Lifting conditionals to inquisitive semantics

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Abstract

We show how any truth-conditional account of indicative or counterfactual conditionals can be lifted to the setting of inquisitive semantics. Whatever base account we choose, the lifted account improves on it in three ways. First, while coinciding with the base account on disjunction-free statements, the lifted account treats disjunctive antecedents as providing multiple assumptions: this derives the principle known as *simplification of disjunctive antecedent*. Moreover, the lifted account extends the base account to cover two further classes of conditional constructions: *conditional questions* and *unconditionals*.

Introduction. We show how any truth-conditional account of indicative or counterfactual conditionals can be lifted to the setting of inquisitive semantics. Whatever base account we choose, the lifted account improves on it in three ways. First, while coinciding with the base account on disjunction-free statements, the lifted account treats disjunctive antecedents as providing multiple assumptions: this derives the principle known as *simplification of disjunctive antecedent.* Moreover, the lifted account extends the base account to cover two further classes of conditional constructions: *conditional questions* and *unconditionals.*

Disjunctive antecedents. Consider the following conditionals. From (1), we can infer (2), but from (2), we cannot infer (3).

(1) If you come in the morning or after 3pm, you'll find me in the library.

(2) If you come in the morning, you'll find me in the library.

(3) If you come in the morning and the library is closed, you'll find me in the library.

The inference from (1) to (2) is an instance of *simplification of disjunctive antecedents* (SDA), while the inference from (2) to (3) is an instance of *strengthening of the antecedent* (SA).

$$\frac{\text{if A or B, then C}}{\text{if A, then C}}\ (\text{SDA}) \qquad\qquad \frac{\text{if A, then C}}{\text{if A and B, then C}}\ (\text{SA})$$

SDA is intuitively valid: conditionals with disjunctive antecedents seem to invite consideration of multiple assumptions; for the conditional to be true, the consequent must follow on each assumption (Fine, 1975, 2012; Ellis *et al.*, 1977; Alonso-Ovalle, 2009). As for SA, it seems *in*valid, as our example shows. But Ellis *et al.* (1977) showed that, in a compositional account of conditionals based on a truth-conditional notion of meaning and on a classical treatment of conjunction and disjunction, SDA and SA are equivalent. This is a problem for classical theories of conditionals, which has recently lead to approaches which advocate a more fine-grained account of disjunction (van Rooij, 2006; Alonso-Ovalle, 2009; Fine, 2012). Our approach fits within this tradition but, as we will see, it has some important advantages.

Conditional questions. While conditionals are the subject of an impressive amount of literature, relatively little attention has been paid to the fact that the class of conditional sentences does not just include statements like (1)-(3), but also questions:

(4) a. If I come in the morning, will I find you in the library?
b. If I had come in the morning, would I have found you in the library?

Existing accounts of conditional questions (Velissaratou, 2000; Isaacs and Rawlins, 2008; Ciardelli *et al.*, 2013) focus on indicative conditional questions like (4-a); by contrast, our lifting can also be combined with an account of counterfactuals to yield an analysis of (4-b).

Unconditionals. Rawlins (2008a,b) has argued that unconditionals such as (5-a,b) should be analyzed on a par with conditionals, by taking the "antecedent" to contribute multiple hypothetical propositions, corresponding to the semantic answers to the issue.

(5) a. Whether there is live music or not, the party will be fun.

b. Whether they play jazz music or tango, the party will be fun.

Our account incorporates the core of Rawlins's proposal, and at the same time, it allows us to make this core compatible with different accounts of the indicative conditional.

