its weapons into the sea, there would be war.
If the US and all other nuclear powers threw their weapons into the sea, there would not be war.

Constraint #2. Counterfactuals validate Simplification of Disjunctive Antecedents. I.e., a counterfactual with a disjunctive antecedent entails the counterfactuals whose antecedents are the individual disjuncts.

Simplification $(\varphi \vee \psi) \mathbin{\Box\!\!\rightarrow} \chi \models \varphi \mathbin{\Box\!\!\rightarrow} \chi, \psi \mathbin{\Box\!\!\rightarrow} \chi$

The argument for this constraint is that this pattern seems systematically validated by counterfactuals with disjunctive antecedents. For example:

(2) If Alice or Bob went to the party, the party would be fun.

a. $\rightsquigarrow$ If Alice went to the party, the party would be fun.

b. $\rightsquigarrow$ If Bob went to the party, the party would be fun.

Constraint #3. Counterfactuals validate Substitution of Logical Equivalents (SLE) in antecedent position. I.e., replacing an antecedent with a logically equivalent antecedent preserves truth value.

Substitution $\varphi \mathrel{\Box\!\!\rightarrow} \psi \vDash \varphi' \mathrel{\Box\!\!\rightarrow} \psi$
(with φ and φ' logically equivalent)

The argument for this constraint is theoretical, rather than empirical. Possible worlds semantics provides an elegant account of counterfactuals, which fits well into a general account of linguistic modality (Kratzer 1981a, 1981b, 1986, 1991, 2012). But this semantics is intensional, i.e. validates the replacement of necessarily equivalent clauses in all positions. *A fortiori*, it validates Substitution.

Unfortunately, if we hold on to a Boolean semantics for disjunction (i.e., if we take '*or*' to mean '$\vee$'), Simplification and Substitution immediately entail Antecedent Strengthening. Hence the three constraints are inconsistent and at least one of them must go.[1] The standard solution consists in retaining Failure of Antecedent Strengthening and Substitution, and jettisoning Simplification. Counterfactuals with disjunctive antecedents like (2) are an acknowledged problem, but it is assumed that they can be accommodated via a local fix.

This paper argues that no local fix will do, and that the trilemma should push us to reconsider some features of the semantics of conditionals. In particular, the correct semantics for conditionals is hyperintensional and hence invalidates Substitution. Similarly to several nonstandard accounts, this semantics makes use of a notion of a truthmaker. But, differently from other truthmaker accounts, this notion of a truthmaker is cognitive rather than metaphysical and is defined exclusively via linguistic means. Truthmakers just are standard propositions; which propositions they are is determined by facts about the syntactic structure of antecedent clauses.

The key idea behind the account is that conditionals are alternative-sensitive.

1 Proof:

i.	$\varphi \mathrel{\Box\!\!\rightarrow} \psi$	
ii.	$(\varphi \vee \varphi^+) \mathrel{\Box\!\!\rightarrow} \psi$	(from i, by SLE)
iii.	$\varphi^+ \mathrel{\Box\!\!\rightarrow} \psi$	(from ii, by SDA)

I will discuss later in the paper (§4) theories that try to account for the phenomenon by dropping a Boolean semantics for disjunction.

It is widely agreed that natural language includes expressions and mechanisms that manipulate alternatives to the linguistic material that is pronounced. One standard example is *only*. Consider:

(3) Only Alice came to the party.

On standard analyses, (3) presupposes that Alice came to the party, and asserts that none of a set of alternative individuals did. This is captured by letting *only* manipulate a set of alternatives. Roughly, alternatives are clauses that are generated from the pronounced material by replacing parts of it. For example, alternatives to (3) may be *Bob came to the party*, *Cynthia came to the party*, etc. Similar mechanisms relying on alternatives inform contemporary accounts of focus, scalar implicature, and so-called free choice effects (among other things).

I argue that, similarly, conditional antecedents are alternative-sensitive. In particular, I use alternative-sensitive mechanisms to define a set of propositions—ways for the antecedent to be true, or truthmakers—that are denoted by conditional antecedents. The resulting truth conditions are, on a rough pass:

> $\ulcorner \varphi \mathrel{\Box\!\!\rightarrow} \psi \urcorner$ = true iff: the propositions $p_1, p_2, \ldots, p_n$ that are ways for φ to be true are such that the closest p_1-, p_2-, …, p_n-worlds make ψ true.

This semantics makes conditionals hyperintensional, since intensionally equivalent sentences can have different alternatives (via their different syntactic structure). But this kind of hyperintensionality is different from that postulated by existing truthmaker accounts. On the one hand, it is well-understood and independently needed. On the other, it can be combined with standard tools from possible worlds semantics for conditionals.

This semantics differs from existing truthmaker accounts also in one other respect: it solves the trilemma by dropping both Substitution and Simplification (though it gets close to vindicating the latter). This is also a welcome feature, since it allows us to sidestep some vexing problems for standard truthmaker accounts.

A word about the scope of the paper: issues concerning Simplification have been discussed mostly in the literature on counterfactuals. But the data naturally generalize to all kinds of conditionals. Here I assume that all conditionals have a structurally uniform semantics and that my claims apply to conditionals across the board.

After setting up some background in §2, I examine and discard existing solutions in §3 and §4. §5-6 develop the positive account, and §7 closes the paper with a brief theoretical discussion.

2 Background

2.1 Comparative closeness semantics

In this section, I introduce a basic possible worlds semantics for conditionals. I follow closely classical ordering semantics for counterfactuals as formulated by Stalnaker (1968) and Lewis (1973a, 1973b). Contemporary semantics for conditionals often diverge from ordering semantics in several ways, but the differences are irrelevant for my purposes.[2]

The key element of Stalnaker/Lewis semantics is a relation of comparative closeness $\preceq_w$. $\preceq_w$ compares worlds with respect to their closeness to a benchmark world w: $w' \preceq_w w''$ says that w' is closer to w than w''. Both Stalnaker and Lewis take $\preceq_w$ to be a total preordering: $\preceq_w$ is transitive, reflexive, and total (in the sense that it is defined over all pairs of worlds). The basic function of $\preceq_w$ is singling out a set of worlds that verify the antecedent and that at the same time are 'maximal', i.e. are such that no other world is more similar to w then they are. Conditionals quantify over the maximal set of worlds so individuated. Using, as is standard, '⟦' and '⟧' for the interpretation function, here are schematic truth conditions:[3]

$$\llbracket \varphi \mathrel{\Box\!\!\rightarrow} \psi \rrbracket^{\preceq,w} = \text{true iff}$$
$$\text{for all } w' \in \mathsf{max}_{\preceq_w}(\{w' \colon \llbracket \varphi \rrbracket^{\preceq,w'} = \text{true}\}),\ \llbracket \psi \rrbracket^{\preceq,w'} = \text{true}$$
$$(\text{where } \mathsf{max}_{\preceq_w}(\{w' \colon \llbracket \varphi \rrbracket^{\preceq,w'} = \text{true}\}) \text{ is the set of closest } \varphi\text{-worlds})$$

This says: all the maximally close$_{\preceq_w}$ φ-worlds are ψ-worlds. For shorthand, we can say that each counterfactual antecedent *selects*, on the basis of $\preceq_w$, a set of worlds it quantifies over.

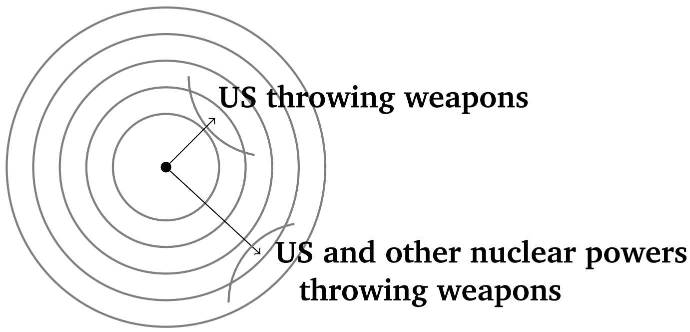
This semantics produces an elegant account of Sobel sequences. Consider:

(1) If the US threw its weapons into the sea, there would be war.
If the US and all other nuclear powers threw their weapons into the sea, there would not be war.

2 Some versions of comparative closeness semantics (e.g. Veltman 1976, or Kratzer 1981a, Kratzer 1981b, 1986, 1991, 2012) exploit so-called premise sets rather than a closeness ordering. Others (for example, von Fintel 2001 and Gillies 2007) remove some crucial elements from the semantics proper and place them in a dynamic account of contextual information. These differences won't matter for my purposes. Premise semantics for counterfactuals are translatable into ordering semantics (precisely, a subtype of ordering semantics is equivalent to premise semantics—see Lewis 1981), and dynamic accounts suffer from the same problems I raise.

3 This is an approximation to both of Stalnaker and Lewis's accounts. For Stalnaker, the ordering singles out, for each world w, a unique world w' that is closest to it. Lewis rejects the so-called limit assumption, i.e. the assumption that there is a $\preceq_w$-maximal set of antecedent worlds.

The set of maximally close US-throwing-weapons worlds need not overlap with the set of maximally close US-and-other-nuclear-powers-throwing-weapons worlds. In particular, the latter might be farther off than the former:



This situation allows for both conditionals in (1) to be true, since the two antecedents select distinct domains of quantification. Hence the discourse in (1) is consistent.

