Conditionals: between language and reasoning

Class 9: Counterfactuals in discourse and modal horizons

January 12, 2018

Part I

Motivations

Puzzle 1: reverse Sobel sequences

(1) If I turned this cup upside down, coffee would pour out. But if I turned this cup upside down and it was empty, nothing would pour out.

(2) If the US destroyed its nuclear weapons tomorrow, there would be war. But if both the US and the USSR destroyed their nuclear weapons, there would be peace.

Sequences of this form are known as Sobel sequences (after J.H. Sobel).

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Now consider what happens when the discourse is reversed:

(3) ??If I turned this cup upside down and it was empty, nothing would pour out. But if I turned this cup upside down, coffee would pour out.

(4) ??If both the US and the USSR destroyed their nuclear weapons tomorrow, there would be peace. But if the US destroyed its nuclear weapons, there would be war.

(5) a. If the US destroyed its nuclear weapons, there would be war.
b. But if both the US and the USSR destroyed their nuclear weapons, there would be peace.

(6) a. If both the US and the USSR destroyed their nuclear weapons, there would be peace.
b. ??But if the US destroyed its nuclear weapons, there would be war.

What is going on?

- In (5), the set of relevant possibilities expands moving from (5-a) to (5-b): the antecedent of (5-b) brings into view the possibility that both powers destroy their nuclear weapons, which were previously not considered.

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- This suggests that, in a discourse involving counterfactuals, the set of relevant possibilities can expand, but cannot shrink.
- This is unexpected from the perspective of minimal-change semantics, since the set of relevant possibilities is determined by the counterfactual antecedent alone, without reference to the larger surrounding discourse.

Puzzle 2: transitivity

Transitivity is invalid in minimal change semantics:

$$\psi \boxright \chi, \varphi \boxright \psi \not\models \varphi \boxright \chi$$

This seems right in view of counterexamples like the following.

(7) Context: playing poker. I have terrible cards, so I fold.

a.	If I had called, I would have lost.	true
b.	If I had had good cards, I would have called.	true
c.	#So if I had had good cards, I would have lost.	not true

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(8) Context: playing poker. I have terrible cards, so I fold.

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Diagnosis

- the first premise brings into view the possibility that I have good card;
- when considering the second premise, we are not allowed to disregard this possibility (contrary to the predictions of minimal change semantics);
- so in the argument above, the second premise does not sound true.

In fact, when instances of transitivity come in the appropriate order, they sound like convincing pieces of reasoning.

$$\frac{\varphi \mathrel{\Box\!\!\rightarrow} \psi \qquad \psi \mathrel{\Box\!\!\rightarrow} \chi}{\varphi \mathrel{\Box\!\!\rightarrow} \chi}$$

(9)
a. If I had had good cards, I would have called.
b. If I had called, I would have either won or lost 50€.
c. So if I had had good cards, I would have either won or lost 50€.

(10)
a. If Alice had come, Bob would have left.
b. If Bob had left, it would have been a dreary party.
c. So if Alice had come, it would have been a dreary party.

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c. So if Alice had come, it would have been a dreary party.

Why is the ordering of the premises so crucial for the validity of the inference?

Puzzle 3: NPI licensing

Consider the English items “any” or “at all”.
These items are licensed only in contexts which are somehow “negative”.

(11) a. Alice didn’t eat any food.
b. Alice didn’t help at all.

(12) a. #Alice ate any food.
b. #Alice helped at all.

For these reasons they are called Negative Polarity Items (NPI).

What does it mean for a context to be “negative”?

- Negation is not needed for these items to be licensed.
- NPI are sometimes licensed by quantifiers. But not always:

(13) a. No guest ate any food.
b. No guest who ate any food regretted it.

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(14) a. #Every guest ate any food.
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(15) a. #Some guest ate any food.
b. #Some guest who ate any food regretted it.

A quantifier $Q(R, S)$ has a restrictor R and a scope S.

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Licensing positions for NPIs:

	Restrictor	Scope
No	✓	✓
Every	✓	x
Some	x	x

Downward entailing environments

A linguistic environment $\varphi[\cdot]$ is downward entailing if it reverses entailment:

$$A \models B \quad \Rightarrow \quad \varphi[B] \models \varphi[A]$$

Example

Negation is downward entailing:

$$A \models B \quad \Rightarrow \quad \neg B \models \neg A$$

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Ladusaw's generalization (1979)

NPIs are licensed exactly in downward entailing contexts.