The account. For the sake of clarity, we implement our account in propositional logic. We assume a language built up from a set $\mathcal{P}$ of atoms by means of conjunction ($\wedge$), disjunction ($\vee$), negation ($\neg$), and conditional ($>$). A model $M = \langle W, V, \rhd \rangle$ for this language consists of a set W of worlds, a valuation function $V : W \times \mathcal{P} \to \{0, 1\}$, and an operation $\rhd$ which maps two propositions (sets of worlds) a and b to a conditional proposition $a \rhd b$. This map encodes the base treatment of conditionals that we generalize. Most accounts of indicative and counterfactual conditionals (e.g., the material account, Stalnaker, 1968; Lewis, 1973; Kratzer, 1986; Veltman, 2005; Schulz, 2011; Kaufmann, 2013) give rise to such a map.

As usual in inquisitive semantics, sentences are interpreted relative to sets of worlds, referred to as *information states*, in terms of a relation called *support*. The support clauses for atoms and the connectives $\wedge, \vee, \neg$ are the standard ones used in inquisitive semantics:

- $s \models p \iff V(w, p) = 1$ for all $w \in s$
- $s \models \varphi \wedge \psi \iff s \models \varphi$ and $s \models \psi$
- $s \models \varphi \vee \psi \iff s \models \varphi$ or $s \models \psi$
- $s \models \neg\varphi \iff s \cap t = \emptyset$ for all $t \models \varphi$

A state s is called an *alternative* for φ if it is a maximal information state supporting φ; the set of alternatives for φ is denoted $\textsc{Alt}(\varphi)$. The *informative content* of a sentence φ, denoted $|\varphi|$, is the union of all the alternatives for φ: $|\varphi| = \bigcup \textsc{Alt}(\varphi)$. In terms of these notions, the support conditions for our conditional operator are defined as follows:

$$s \models \varphi > \psi \iff \text{for all } a \in \textsc{Alt}(\varphi) \text{ there exists some } a' \in \textsc{Alt}(\psi) \text{ such that } s \subseteq a \rhd a'$$

A sentence φ is said to be *inquisitive* if $\textsc{Alt}(\varphi)$ contains two or more alternatives. A sentence φ *entails* ψ, notation $\varphi \models \psi$, if ψ is supported whenever φ is supported; φ and ψ are *equivalent*, notation $\varphi \equiv \psi$, if they are supported by the same states.

Predictions. Natural language sentences are translated as follows: the conditional and unconditional constructions translate to $>$; or, and, not translate to $\vee, \wedge, \neg$. Declarative consequents involve an operator !, defined as $!\varphi := \neg\neg\varphi$, which ensures non-inquisitiveness: $\textsc{Alt}(!\varphi) = \{|\varphi|\}$; to reduce clutter, we omit '!' whenever its effect is vacuous. Interrogative consequents involve no '!', and thus, they are typically inquisitive. Polar questions are translated by means of the operator ?, defined as $?\varphi := \varphi \vee \neg\varphi$. Now suppose sentences A,B,C are translated to three atoms p, q, r, which are independent in the given model. We have:

- if A, then C. $\rightsquigarrow$ $p > r$
- if A or B, then C. $\rightsquigarrow$ $p \vee q > r$
- if A, then C? $\rightsquigarrow$ $p > ?r$
- if A, then B or C? $\rightsquigarrow$ $p > q \vee r$
- whether A or not, C. $\rightsquigarrow$ $?p > r$
- whether A or B, C. $\rightsquigarrow$ $p \vee q > r$

Let us now examine the predictions that this account makes. For a basic conditional if A, then C, our account boils down to the base account: $\textsc{Alt}(p > r) = \{\, |p| \rhd |r| \,\}$. An analogous result obtains for any conditional statement whose antecedent does not involve disjunction. In particular, notice that if our base account of conditionals in not monotonic in the first component, then we predict the principle SA to be invalid: $p > r \not\models (p \wedge q) > r$.