Throughout the paper, I also make assumptions about the syntactic structure of conditionals. With Kratzer (1981a, 1981b, 1986, 1991, 2012), I assume that all conditionals are modalized statements. The *if*-clause is used to restrict the background domain of quantification of the modal, which is usually called *modal base*. For example, the structure of the first conditional in (1) is:

(4) [if the US threw its weapons into the sea] [would [there be war]]

Notice that the modal *would* has two propositional arguments: one is the proposition expressed by the *if*-clause, the other the proposition expressed by the consequent clause (usually called *prejacent*).

There is a large literature on how closeness should be interpreted for various kinds of conditionals.[4] These questions are orthogonal to all my main points in this paper, so I ignore them throughout.

2.2 Disjunctive antecedents

Recall from the introduction: a conditional with disjunctive antecedents seems to entail the conditionals with the two individual disjuncts as antecedents:[5]

4 Some classical papers for the case of counterfactuals are Fine 1975, Jackson 1977, Lewis 1979; see Bennett 2003 for a useful overview. For some recent literature on the topic, see Schaffer 2004, Williams 2008.

5 The problem was noticed independently by Fine 1975 and Nute 1975, and has been discussed extensively. For some treatments of disjunctive antecedents within a classical or minimally modified comparative closeness framework, see Lewis 1977, Nute 1980, Klinedinst 2007 and

(2) If Alice or Bob went to the party, the party would be fun.

  a. ⇝ If Alice went to the party, the party would be fun.
  b. ⇝ If Bob went to the party, the party would be fun.

Following suit on the literature, I use the label 'Simplification' for the phenomenon exemplified by (2)–(2-b). (Notice that the label 'Simplification' does double duty: it denotes both the phenomenon and the logical rule. I rely on context to disambiguate.) The intuitions supporting Simplification can be sharpened by considering the corresponding Sobel sequences:

(5) #If Alice or Bob went to the party, the party would be fun.
  If Bob went, the party would be dreary.

The infelicity of (5) is unexpected on closeness semantics. Just assume that the closest Anna-going-to-the-party worlds are all closer than the closest Bob-going-to-the-party-worlds. Then the set selected by the two counterfactuals in (5) are disjoint, hence (5) is predicted to be consistent.

To sum up the problem: the same semantics mechanism that delivers a consistent reading of (1) also delivers a consistent reading of (5). Yet the data systematically patterns in different ways in the two cases. The problem posed by disjunctive antecedents is accounting for this phenomenon, and examining its repercussions on the semantics of conditionals.

2.3 Roadmap

Attempts at capturing Simplification generally fall into one of two categories.[6] The first assimilates it to scalar phenomena like implicature; the second resorts to a semantics where disjunctive clauses denote sets of propositions. The next two sections are devoted to discussing these accounts.

3 Simplification as a scalar implicature

One breed of accounts (see e.g. Klinedinst 2007, 2009, Schwarz 2014) tries to assimilate Simplification to a well-understood scalar phenomenon, i.e. scalar implicature (Grice 1975, Gazdar 1979, Sauerland 2004). Roughly, scalar im-

2009, Alonso-Ovalle 2009.

6 Early discussions of the problem (for example, Lewis 1977 and McKay & Van Inwagen 1977), often endorse a different solution, i.e. that we just regiment conditionals with disjunctive antecedents, *à la* Quine, as conjunctions of conditionals. Since then, the goal of a theory of counterfactuals has shifted from regimentation to a genuine compositional semantics. In the modern context, solutions in the style of Lewis and McKay & Van Inwagen are nonstarters.

plicature is the phenomenon whereby sentences involving certain lexical items (so-called 'scalar' items) systematically receive an interpretation that is stronger than their basic meaning.[7] I will say more about implicature in §5. For the moment, let me just point to a typical example: a sentence involving *some* like (6-a) is normally read as having the meaning in (6-b).

(6) a. Sarah talked to some of her students.
b. Sarah talked to some but not all of her students.

Like *some*, *or* is a paradigmatic example of a scalar item. Hence it is a plausible hypothesis that Simplification is a kind of implicature, triggered by the presence of disjunction.

Accounts in this strand proceed in two steps. First, they show how we can use scalar reasoning to strengthened the antecedent:

$$\varphi \vee \psi \mathrel{\Box\!\!\rightarrow} \chi \quad \rightsquigarrow \quad (\varphi \vee \psi)^+ \mathrel{\Box\!\!\rightarrow} \chi$$

Then, they show that the conditional with the strengthened antecedent (contrary to the conditional on its basic meaning) entails the two simplified conditionals.

$$(\varphi \vee \psi)^+ \mathrel{\Box\!\!\rightarrow} \chi \vDash \varphi \mathrel{\Box\!\!\rightarrow} \chi, \psi \mathrel{\Box\!\!\rightarrow} \chi$$

The distinctive feature of these accounts is that they preserve the basic form of comparative closeness semantics. In particular, conditional antecedents still denote a unique propositions (though not quite the one expressed by the basic meaning of the antecedent clause).

For current purposes, it's not important to focus on the precise mechanics of scalar strengthening. All that I need is point out the final effect of this strengthening as it applies to disjunctive antecedents. A conditional with disjunctive antecedent is taken to quantify over a 'mixed' set of worlds, i.e. a set of worlds that includes some worlds verifying each disjunct. More precisely, scalar strengthening enforces the following:

> **Diversity Condition** (DC): The worlds that count as closest for the purposes of evaluating a conditional of the form $\ulcorner \varphi \vee \psi \mathrel{\Box\!\!\rightarrow} \chi \urcorner$ include both φ- and ψ-worlds.

Once the strengthening captured by the Diversity Condition is in place, a conditional with disjunctive antecedents entails the two simplified conditionals—at

7 Here I skirt over the issue whether implicatures are a purely pragmatic phenomenon, as in Grice's and neogricean accounts (Grice 1975, Gazdar 1979, Sauerland 2004), or a semantic one (for proposals in this vein, see, among many, Chierchia 2004, 2013, Fox 2007, Chierchia et al. 2008).

least as long as we consider conditionals involving universal quantification (more on this shortly).

As an aside, let me notice that deriving the Diversity Condition is far from trivial, even if we assume that scalar implicatures can be computed in conditional antecedents. The best existing attempt is Klinedinst's (2007, 2009). Klinedinst's derivation of the Diversity Condition passes through a switch to a plural semantics for modals, i.e. a semantics where modals quantify over pluralities of worlds, rather than individual worlds.[8] Here I won't worry about this part of the proposal. Rather, I argue that, even if we grant that we can derive the Diversity Condition as a kind of implicature, scalar accounts fail.

Before attacking scalar accounts, let me point to a desirable and important prediction they make. Scalar implicatures are standardly taken to be an optional mechanism. For example, while *some* normally receives a *some but not all* interpretation, it need not when the context suggests otherwise, as showed by the consistency of (7).

(7) Sarah talked to some of her students. In fact, she talked to all of them.

Similarly, Simplification is an optional effect. Consider:

(8) If Spain had fought with the Axis or the Allies, she would have fought with the Axis. (McKay & Van Inwagen 1977)

Obviously (8) does not entail:

(9) If Spain had fought with the Allies, she would have fought with the Axis.

Below, I present further evidence that Simplification is an optional effect. I take it as an important *desideratum* that we be able to predict the optionality of Simplification. I will come back to this point in §6. Now let me state my case against scalar accounts.

3.1 Argument #1: downward entailing environments

My first argument concerns so-called downward entailing (henceforth, DE) environments. DE environments are linguistic environments that reverse the direction of entailment. Classical examples are negation, verbs like *doubt*, and quantifier phrases like *no student*.

(10) a. Jane runs ⇒ Jane moves

8 While my final account of disjunctive antecedents is very different from Klinedinst's, I am heavily indebted to him for pointing out the relevance of the semantics of plurals to conditionals.

b. Jane doesn't move ⇒ Jane doesn't run
c. I doubt that Jane moves ⇒ I doubt that Jane runs
d. No student moves ⇒ No student runs

DE environments provide a test for distinguishing meaning effects that are hard-wired into the basic semantics of a sentence from meaning effects that are the result of scalar strengthening. The latter, but not the former, usually disappear in DE environments.

For illustration, consider a paradigm example of scalar implicatures, i.e. the exclusivity implicature of bare disjunctions: $\ulcorner\varphi$ *or* $\psi\urcorner$ is usually strengthened with the negation of $\ulcorner\varphi$ *and* $\psi\urcorner$. For example, (11-a) is normally read as having the stronger meaning in (11-b).

(11) a. Jane talked to Mary or Sue.
b. ≈ Jane talked to exactly one of Mary and Sue.

But the stronger meaning disappears under a DE operator.

(12) a. It's not the case that Jane talked to Mary or Sue.
b. ≉ It's not the case that Jane talked to exactly one of Mary and Sue.

(13) a. I doubt that Jane talked to Mary or Sue.
b. ≉I doubt that Jane talked to exactly one of Mary and Sue.

(14) a. No student talked to Mary or Sue.
b. ≉No student talked to exactly one of Mary and Sue.