- Consider the following pairs of restrictors and scopes:
  - German $\models$ human
  - run on Mars $\models$ be on Mars
- No is downward entailing in both positions:
  - No humans have been on Mars $\models$ No Germans have been on Mars.
  - No humans have been on Mars $\models$ No humans have run on Mars
- Every is downward entailing only in the restrictor:
  - All humans have been on Mars $\models$ All Germans have been on Mars.
  - All humans have been on Mars $\not\models$ All humans have run on Mars.
- Some is not downward entailing in either argument:
  - Some humans have been on Mars $\not\models$ Some Germans have been on Mars.
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- Some is not downward entailing in either argument:
  - Some humans have been on Mars $\not\models$ Some Germans have been on Mars.
  - Some humans have been on Mars $\not\models$ Some humans have run on Mars.
- So, Ladusaw's generalization predicts just the pattern we observed!

Back to conditionals

NPI are licensed in conditional antecedents.

(19) If John had any training in semantics he would know what NPIs are.

(20) If John had helped at all we would have been on time.

- If Ladusaw's account of NPI licensing is right, conditional antecedents must be a downward entailing environment.

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- This is nothing but Antecedent Strengthening.
- But wait... antecedent strengthening is invalid:

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- This is a puzzle!

von Fintel strategy:

- “It would be nice if we had a semantics of conditionals that gave us some kind of limited monotonicity to plug into the theory of NPI licensing.”
- Aim: “formulate a limited kind of entailment with respect to which counterfactual antecedents will be downward monotone environments hospitable to NPIs.”

Part II

Modal horizon semantics

Dynamic semantics (Kamp 81, Heim 82, Veltman 85, Groenendijk&Stokhof 89)
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Modal horizon semantics: basic idea

- Besides a similarity ordering, the context includes a modal horizon, a set of counterfactual possibilities which are currently relevant.
- A counterfactual conditional $\varphi > \psi$ has a twofold effect on the context:
  - it broadens the modal horizon minimally to ensure that it contains φ-worlds;
  - it claims that all the φ-worlds within the updated modal horizon are ψ-worlds.

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  - it broadens the modal horizon minimally to ensure that it contains φ-worlds;
  - it claims that all the φ-worlds within the updated modal horizon are ψ-worlds.
- The semantics of counterfactuals is broken down into two components:
  - their potential to update the modal horizon;
  - the truth-conditions of a strict conditional over the resulting modal horizon.

Contexts

A context for the interpretation of counterfactuals consists of two things:

- a relative similarity ordering $\leq$, as in minimal change semantics; which determines a system of spheres around each world.
- a function f that maps each world w to a sphere $f(w)$ around w; $f(w)$ is called the modal horizon of w.

Assumptions

- at the outset of a discourse, the modal horizon is $f(w) = \{w\}$
- throughout the discourse, only f evolves, while $\leq$ is held fixed

Semantics of counterfactuals

(simple version: needs refinement to deal with nested conditionals)

- Context-change potential:
  the utterance of $\varphi > \psi$ transforms a context $c = \langle f, \leq \rangle$ into $c[\varphi > \psi] = \langle f^{\leq}_{\varphi}, \leq \rangle$:

  $$f^{\leq}_{\varphi}(w) = f(w) \cup S^{\varphi}_{w}$$

  where S^{φ}_{w} is the closest $\leq$-sphere around w which contains φ-worlds
  (if φ is not entertainable we can let $f^{\leq}_{\varphi}(w) = f(w)$).

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  Equivalently, for φ entertainable:

  $$f^{\leq}_{\varphi}(w) = \begin{cases} f(w) & \text{if } f(w) \text{ contains } \varphi\text{-worlds} \\ S^{\varphi}_{w} & \text{otherwise} \end{cases}$$

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  where S_w^φ is the closest $\leq$-sphere around w which contains φ-worlds
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- Truth-conditions for a discourse:
  a discourse $\varphi_1; \ldots; \varphi_n$ is true at a world w in context $c = \langle f, \leq \rangle$ in case:
  φ_1 is true at $\langle w, c \rangle$, φ_2 is true at $\langle w, c[\varphi_1] \rangle$, etc.

Predictions I

for single counterfactuals the account predicts exactly the same truth-conditions as given by minimal change semantics.

Proof:

- Take the initial context $\langle f, \leq \rangle$, where $f(w) = \{w\}$.
- Updating the modal horizon with $\varphi > \psi$ yields:

$$f^{\leq}_{\varphi}(w) = f(w) \cup S^{\varphi}_{w} = \{w\} \cup S^{\varphi}_{w} = S^{\varphi}_{w}$$

- $\varphi > \psi$ is true at $w \iff f^{\leq}_{\varphi}(w) \cap |\varphi| \subseteq |\psi| \iff S^{\varphi}_{w} \cap |\varphi| \subseteq |\psi|$

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The new dynamic setup makes a difference only when we look at counterfactuals in discourse.