Next, consider a conditional if A or B, then C with a disjunctive antecedent. We have $\text{ALT}((p \vee q) > r) = \{\, |p > r| \cap |q > r| \,\}$. So, our account does justice to the intuition that disjunctive antecedents provide two distinct assumptions. We also have the logical equivalence $(p \vee q) > r \equiv (p > r) \wedge (q > r)$, which implies the validity of SDA.[1] Notice that this follows from the lifting operation, regardless of the base account we chose. Now consider the conditional question if A, then C?. Our account gives $\text{ALT}(p > ?r) = \{|p > r|, |p > \neg r|\}$. So, we predict the question to be inquisitive, with two alternatives corresponding to the statements if A, C and if A, not C. Similarly, the conditional question if A, then B or C? has two alternatives, corresponding to if A, B and if A, C.

Finally, consider the unconditional statement whether A or not, C. Our system yields $\text{ALT}(?p > r) = \{|p > r| \cap |\neg p > r|\} = \{|(p > r) \wedge (\neg p > r)|\}$. So, our statement is not inquisitive, and it is predicted to be equivalent with the conjunction if A, C, and if not A, C. Similarly, the unconditional whether A or B, C is predicted to be equivalent with the conjunction if A, C, and if B, C.

One may wonder how an unconditional whether A or B, C is different from a conditional if A or B, then C, given that we have translated the two in the same way. We take this difference to be not one of informative content or alternatives, but one of presupposition: the unconditional presupposes the truth of A or B, while the conditional does not. By appealing to *maximize presupposition*, this also explains the oddness of conditionals of the form if A or not A, then C: as the truth of A or not A can always be presupposed, one is required to use the unconditional form whether A or not, C instead.

Comparison with previous accounts of disjunctive antecedents. In recent years, several proposals for dealing with the problem of disjunctive antecedents have been made. Alonso-Ovalle (2009) proposed to take disjunction to map two propositions a and b to a pair $\{a, b\}$, and to take a conditional to involve a universal quantification over this set. While our proposal is inspired by this account, it is not based on an ad-hoc adjustment to the meaning of disjunction, but on a principled logical theory of propositional connectives (Ciardelli and Roelofsen, 2011; Roelofsen, 2013). This also avoids some problematic predictions that arise by interpreting *or* as pair formation (Ciardelli and Roelofsen, 2015).

A proposal similar in spirit, but based on the framework of *truth-maker semantics*, has been put forward by Fine (2012). In this theory, semantics is given by a specification of *truth-makers*, and the account of conditionals prescribes that each truth maker for the antecedent should be treated as a separate assumption. One important difference with our account is that Fine's system validates the *de Morgan law* $\neg p \vee \neg q \equiv \neg(p \wedge q)$. But this law appears to be invalid in the context of conditional antecedents: recent experimental work (Champollion *et al.* (2016), to be presented at SALT as a poster) shows that the following two sentences can come apart in truth-values:

(6) If switch A or switch B was down, the light would be off. $(\neg p \vee \neg q) > l$

(7) If switch A and switch B were not both up, the light would be off. $\neg(p \wedge q) > l$

[1] Counterexamples to SDA can be explained by assuming that a non-inquisitive closure operator *can* be inserted in the antecedent, though this is not the default. Observations about the syntax and prosody of these counterexamples seem to support this assumption; we will discuss this evidence in the talk.

This is problematic for Fine's system. In our system, de Morgan's law is invalid: $\neg p \vee \neg q$ has two alternatives, while $\neg(p \wedge q)$ has only one. We can thus account for the difference in truth-values between (7-a) and (7-b) by assuming that (7-a) involves two different assumptions, namely $|\neg p|$ and $|\neg q|$, while (7-b) involves just one, namely $|\neg(p \wedge q)|$.

Conclusion. By lifting an arbitrary truth-conditional account of (indicative or counterfactual) conditionals to the setting of inquisitive semantics, we obtain at once a simple and natural extension of the original account to: (i) conditionals with disjunctive antecedents; (ii) conditional questions; and (iii) unconditionals. While many details of each of these phenomena remain to be considered more carefully, we believe this construction is worthy of consideration, due to its flexibility—many accounts of conditionals are suitable starting points for it—its simplicity, and its unifying power.

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