(12-a) is not read as having the meaning in (12-b). If it did, then it could be used to say that John either talked to none or both of John and Mary—which is obviously not the case. Similarly, *mutatis mutandis*, for (13-a) and (14-a).

From a theoretical perspective, the disappearance of scalar implicatures in DE environments is fully expected. Scalar implicatures are optional effects that aim at increasing the information carried by a sentence. But, in environments where the direction of entailment is reversed, they would produce an overall weakening. Hence speakers have a preference for not computing implicatures in these environments.

Another well-known family of scalar effects, i.e. free choice effects, also disappear under DE operators. Free choice consists in the distributive interpretation of certain linguistic phrases in the scope of existential quantifiers.[9] A classical

9 The free choice effect was first pointed out by Von Wright 1968 and Kamp 1973; for some recent accounts that characterize free choice as a kind of implicature, see Kratzer & Shimoyama 2002, Fox 2007, Klinedinst 2007, Chemla 2010, Franke 2011, Alonso-Ovalle 2006, Chierchia 2013. For examples of views that are not implicature-based, see (among many), Geurts 2005, Simons

illustration involves, again, disjunction:

(15) Mary may go to Paris or Berlin.

a. $\rightsquigarrow$ Mary may go to Paris.
b. $\rightsquigarrow$ Mary may go to Berlin.

There is no agreement on the proper account of free choice, but most theorists converge on the idea that it is a kind of implicature. The main argument (Kratzer & Shimoyama 2002, Alonso-Ovalle 2006, Fox 2007) is just that it disappears in DE environments:

(16) a. It's not the case that Mary may go to Paris or Berlin.
b. $\not\approx$ It's not the case that: Mary may go to Paris and she may go to Berlin.

(17) a. I doubt that Mary may go to Paris or Berlin.
b. $\not\approx$ I doubt that: Mary may go to Paris and she may go to Berlin.

(18) a. No student may go to Paris or Berlin.
b. $\not\approx$ No student is such that that: they may go to Paris and they may go to Berlin.

My first argument is simple: differently from implicatures and free choice effects, Simplification does *not* disappear in DE environments.[10]

(19) It's not the case that, if Alice or Bob went, the party would be fun.

a. $\rightsquigarrow$ It's not the case that, if Alice went, the party would be fun.
b. $\rightsquigarrow$ It's not the case that, if Bob went, the party would be fun.

(20) I doubt that, if Alice or Bob went, the party would be fun.

a. I doubt that, if Alice went, the party would be fun.
b. I doubt that, if Bob went, the party would be fun.

(21) None of my friends would have fun at the party if Alice or Bob went.

a. $\rightsquigarrow$ None of my friends would have fun at the party if Alice went.
b. $\rightsquigarrow$ None of my friends would have fun at the party if Bob went.

This is surprising on a scalar view of Simplification, while it is expected on a view that hardwires Simplification in the meaning of conditionals.

Incidentally, let me observe that the distributive mechanism exemplified

2005, Barker 2010.

10 This point is first made in Alonso-Ovalle 2006, pages 30-2, and attributed to Kratzer. Notice that Alonso-Ovalle claims that Simplification persists exactly in the same form in DE environments, contrary to what I say here and in §6.

by (19) and (20) is slightly different from what we observed in unembedded conditionals. If the conditional in (say) (20) was 'distributed' over the disjuncts, as it happens for (2), it would mean:

(22) I doubt the following: it is both the case that, if Alice went to the party, the party would be fun, and that, if Bob went to the party, the party would be fun.

which is not what (20) says. I get back to this in §6.

3.2 Argument #2: probability operators

My second argument is based on an empirical observation: Simplification still obtains with *probably*-conditionals, i.e. conditionals of the form ⌜If φ, probably ψ⌝. To see this, start by noticing that, intuitively, an assertion of (23) suggests that (23-a) and (23-b) are true:

(23) If Alice or Bob went to the party, probably Mary went too.
  a. ⇝ If Alice went to the party, probably Mary went too.
  b. ⇝ If Bob went to the party, probably Mary went too.

Moreover, we can construct example where the Simplification reading is required to make a *probably*-conditional true. Consider the following scenario:

> *Raffle.* Sarah bought 40 tickets in a 100-ticket raffle. The tickets she bought were numbered 31 to 70. The winning ticket was just picked. We're not told which ticket won, but we hear two rumors. On the first, the winning ticket is among tickets 1 to 70; on the second, it is among tickets 31 to 100.

Suppose that you say:

(24) If the winning ticket is between 1 and 70 or between 31 and 100, probably Sarah won.

(24) has a true reading. This is a reading on which Simplification holds, and (24) entails:

(25) a. If the winning ticket is between 1 and 70, probably Sarah won.
  b. If the winning ticket is between 31 and 100, probably Sarah won.

Notice that we need the Simplification reading to make *raffle* true. (24) is not true if it read as equivalent to:

(26) If the winning ticket is between 1 and 100, probably Sarah won.

Now, the problem for the scalar account is simply that it fails to predict the Simplification readings of *probably*-conditionals like (23) and (24).

To explore the predictions of the scalar account, I need some assumptions about *probably* and *probably*-conditionals. First, following Kratzer (1981b, 1991, 2012), I assume that *if*-clauses work as restrictors of the domain of quantification (modal base) of modals. Moreover, following recent work (Yalcin 2010, Lassiter 2011, Holliday & Icard 2013), I assume that *probably* has a probabilistic semantics (or at least a semantics that yields an equivalent logic). Roughly, ⌜*probably* φ⌝ says that the probability of φ is higher than .5. These assumptions result in intuitive truth conditions for *probably*-conditionals. ⌜If φ, probably ψ⌝ simply says that the conditional probability of ψ, given φ, is higher than .5.[11]

Now, it's easy to see that scalar accounts, combined with this basic semantics for *probably*-conditionals, fail to predict Simplification. They key maneuver of scalar accounts, recall, is using scalar reasoning to make the domain of quantification of conditionals suitably diverse. For the case of *probably*-conditional, this amounts to enforcing the following:

> **Diversity Condition*** (DC*): The worlds quantified over by a conditional of the form ⌜ if φ or ψ, probably χ⌝ include both φ- and ψ-worlds.

As we saw, for counterfactuals the analog of DC* is sufficient to derive Simplification. This derivation is guaranteed by a special property of closeness orderings: if the closest φ-or-ψ-worlds include a set of φ-worlds, then the latter also count as the set of closest φ-worlds (ditto for ψ-worlds). Call this property 'Persistence'. Given the Diversity Condition, Persistence guarantees that, if all closest φ-or-ψ-worlds make p true, the closest φ-worlds also make p true.[12]

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11 More formally, and loosely following the semantics in Yalcin 2010: I assume that the denotation of *probably* is relativized to a probability space parameter. A probability space is a pair $\langle E, Pr\rangle$ of a set of possible worlds E and a probability measure Pr. *Probably* φ says that the probability of the proposition expressed by φ according to Pr is greater than .5.

(27) $[\![\text{probably } \varphi]\!]^{w,\langle E,Pr\rangle} = \text{true iff } Pr_E(\{w' : [\![\varphi]\!]^{w',\langle E,Pr\rangle} = 1\}) > .5$

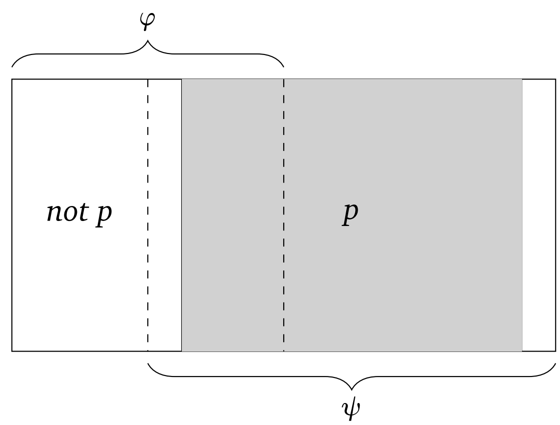
(Where $Pr_p(q)$ is understood as $Pr(q|p)$.) Accordingly, in *probably*-conditionals the *if*-clause is understood as restricting the epistemic space over which probabilities are distributed.

(28) $[\![\text{if } \varphi, \text{ probably } \psi]\!]^{w,\langle E,Pr\rangle} = \text{true iff } Pr_{E\cap[\![\varphi]\!]}(\{w' : [\![\psi]\!]^{w',\langle E,Pr\rangle} = 1\}) > .5$

12 A formal definition of Persistence, in the context of Lewis semantics with limit assumption:

> **Persistence.** For any set of worlds S, S' s.t. $S' \subseteq S$: if $S' \cap \max_{\preceq_w}(S) \neq \varnothing$,

But no analog of Persistence holds for *probably*-conditionals. It might be that, within the set of φ-or-ψ-worlds, the p-worlds are assigned a greater amount of probability than the non-p-worlds and that, at the same time, within the set of φ-worlds, the non-p-worlds have greater probability. Here is a diagram representing this situation (the size of the cells represents amount of probability):



Hence it might be that (i) the Diversity Condition* is satisfied, (ii) ⌜ if φ or ψ, probably χ ⌝ is true, and (iii) ⌜ if φ, probably χ ⌝ is false. As a result, scalar accounts cannot predict Simplification in *probably*-conditionals.