Dynamic consistency

A discourse $\varphi_1; \ldots; \varphi_n$ is consistent if there is a pair $\langle w, c\rangle$ at which it is true.

Predictions II: Sobel sequences

Sobel sequences like (22) are consistent,
but reverse Sobel sequences like (23) are not.

(22) If the US destroyed its nuclear weapons, there would be war. But if both the US and the USSR destroyed their nuclear weapons, there would be peace.

$\varphi > \chi; \;\; \varphi \wedge \psi > \neg\chi$

(23) If both the US and the USSR destroyed their nuclear weapons, there would be peace. But if the US destroyed its nuclear weapons, there would be war.

$\varphi \wedge \psi > \neg\chi; \;\; \varphi > \chi$

Dynamic validity

A discourse $\varphi_1; \ldots; \varphi_n$ dynamically entails ψ (notation: $\varphi_1; \ldots; \varphi_n \models_d \psi$) if for any pair $\langle w, c \rangle$, if:

- φ_1 is true at $\langle w, c \rangle$
- φ_2 is true at $\langle w, c[\varphi_1] \rangle$
- $\ldots$

then ψ is true at $\langle w, c[\varphi_1] \ldots [\varphi_n] \rangle$.

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Predictions III: transitivity

- $\varphi > \psi;\ \psi > \chi \ \models_d \ \varphi > \chi$
- $\psi > \chi;\ \varphi > \psi \ \not\models_d \ \varphi > \chi$

This accounts for the fact that counterexamples to transitivity only seem to work when the premises are ordered in a specific way.

What about the NPI puzzle?

Antecedent strengthening is not dynamically valid.

$$\varphi > \chi \quad \not\models_d \quad \varphi \wedge \psi > \chi$$

- It could be that the modal horizon in $c[\varphi > \chi]$ contains no $\varphi \wedge \psi$-worlds;
- Processing $\varphi \wedge \psi > \chi$ expands the modal horizon to include such worlds, and there is no guarantee that they are χ worlds.

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If the notion of entailment relevant for NPI licensing is the dynamic one, conditional antecedents are still not predicted to license NPIs.

von Fintel's idea

- We can consider a notion of entailment which requires the context to remain fixed throughout the argument.
- For this to happen, the initial modal horizon must be rich enough to contain *phi*-worlds corresponding to all antecedents φ in the argument.
- von Fintel calls this notion Strawson entailment.

Admittance

Let us say that a context c admits a sentence φ if $c[\varphi] = c$.
In particular, c admits $\varphi > \psi$ if the modal horizon contains some φ-worlds.

Strawson entailment

Sentences $\varphi_1, \ldots, \varphi_n$ Strawson-entail ψ (notation: $\varphi_1, \ldots, \varphi_n \models_s \psi$)
if for every world w and every context c which admits all of $\varphi_1, \ldots, \varphi_n, \psi$:
if $\varphi_1, \ldots, \varphi_n$ are all true at $\langle w, c \rangle$, so is ψ.

Antecedent strengthening is Strawson valid:

$$\varphi > \chi \quad \models_s \quad \varphi \wedge \psi > \chi$$

- Take a world w and a context $c = \langle f, \leq \rangle$ that admits both sentences.
- This means that the modal horizon $f(w)$ contains $\varphi \wedge \psi$ worlds.
- Notice that when the modal horizon already contains antecedent worlds, von Fintel's accounts coincides with a strict conditional account.
- If $\varphi > \chi$ is true at $\langle w, c \rangle$, all φ-worlds in $f(w)$ are χ-worlds.
- In particular, all $\varphi \wedge \psi$-worlds in $f(w)$ are χ-worlds.
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More generally, if $\sigma \models_s \varphi$ then $\varphi > \chi \models_s \sigma > \chi$.
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vF's proposal: Strawson entailment is the notion relevant for NPI licensing.
So, the fact that they license NPI is predicted by Ladusaw's generalization.

One remaning issue

Throughout a discourse, the modal horizon does not *always* expand. Sometimes it can be reset.

(24) If the US destroyed its nuclear weapons, there would be war. Well, if all nuclear powers destroyed their nuclear weapons, there would be peace. But that would never happen. So, as things stand, if the US destroyed its nuclear weapons, there would be war.

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Reset is not always signaled explicitly:

(25) A: If John had been at the party, that would have been a lot of fun.
B: Well, if John had been at the party and had gotten into a fight with Perry, that would have been no fun at all.
A: But Perry wasn't there; so if John had been at the party, he would not have gotten into a fight with him.

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This is not always possible, though:

(26) A: If John had been at the party, that would have been a lot of fun.
B: But he wasn't at the party.
A: I know; I said *if he had been there*, that would have been fun.