3.3 Argument #3: nonclosest worlds

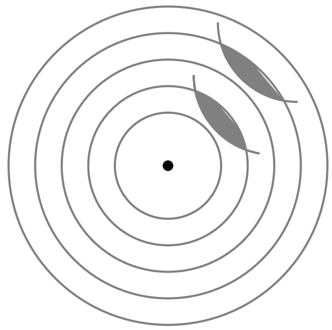
My third argument exploits conditional logic. Consider again:

(2) If Alice or Bob came, the party would be fun.

We can prove that, in certain contexts, the set of worlds selected by the antecedent of (2) is the union of two discontinuous segments of the ordering (i.e. two segments such that all worlds in the first segment are strictly closer than all worlds in the second):

$$\max_{\preceq_w}(S') = \max_{\preceq_w}(S) \cap S'$$

As Schlenker 2004 points out, Persistence generalizes a property entailed by condition 4 of Stalnaker's 1968 semantics. Charlow 2013 also discusses Persistence (under the label 'Stability') for deontic selection functions.



This situation is straightforwardly incompatible with closeness semantics, and suggests that the basic assumption behind scalar account fails: disjunctive antecedents do *not* denote a unique proposition.

The argument requires some setup. First, I borrow a scenario and some judgments from Lewis (1973a, p. 33):

> Otto is Waldo's successful rival for Anna's affections. Waldo still tags around after Anna, but never runs the risk of meeting Otto. Otto was locked up at the time of the party, so that his going to it is a far-fetched supposition; but Anna almost did go.

(29) If Anna had gone to the party, Waldo would have gone. ✓

(30) If Otto had gone to the party, Anna would have gone. ✓

(31) If Otto had gone to the party, Waldo would have gone. ✗

(29)–(31) is one of the triads Lewis uses to show that transitivity (below) is invalid for counterfactuals.

Transitivity $\varphi \mathrel{\Box\!\!\rightarrow} \psi, \psi \mathrel{\Box\!\!\rightarrow} \chi \vDash \varphi \mathrel{\Box\!\!\rightarrow} \chi$

Second, I observe that Simplification persists also in the backdrop of this scenario. For example, (32) is still infelicitous.

(32) #If Otto or Anna had gone, it would have been a lovely party.
If Otto had gone, it would have been a dreary party.

Finally, I assume that the Diversity Condition holds for (32) in the relevant context.

The judgments about (29)–(31), together with the Diversity Condition, yield a surprising conclusion. Configurations like (29)–(31) force certain facts about the ordering. In particular, Anna-worlds must be strictly closer than Otto-worlds. This descends from a general fact about transitivity-violating configurations.

Fact. Consider any triplet of counterfactuals of the form:

(a) $\varphi \mathrel{\Box\!\!\rightarrow} \psi$
(b) $\psi \mathrel{\Box\!\!\rightarrow} \chi$
(c) $\varphi \mathrel{\Box\!\!\rightarrow} \chi$

if (a), (b) are true and (c) false, then the closest ψ-worlds must be strictly closer than the closest φ-worlds.[13]

Hence the judgments on (29)–(31) require that the closest Anna-worlds must be closer than the closest Otto-worlds. Now consider again:

(33) If Otto or Anna had come, it would have been a lovely party.

By the Diversity Condition, (33) quantifies over both Otto and Anna worlds. Hence (33) quantifies over discontinuous segments of the ordering:

---

13 PROOF. I consider a Lewis semantics without limit assumption; the result follows immediately for stronger semantics, including a Lewis-style semantics with limit assumption and Stalnaker semantics. The truth conditions of (a)–(c) are, respectively:

(a) $\exists v \in \varphi : \forall u((u \preceq_w v) \supset u \in (\varphi \supset \psi))$
(b) $\exists v \in \psi : \forall u((u \preceq_w v) \supset u \in (\psi \supset \chi))$
(c) $\exists v \in \varphi : \forall u((u \preceq_w v) \supset u \in (\varphi \supset \chi))$

Now, consider (b): it says that there is a ψ-world (call it 'w_ψ') such that all worlds at least as close as it make true the material conditional $\ulcorner \psi \supset \chi \urcorner$. In the Lewis framework, the claim stated in FACT translates as follows:

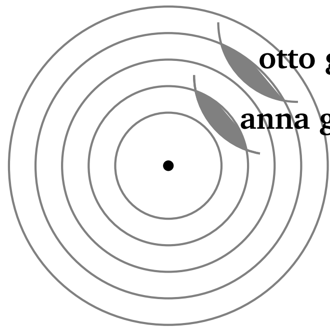
For all φ-worlds w': $w_\psi \prec_w w'$

Suppose, for *reductio*, that this is not the case. Then there is a φ-world, call it 'w^*', such that $w^* \preceq_w w_\psi$. Now, consider (a): it says that there is a φ-world such that all worlds at least as close as it validate the material conditional $\ulcorner \varphi \supset \psi \urcorner$. There are two cases: either (i) w^* is such a world; or (ii) there is some $w' \preceq_w w^*$ that is such a world. In either case, we have that there is a w_φ that works as a witness of (b), and such that $w_\varphi \preceq_w w^*$. By the transitivity of $\preceq_w$, we have that $w_\varphi \preceq w_\psi$. Now, by (a), we know that all worlds at least as close to w_φ validate $\ulcorner \varphi \supset \psi \urcorner$. Since $w_\varphi \preceq w_\psi$, we know that those worlds also validate $\ulcorner \psi \supset \chi \urcorner$. But then, by the transitivity of $\supset$, we have that all worlds at least as close to w_φ validate $\ulcorner \varphi \supset \chi \urcorner$; i.e., $\forall u((u \preceq_w w_\varphi) \supset u \in (\varphi \supset \chi))$. But now, by existential generalization on w_φ, we get exactly (c), i.e. the truth condition of $\ulcorner \varphi \mathrel{\Box\!\!\rightarrow} \psi \urcorner$. Hence $\ulcorner \varphi \mathrel{\Box\!\!\rightarrow} \psi \urcorner$ is true after all. Contradiction.

I should note that the result does *not* follow for a Kratzer-style semantics with partial orderings. But, in that case, the point can be made by replacing (31) with:

(i) If Otto had gone to the party, Waldo would not have gone.

(i) sounds true in Lewis's party scenario. In Kratzer's semantics, this gives us strictly more information than the falsity of (31) and allows us to prove that (33) quantifies over separate segments of the ordering. The proof is left as an exercise to the reader.



One natural conclusion is that that disjunctive antecedents do not denote a unique proposition. Rather, they somehow denote two propositions—i.e. the two propositions individually denoted by each disjunct. Let me now turn to accounts that pursue this idea.

4 Simplification in alternative semantics

4.1 Disjunctive clauses denote sets of propositions

A second breed of accounts tries to explain Simplification by resorting to a so-called alternative semantics for disjunction. Alternative semantics frameworks are derived from Hamblin's seminal work on questions (Hamblin 1973). The central idea is that several linguistic constructions, including disjunctive sentences, denote sets of propositions. Analyses of Simplification in this strand have been proposed by Alonso-Ovalle 2006, 2009 and van Rooij 2006. For concreteness, here I follow the account in Alonso-Ovalle 2009.[14]

14 There is a close relative of alternative semantics account that for reasons of space I won't discuss here—i.e., accounts that link directly conditionals and questions. (For some examples, see Levi 1996 in the formal epistemology tradition, and Starr 2014 in the semantics tradition. See also Rawlins 2013 for a treatment of so-called unconditionals along these lines.) These accounts treat conditional suppositions as involving questions, understood as partitions on (a subset of) logical space. The idea of using questions to account for Simplification, while at the same time bridging the semantics of conditionals with that of questions is very appealing. But this idea runs into an immediate problem: the alternative involved in Simplification don't exploit a partition. Consider the following example:

(i) If one of Al, Beth, and Charlie came to the party, another one of them will come too.

(i) has a Simplification reading—i.e. a reading on which it entails:

(ii) a. If Al came, one between Beth and Charlie would come too.
b. If Beth came, one between Al and Charlie would come too.
c. If Charlie came, one between Al and Beth would come too.

On Alonso-Ovalle's account, a disjunctive clause denotes not a single proposition, but rather the set of the propositions denoted by the disjuncts:

$$[\![\varphi \vee \psi]\!] = \{[\![\varphi]\!], [\![\psi]\!]\}$$

I call the propositions appearing in the denotation of a disjunctive clause 'propositional alternatives' (to distinguish them from alternatives *tout court*, which I take to be linguistic objects). *If*-clauses work as universal quantifiers over the set of propositional alternatives denoted in the antecedent. Schematically, the resulting truth conditions for conditionals are:

(34) $[\![\varphi \vee \psi \mathrel{\Box\!\!\rightarrow} \chi]\!]^{\preceq,w}$ = true iff:
for all $p \in \{[\![\varphi]\!]^{\preceq,w}, [\![\psi]\!]^{\preceq,w}\}$, for all $w' \in \max_{\preceq_w}(p)$, $[\![\psi]\!]^{\preceq,w'}$ = true

This immediately yields a semantic vindication of Simplification.

The semantics that I develop in §5–6 shares many features with (34). In particular, contrary to orthodoxy and together with Alonso-Ovalle, I assume that conditional antecedents have a set-type denotation. But there is a substantial difference.

In Alonso-Ovalle's system, propositional alternatives are generated directly by the lexical meaning of *or*. One effect of this choice is that the generation of propositional alternatives in Alonso-Ovalle's system is 'local', in the following sense. Alternatives are generated at a certain stage in the compositional computation, and are then available to combine with items that take scope above disjunction. Accounts that are local in this sense are problematic; let me illustrate why.

4.2 The problem: too few alternatives

Using the meaning of *or* to generate propositional alternative yields wrong predictions: in short, we end up getting too few alternatives. For illustration, consider (35), which I take to have the logical form in (36):

(35) Every student read *War and Peace* or *Anna Karenina*.

(36) Every student [λ_1. [x_1 read *War and Peace* or x_1 read *Anna Karenina*]]

Propositional alternatives enter the compositional computation when *or* is interpreted: hence, in this case, before the complex predicate λ_1. *[x_1 read* War and Peace *or x_1 read* Anna Karenina*]* is combined with the quantifier *every*

Now, it is crucial for this reading to be available that the antecedents of the conditionals in (ii) be understood as compatible—otherwise, the Simplification reading would be contradictory.

student. The complex predicate denotes a set of two properties (functions from individuals and worlds to truth values), as indicated below:

(37) $[\![\text{read W\&P or AK}]\!] =$
$\{\lambda x.\ \lambda w.\ x \text{ read W\&P in } w,\ \lambda x.\ \lambda w.\ x \text{ read AK in } w\}$

The two elements of this set combine 'pointwise' with the meaning of the quantifier *every student*.[15] The end result is that (35) denotes a set of two propositions:

(38) $[\![(35)]\!] =$
$\{\lambda w.\ \text{Every student read AK in } w,\ \lambda w.\ \text{Every student read W\&P in } w\}$

But these alternatives are not enough. Consider the following discourse:

(39) # If every student read *Anna Karenina* or *War and Peace*, the world would be a better place.
But if some students read *Anna Karenina* and some read *War and Peace*, the world would not be a better place.

Like our running example (2), (39) is a bad Sobel sequence. The obvious explanation is that the first conditional in the sequence entails a sentence inconsistent with the second conditional, again via Simplification:

(40) If every student read *Anna Karenina* or *War and Peace*, the world would be a better place.

$\rightsquigarrow$If some students read *Anna Karenina* and some read *War and Peace*, the world would be a better place.

But *Some students read AK and some students read W&P* is not among the alternatives to *All students read AK and W&P*. Hence an Alonso-Ovalle-style semantics misses the prediction that (39) is infelicitous.[16]

It may be that we can fix the problem while remaining in a 'local' framework.

---

15 As is standard in Hamblin-style systems, Alonso-Ovalle uses a rule of Pointwise Functional Application, which is used to handle set-type denotations.

Pointwise Functional Application (PFA)
If $[[\alpha]] \subseteq D_{\langle\sigma,\tau\rangle}$ and $[[\beta]] \subseteq D_{\tau}$,
then $[[\alpha(\beta)]] = \{c \in \tau :\ \exists a \in [[\alpha]] \wedge \exists b \in [[\beta]] :\ c = a(b)\}$

Informally, PFA mandates combining each element in a set with each element in every other set. Notice also that I'm skirting over the fact that the LF in (36) involves lambda-abstraction. This introduces nontrivial complications that are orthogonal to my main point here. (See Novel & Romero 2010 for the functioning of binding in Hamblin semantics.)

16 Many thanks to *[name omitted for blind review]* for extended discussion on this point, and for pointing out the existence of the problem in the first place.

But the fix is not going to be trivial.[17] Rather than pursing this, in the next section I pursue a 'global' account, where propositional alternatives are generated at the end of the compositional computation.

5 Alternative-sensitivity

My basic proposal is that conditional antecedents denote sets of propositions, each of which specifies a way for the antecedent to be true. These propositions may combine 'pointwise' with the main modal in a conditional, giving rise to Simplification. Roughly, the resulting truth conditions are:

> $\ulcorner \varphi \mathrel{\Box\!\!\rightarrow} \psi \urcorner$ = true iff: the propositions $p_1, p_2, \ldots, p_n$ that are ways for φ to be true are such that the closest p_1-, p_2-, …, p_n-worlds make ψ true.

This proposal immediately solves the problems raised in §3. First, the distribution effect is semantic, hence it is expected to persist in all linguistic environments. Second, since it is tied to the semantics of *if*-clauses, we expect the effect to take place in all conditionals, including *probably*-conditionals. Finally, if the closest worlds verifying each of the two disjuncts are at different distances from the actual world, the proposal allows for quantification over nonclosest worlds. I will also explain how the problems in §4 are addressed.

While the basic idea is intuitive, it's unclear how to define, in a systematic and principled way, the notion of a way for a sentence to be true. This section shows how to do this merely on the basis of syntactic alternatives.

5.1 Alternatives

Given a sentence S, speakers systematically take some sentences, and not others, to work as alternatives for S. For example, a conjunctive sentence like (41-b) normally works as an alternative for a disjunctive sentence like (41-a).

(41) a. Johanna talked to Mary or Sue
b. Johanna talked to Mary and Sue

17 The reason: to generate the right propositional alternatives, we need information about lexical items that take scope above disjunction when we are computing the meaning of the disjunctive phrase. For example, we would need the semantics to somehow 'see' that there is a universal quantifier above when computing the meaning of the complex predicate λ_1. *[*x_1 *read* War and Peace *or* x_1 *read* Anna Karenina*]*. It's unclear how this can be done compositionally.

This is showed by facts about implicature. Scalar implicatures are generated by negating more informative (i.e. stronger) alternatives to a sentence. The scalar implicature normally generated by (41-a) shows that (41-b) works as an alternative to it (and hence is what is negated in order to produce the implicature.)

(42) Johanna talked to Mary or Sue
$\rightsquigarrow$ Johanna did not talk to both Mary and Sue

Conversely, (43), even though it is a relevant and more informative variant of (41-a), does *not* work as an alternative to it.

(43) Johanna talked to exactly one between Mary and Sue

If it did, then an utterance of (41-a) would implicate (via negation of (43)) that Johanna talked to both Mary and Sue—which is obviously wrong.

The problem of specifying alternatives is the problem of specifying, in a principled way, which sentences work as alternatives of which others. Traditional accounts of alternatives merely stipulate that alternatives are part of the meaning of lexical items. For example, it is part of the lexical meaning of *or* that *or* is on a 'lexical scale' that also includes *and*. Recently, a nonstipulative option has emerged, thanks to Katzir 2007. In what follows, I'm going to assume Katzir's theory of alternatives, though nothing in my account depends on this.[18]

Katzir's account is built around two principles: relevance and complexity. Alternatives to a sentence S are all and only those sentences that are relevant in the context and no more complex than S. The notion of complexity here is technical. Roughly, S' counts as at most as complex as S just in case we can derive S' from S by either deleting syntactic constituents from S, or replacing them with syntactic items that are part of a given substitution source. The substitution source is defined as the union of the whole lexicon with items that have been pronounced in the context. I relegate the precise formulation of Katzir's algorithm to a footnote.[19]

18 The problem of explaining why (41-b), but not (43), is an alternative to (41)-a, is called 'symmetry problem'. The symmetry problem was first noticed by Kroch 1972 (standing to the historical information in Fox 2007), and earned its name in class notes by Kai von Fintel and Irene Heim at MIT. For a contemporary statement of the problem, see Sauerland 2004. For approaches based on lexical scales (commonly called *Horn scales*), see Horn 1972, Gazdar 1979, Horn 1989. For a refinement of Katzir's approach, see Fox & Katzir 2011.

19 First, we define the notion of a structure being at most as complex as another in context c (represented as '$\preceq_c$ '):

> $S' \preceq_c S$ iff S' can be derived from S by successive replacements of syntactic sub-constituents of S with elements of the substitution source for S in c, $SS(S,c)$

(The notion of a sub-constituent is a standard one in syntax; see e.g. Carnie 2013.) Then we

5.2 Stability

This section is the heart of the paper. It describes the algorithm for generating 'ways for a sentence to be true'—or, for short, truthmakers of a sentence. While the starting point—i.e. what alternatives are in play—is shared with existing literature, the algorithm is entirely new.

I allow myself to be sloppy in two ways. First, while alternatives are syntactic items, sometimes I treat them as propositions. Second, I suppress all reference to context. In both cases, the sloppiness is harmless.

Here is the basic proposal. Let ALT_S be the set of alternatives to S. The ways for S to be true are propositions that are (a) stronger than that expressed by S, and (b) individuated by the subsets of ALT_S that are *stable* and *minimal*. Stability is the key new notion. I say that a subset of ALT_S is stable iff it is *consistent with the negation of every alternative that is not a member of it*. The intuition is that a set of alternatives is stable just in case it contains enough information to stand alone—even if all other alternatives are false, it's still consistent to suppose that all sentences in the set are true.

I state formal definitions in a few paragraphs, but let me walk you through an example first:

(44) Otto or Anna went to the party

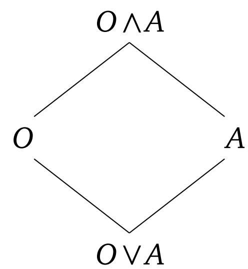
For the time being, I simply assume that the alternatives to (44) are:

(45)
$$\left\{\begin{array}{ll} \text{Otto or Anna went to the party} & O \vee A \\ \text{Otto went to the party} & O \\ \text{Anna went to the party} & A \\ \text{Otto and Anna went to the party} & O \wedge A \end{array}\right\}$$

(Some extra alternatives may be present—for example, if a third individual, John, is salient in the context, *John went to the party* will be an alternative. I show below that this is irrelevant.) Crucially, the alternatives in (48) can be ordered by logical strength (stronger alternatives are above weaker ones):

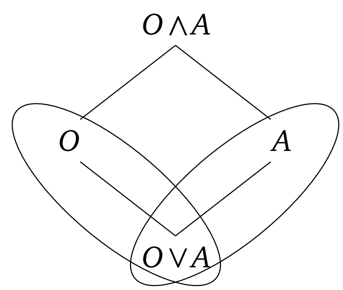
define the notion of a substitution source for a sentence S in a context c, as follows:

> The substitution source for sentence S in context c is the union of:
>
> i. The lexicon;
>
> ii. the subconstituents of S;
>
> iii. the set of salient constituents in C.



We proceed by checking what the stable subsets of $ALT_{(44)}$ are. It's easy to see that these subsets are $\{O \vee A, O\}$, $\{O \vee A, A\}$, and $ALT_{(44)}$ itself. For a comparison, consider $\{O \vee A\}$: this set is not stable, since it's inconsistent when supplemented with the negation of all the other alternatives.

Of all the stable subsets of $ALT_{(44)}$, we take only the minimal ones—i.e. the ones that are not proper supersets of any other stable subset of $ALT_{(44)}$.[20] We are left with $\{O \vee A, O\}$ and $\{O \vee A, A\}$:



The last step is using this machinery to capture the notion of a way for a sentence S to be true—what I call a *truthmaker* of S. This step is simple. First, we use sets of alternatives to individuate propositions. In particular, we

20 Why minimality? One might think that *all* the stable alternative sets to the antecedent should be considered. But I have learned of decisive examples from *[name omitted for blind review]* (p.c.). Here is a variant on his examples:

> *Scenario.* The three passengers in a small plane, contrary to the pilot's recommendations, clustered on the left-hand side of the plane because they enjoyed sitting together. As a result, the plane was unbalanced and crashed.
>
> (i) If some passengers had sat on the right-hand side, the plane would not have crashed.

(i) seems true. This suggests that the relevant 'ways for the antecedent to be true' won't include the way characterized by the strongest alternatives in the set. If the relevant 'ways' included the proposition *All passengers sat on the right-hand side*, the conditional would not be true (since then the plane would still have crashed).

take the propositions denoted by the conjunction of all sentences in each set of alternatives. In our example, we obtain the proposition that Otto went to the party—call this 'o'—and the proposition that Anna went to the party—call this 'a'. Then, of the propositions obtained in this way, we keep only those that entail S itself. Since it's useful to have a term, I call the propositions that pass this test the *truthmakers* of S. In our example, both o and a entail the proposition expressed by (44), hence they're both truthmakers of (44).

The entailment condition—i.e., the condition that a truthmaker must entail the proposition expressed by the antecedent—also screens off irrelevant alternatives. I discuss a case in detail in a footnote.[21]

5.3 Truthmakers for complex sentences

In §4, I pointed out that Alonso-Ovalle's algorithm is 'local': alternatives are generated in the course of the compositional computation of the relevant clause. Conversely, the stability algorithm is 'global', in the sense that it generates alternatives only at the end of the compositional computation of the clause. This difference is at the basis of a difference in predictions about complex sentences. Consider again (35):

(35) Every student read *War and Peace* or *Anna Karenina*.

We saw that (35) was problematic for Alonso-Ovalle's account, which missed the prediction that (47) is a truthmaker of (35).

(47) Some students read *Anna Karenina* and some read *War and Peace*.

21 Consider again (44). Suppose that a third individual—call him 'John'—is contextually relevant, so that he affects what alternatives are computed. The alternatives to (44) now are:

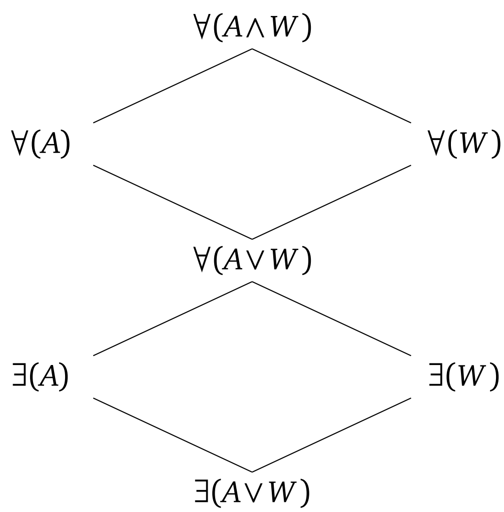
$$(46)\quad \left\{ \begin{array}{ll} \text{Otto or Anna went to the party} & O \vee A \\ \text{Otto went to the party} & O \\ \text{Anna went to the party} & A \\ \text{Otto and Anna went to the party} & O \wedge A \\ \text{John went to the party} & J \\ \text{Otto or John went to the party} & O \vee J \\ \text{John or Anna went to the party} & J \vee A \\ \text{Otto and John went to the party} & O \wedge J \\ \text{John and Anna went to the party} & J \wedge A \end{array} \right\}$$

The minimal stable subsets of the alternative set are: $\{O \vee A, A\}$, $\{O \vee A, O\}$, $\{J \vee A, J\}$, $\{J \vee A, A\}$. By conjoining the clauses in each set, we get three propositions: *Otto went to the party*, *Anna went to the party*, *John went to the party*. But only the former two entail the prejacent and hence qualify as truthmakers.

Let me now show that, on the contrary, the stability algorithm yields the right prediction here. Assume, in line with Katzir's theory, that (35) has eight alternatives, generated by considering substituted for the quantifier *every student* and for the disjunction:

(48)
$$\left\{ \begin{array}{lc} \text{Every student read } \textit{War and Peace} \text{ and } \textit{Anna Karenina} & \forall(A \wedge W) \\ \text{Every student read } \textit{Anna Karenina} & \forall(A) \\ \text{Every student read } \textit{War and Peace} & \forall(W) \\ \text{Every student read } \textit{War and Peace} \text{ or } \textit{Anna Karenina} & \forall(A \vee W) \\ \text{Some students read } \textit{War and Peace} \text{ and } \textit{Anna Karenina} & \exists(A \wedge W) \\ \text{Some students read } \textit{Anna Karenina} & \exists(A) \\ \text{Some students read } \textit{War and Peace} & \exists(W) \\ \text{Some students read } \textit{War and Peace} \text{ or } \textit{Anna Karenina} & \exists(A \vee W) \end{array} \right\}$$

Plotting them by strength, we obtain:[22]



There are three minimal stable subsets of $ALT_{(35)}$, each of which yields one truthmaker:

22 In the diagram, I'm leaving out the existential-conjunctive alternative *Some student(AK ∧ W&P)*, because it doesn't end up figuring in any of the minimal stable subsets of $ALT_{(35)}$. Also, I am assuming that the universal alternatives entail the corresponding existential ones. (On the assumption that universal determiners presuppose existence, the relevant notion of entailment is Strawson-entailment; see von Fintel 1999.)

$$\left\{\begin{array}{l}\forall(A)\\ \forall(A\vee W)\\ \exists(A)\\ \exists(A\vee W)\end{array}\right\} \qquad \left\{\begin{array}{l}\forall(W)\\ \forall(A\vee W)\\ \exists(W)\\ \exists(A\vee W)\end{array}\right\} \qquad \left\{\begin{array}{l}\forall(A\vee W)\\ \exists(A)\\ \exists(W)\\ \exists(A\vee W)\end{array}\right\}$$

$$\Downarrow \qquad\qquad \Downarrow \qquad\qquad \Downarrow$$

Every student read *AK*   Every student read *W&P*   Some students read *AK* and some students read *W&P*

In combination with the semantics for conditionals in §6, this will predict the infelicity of (39), as desired.

(39) #If every student read *Anna Karenina* or *War and Peace*, the world would be a better place.
But if some students read *Anna Karenina* and some read *War and Peace*, the world would not be a better place.

Hence a theory based on the stability algorithm has an empirical advantage over Hamblin-style semantics.

Technicalities

Following common usage, I use '$\sigma^{\neg}$' to denote the set of negations of the sentences in σ; and I use the notion of a set of sentences being consistent with another set of sentences as a natural extensions of the notion of consistency for propositions.

I say that a subset of ALT_S is *stable* with respect to ALT_S iff it is consistent with the negation of every alternative that is not a member of it.

$\sigma \subseteq ALT_S$ is *stable* (with respect to ALT_S) iff $\sigma \cup (ALT_S - \sigma)^{\neg} \nvDash \bot$

This is combined with minimality in the obvious way.

$\sigma \subseteq ALT_S$ is *minimal stable* (with respect to ALT_S) iff

(i) σ is stable with respect to ALT_S, and
(ii) $\neg\exists\sigma'$: σ' is stable and $\sigma' \subset \sigma$.

Notice that, on this definition: (a) stability immediately entails consistency; (b) the stable subsets of ALT_S are closed under weaker alternatives.

The notion of minimal stability is related in interesting ways to other notions appearing in the literature on alternatives and implicature. I discuss these connections in a footnote.[23]

23 First, minimal stability is something like the converse of the notion that Danny Fox (2007) dubs

Finally, here is the definition of a truthmaker.

> p is *a truthmaker of S* iff
>
> (i) for some $\sigma \subseteq ALT_S$ such that σ is maximal stable with respect to ALT_S, $[\![\bigwedge \sigma]\!] = p$; and
>
> (ii) $p \vDash [\![S]\!]$.

The truthmakers of S are the propositions denoted by the conjunctive closure of minimal stable sets of alternatives to S, and that are at least as strong as S.

The denotation of *if*-clauses on the new semantics is just the set of truthmakers of the *if*-clause.

$$[\![\text{if } \varphi]\!]^{\preceq,w} = \{p\colon\ p \text{ is a truthmaker of } \varphi\}$$

6 Conditionals as descriptions

I have explained how truthmakers are derived. But I have not explained what role they play in an overall semantics for conditionals. A first, natural suggestion is that conditionals quantify universally over truthmakers.

> $\ulcorner \varphi \mathrel{\Box\!\!\rightarrow} \psi \urcorner$ = true iff: for all truthmakers p' of φ, the closest p'-worlds make ψ true.

This is the route that existing version of truthmaker semantics (e.g.Van Fraassen 1969, Fine 2012b, 2012a) take, and that leads to a semantic vindication of Simplification. This route is natural, but wrong. In this section, I propose a better alternative: conditionals refer to, rather than quantify over, sets of propositions. The difference is structurally analogous to that between universally quantified determiner phrases (like *all boys*) and plural definite descriptions (like *the boys*).

'maximal exclusion'. A maximal exclusions of S is a maximal subset of alternatives $\sigma \subseteq ALT_S$ such that the negation of all the alternatives in σ is consistent with S. For example, the maximal exclusions of $ALT_{(44)}$ are $\{O, O \wedge A\}$ and $\{A, O \wedge A\}$. Fox uses maximal exclusions to characterize the algorithm that generates scalar implicature. Second, minimal stable sets of alternatives seems to correspond to the alternatives that Chierchia (2013) dubs 'domain alternatives'. Chierchia gives a semi-formal characterization of domain alternatives for a disjunction or an existential quantifier as 'all the subdomains of the domain of disjunction/existential quantification' (2013, p. 116; Chierchia relies on the idea that disjunction can be understood as an existential quantifier over the disjuncts). It's unclear how this formulation can be generalized to cases where the relevant lexical material doesn't involve a quantifier domain argument. Minimal stability improves on Chierchia's characterization, both because it's more precise and because it's more general.

The resulting semantics is similar to that using universal quantification, but handles much better a number of problem cases.[24]

6.1 Homogeneity

My argument against the validity of Simplification connects to the data about distribution effects in DE environments.

(19) It's not the case that, if Alice or Bob went, the party would be fun.
 a. ⇝ It's not the case that, if Alice went, the party would be fun.
 b. ⇝ It's not the case that, if Bob went, the party would be fun.

(20) I doubt that, if Alice or Bob went, the party would be fun.
 a. ⇝ I doubt that, if Alice went, the party would be fun.
 b. ⇝ I doubt that, if Bob went, the party would be fun.

(21) None of my friends would have fun at the party if Alice or Bob went.
 a. ⇝ None of my friends would have fun at the party if Alice went.
 b. ⇝ None of my friends would have fun at the party if Bob went.

(19)–(21) show that Simplification persists, in some form, in DE environments. But they also show that it doesn't work the way it should if Simplification was valid. In that case, (20) (say) would mean:

(49) I doubt the following: it is both the case that, if Alice went to the party, the party would be fun, and that, if Bob went to the party, the party would be fun.

The problem extends systematically to all occurrences of conditionals in DE environments. This is a strong argument against the semantic validity of Simplification.[25]

24 The semantics builds on existing accounts of correlatives: in particular, see Dayal 1996 for the claim that correlative constructions should be treated on the model of descriptions. See also Schlenker 2004 for the claim that conditionals work as descriptions.

25 Alonso-Ovalle 2006, pages 30-2, makes a different empirical claim. His example (attributed to Kratzer) uses the DE locution *It is plain false that*:

(i) It is plain false that Hitler would have been pleased if Spain had joined Germany or the U.S.

Alonso-Ovalle claims that (i) sounds true, and that hence we have evidence that conditionals do involve universal quantification over propositional alternatives. I agree that the judgment about (i) is less clear than (19) or (20), but I dispute that the locution *it is plain false that* works as a reliable diagnostic, since it seems to negate presuppositions as well. (Compare: *It is plain false*

Luckily, the pattern displayed by (19) and (20) is well-known and naturally suggests an account. Here I illustrate it via a parallel with plural definite descriptions, though several items in language exhibit it.[26] In their unembedded occurrences, plural descriptions are interpreted universally:

(50) The boys went swimming.
$\approx$ Each boy went swimming.

But this interpretation disappears in DE environments. There the universal quantifier appears to take scope outside the DE element.

(51) I doubt that the boys went swimming.
$\not\approx$ I doubt that each boy went swimming.
$\approx$ For each of the boys, I doubt that he went swimming.

Schematically ('$\textsc{op}_{DE}$' stands for 'DE operator'):

$$\text{The } Fs \text{ are } G \Rightarrow \text{For each individual } x \text{ that is } F,\ x \text{ is } G$$

$$\textsc{op}_{DE}\ [\text{The } Fs \text{ are } G] \Rightarrow \text{For each individual } x \text{ that is } F,\ \textsc{op}_{DE}[x \text{ is } G]$$

This puzzling effect is known as *homogeneity effect*[27] (the intuition is that the set of boys is homogenous with respect to the property denoted by the predicate: either all boys possess it, or none does). My observation is that conditionals generate an analogous homogeneity effect with respect to the truthmakers of their antecedents. Schematically (and allowing for some use-mention sloppiness):

$$\varphi \mathrel{\Box\!\!\rightarrow} \psi \Rightarrow \text{For each truthmaker } \rho \text{ of } \varphi,\ \ulcorner \rho \mathrel{\Box\!\!\rightarrow} \psi \urcorner$$

$$\textsc{op}_{DE}[\varphi \mathrel{\Box\!\!\rightarrow} \psi] \Rightarrow \text{For each truthmaker } \rho \text{ of } \varphi,\ \ulcorner \textsc{op}_{DE}\ [\rho \mathrel{\Box\!\!\rightarrow} \psi] \urcorner$$

Given this parallel, I take the semantics of plural descriptions as a guide to the semantics of conditional antecedents. The analogy between descriptions and conditionals is not new: my account connects naturally to other theories on the market (Bittner 2001, Schein 2003, Schlenker 2004). The key difference is that these theories analyze conditionals as descriptions of worlds, while I analyze them as descriptions of truthmakers.

that the King of France is bald, since there is no King of France seems also felicitous.) (19)–(21) provide a better test.

26 An incomplete list includes: generic statements, bare plurals, embedded interrogatives, and statements about the future involving *will*. See Gajewski 2005, as well as other references in footnote 27, for a comprehensive discussion.

27 Homogeneity is the subject of a large and active debate. For some relevant work, see Fodor 1970, Löbner 1985, Von Fintel 1997, Gajewski 2005, Malamud 2012, Magri 2014.

6.2 The analogy with plural descriptions

Most theories take plural expressions in language to denote pluralities (also called 'plural individuals'). For current purposes, we can take pluralities to be sets of atomic individuals.[28] Plural terms denote sets of individuals: e.g., *Alph and Bob* denotes the set $\{a, b\}$ containing the atomic individuals Alph and Bob. Plural predicates denote sets of sets: e.g., *boys* denotes the set of all sets of boys (equivalently, the powerset of the denotation of the singular *boy*).

Plural descriptions are treated as referring to the largest plurality[29] of individuals that satisfies the predicate appearing in the description:

> $[\![$The $\varphi]\!]$ = the (plural) individual i s.t. i is the unique maximal individual of which $\varphi(i)$ is true.

Hence, if Alph, Bob, and Chad are all and only the boys within the domain of quantification, we have:

(52) $[\![\text{The boys}]\!] = \{a, b, c\}$

This basic account is supplemented with some extra features, two of which are relevant here.

First, plural descriptions admit of both distributive and collective readings. These are illustrated by, respectively, (53) and (54):

(53) The boys carried a backpack
≈ For each of the boys, he carried a backpack

(54) The boys carried a piano together
≈ All of the boys jointly carried a piano

Compositionally, it is usually assumed that the distributive reading involves an optional distributivity operator, DIST, that is adjoined to the predicate. Roughly, the distributivity operator takes as argument a property and a plurality of indi-

28 Pluralities are sometimes understood as sets, and sometimes as mereological sums of individuals. The *locus classicus* for the introduction of the sum approach is Link 2002; see also Landman 1989. Set-type approaches are presented by Hoeksema 1983 and Schwarzschild 1996, among others (though Schwarzschild uses a kind of nonstandard set theory). The sum approach seems dominant nowadays; I use the set approach for ease of exposition. For some useful overviews about the semantics of plurals, see Nouwen 2014, Winter & Scha 2014.

29 More precisely, they are treated as referring to the maximal plurality of individuals satisfying the predicate, and normally 'maximal' is understood as 'largest'. This is the classical theory derived from the work of Sharvy 1980 and Link 2002. Recently, von Fintel et al. 2014 have given a convincing argument to the effect that the relevant measure of maximality is based on informativity. So far as I can see, shifting to their proposal makes no difference to my account.

viduals, and says that the property is true of each individual that is a part of the plurality. Schematically:

$$\llbracket [\text{The } Fs] \ \textsc{dist}[Gs] \ \rrbracket = \\ \text{true iff } \forall x\colon x \text{ is atomic and } \llbracket Fs \rrbracket(x) = 1, \llbracket Gs \rrbracket(x) = 1$$

Second, distributivity operators carry a semantic presupposition that either all the individuals picked out by the description satisfy the predicate, or they all don't.[30] This all-or-nothing presupposition serves to capture homogeneity effects on the distributive reading (collective readings immediately validate homogeneity).[31] By negating *The boys went swimming* we get (via the distributivity operator) that not all boys went swimming. Combined with the all-or-nothing presupposition, this gets us the perceived truth conditions, i.e. that none of the boys went swimming.

My account consists simply in importing these features to conditionals. In a slogan: conditionals are descriptions of truthmakers. My account and its predictions fall out immediately by switching truthmakers for individuals in the semantics I just sketched.

To start with, *if*-clauses denote sets of propositions. In addition, I assume the existence of an optional distributivity operator $\textsc{dist}_\pi$, analogous to $\textsc{dist}$ but operating over propositions. $\textsc{dist}_\pi$ takes as arguments a function from propositions to truth values (i.e. the denotation of the consequent of a conditional) and a set of propositions, and says that the function maps each proposition in the set to true. Schematically:

$$\llbracket [\text{If } \varphi] \ \textsc{dist}_\pi[\psi] \ \rrbracket = \text{true iff } \forall p\colon p \in \llbracket \text{if } \varphi \rrbracket, \llbracket \psi \rrbracket(p) = \text{true}$$

$\textsc{dist}_\pi$ is also the bearer of an all-or-nothing presupposition, again analogous to the one in use on the distributivity operator for individuals.

$\textsc{dist}_\pi$ is what generates Simplification. Take our running example (2), and assume that it has the distributive LF, represented below:

(55) [If Alice or Bob went to the party] $\textsc{dist}_\pi$[would [the party be fun]]

---

30 Here is the entry:

$$\llbracket \textsc{dist} \rrbracket = \lambda P.\ \lambda xx: \\ \forall yy \leq xx.\ (Atom(yy) \to P(yy)) \vee \forall yy \leq xx.\ (Atom(yy) \to \neg P(yy)). \\ \forall yy \leq xx.\ (Atom(yy) \to P(yy))$$

(Following a widespread convention, I use double variables like 'xx' to range over pluralities.)

31 I should note that this is only one of the ways to capture homogeneity (for which see Von Fintel 1997, Gajewski 2005), and there is no agreement that it is the correct one. Nothing in my account of conditionals depends on accounting for homogeneity via this route.

The *if*-clause in (55) denotes the set of the propositions expressed by the two disjuncts. DIST_π ensures that these propositions are combined individually with the rest of the clause. The resulting truth conditions are:

(56) $\forall p \in \{$ *Alice went*, *Bob went*$\}$, $\mathsf{max}_{\preceq_w}(p) \in [\![$ party be fun $]\!]$

Hence (2), on the parsing in (55), entails

(2) a. If Alice went to the party, the party would be fun.
b. If Bob went to the party, the party would be fun.

Since I assume that the distributivity operator is optional, again in analogy with the semantics of plurals, I am committed to readings on which Simplification fails. In fact, this prediction is borne out. The counterpart of collective readings for conditionals are just examples like:

(8) If Spain had fought with the Axis or the Allies, she would have fought with the Axis.

Hence, differently from other truthmaker theories, I do not vindicate Simplification. But this failure is expected and descends from independently motivated features of the theory.

Technicalities

The main innovation is letting *if*-clauses denote sets of propositions. To do this, I treat *if* as a set-forming operator: *if* takes as argument a clause and a set of alternatives, and generates a set of truthmakers for that clause.

$$[\![\text{if}]\!]^{\preceq,w} = \lambda p_{\langle s,t\rangle}.\ \lambda ALT.\ \{q_{\langle s,t\rangle}\colon q \text{ is a truthmaker}_{ALT} \text{ of } p\}$$

The distributivity operator DIST_π takes as argument a set of propositions and quantifies over singletons of propositions within that set. (The quantification is over singletons rather than over the propositions themselves for type-theoretic reasons—this way, the input argument to the modal is of the same type whether DIST_π is present or not.) In addition, exactly like the distributivity operator for individuals, it carries the homogeneity presupposition. This is the lexical entry (I use ‘P’ as a type for sets of propositions):

$$[\![\text{DIST}_\pi]\!]^{\preceq,w} = \lambda\Phi_{\langle st,t\rangle}.\ \lambda S_{\text{P}} : \forall p \in S.\ \Phi(\{p\}) = 1 \vee \forall p \in S.\ \Phi(\{p\}) = 0.$$
$$\forall p \in S, \Phi(\{p\}) = 1$$

Finally, modals appearing in conditionals work in a standard way, aside from two tweaks. First, the outermost argument of a modal is a set of propositions, rather a proposition. Second, modals 'extract' from their set-type argument a proposition in the following way: they take the proposition generated by the disjunctive closure of the propositions in the set. When the set is a singleton, the result is just the unique proposition in the set. When the set is not a singleton, this gets back the proposition expressed by the antecedent. The latter case is the one that generates violations of Simplification.

For an example, here is the lexical meaning of *would*:

$$[\![\text{would}]\!]^{\preceq,w} = \lambda S_{\mathrm{P}}.\ \lambda p.\ \forall w' \in \mathsf{max}_{\preceq,w}(\bigvee S) = 1,\ p(w') = 1$$

7 Hyperintensionality and syntactic complexity

I started from an inconsistent triad of apparent *desiderata* about conditional logic: Failure of Antecedent Strengthening, Simplification of Disjunctive Antecedent, and Substitution of Logical Equivalents. Standard semantics for conditionals drops Simplification and preserves the other two. My account drops both Simplification and Substitution, but it is very much in the spirit of Simplification-vindicating accounts. More in detail, my account allows for two parsings of conditionals, in analogy with the semantics of plurals: one involves a distributivity operator, the other does not. The parsing involving a distributivity operator vindicates Simplification, while the other doesn't.

The main theoretical move of my account is dropping Substitution. This makes conditionals hyperintensional: we can't preserve truth value under substitutions of necessarily equivalent antecedents. Pairs of conditionals exemplifying this failure are easy to find. For example:

(57) If Anna came to the party, the party would be fun.

(58) If Anna, or Otto and Anna, came to the party, the party would be fun.

The antecedents of (57) and (58) are logically equivalent, yet (on the distributive parsing of (58)) the two conditionals have different truth conditions.

Dropping Substitution goes against a long tradition of work on which the semantics for conditionals is intensional. But my account also diverges from existing hyperintensional semantics, which generally rely on a metaphysics of fine-grained entities and drop all talk of worlds and comparative closeness.[32] All the main tools I use (possible worlds, closeness, alternatives) are already available

32 For a counterfactual semantics employing impossible worlds, see, among many, Nolan 1997. For a semantics using states, see Fine 2012a and 2012b, as well as the version of Fine's semantics in

in the literature. Moreover, my notion of a truthmaker is not metaphysical, but cognitive: truthmakers are just standard propositions; which propositions count as truthmakers is determined on the basis of grammatical mechanisms tied to alternatives.

The kind of hyperintensionality resulting from my view is pretty mundane. Its source is the fact that logically equivalent sentences may have different alternatives. This kind of hyperintensionality is also widespread through language. Consider:

(59) a. John only read *Anna Karenina*.
$\Rightarrow$ John did not read *War and Peace*.

b. John only read either *Anna Karenina*, or *War and Peace* and *Anna Karenina*.
$\not\Rightarrow$ John did not read *War and Peace*.

The prejacents of *only* in (59)-a and (59)-b are logically equivalent, yet the two sentences have different truth conditions. Hence *only* is a hyperintensional operator. This kind of hyperintensionality has its origins in grammar, rather than in metaphysics. My main point in this paper has been that the same kind of hyperintensionality is at work in conditionals. We have both a good conceptual grasp of this hyperintensionality and the technical tools to model it. Incorporating it into a theory of conditionals may bring in extra complexity, but no new ontological or explanatory costs.[33]

Briggs 2012.

33 *[Acknowledgments suppressed for blind review.]*

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