Conditionals, Questions and Content

A Theory, A Puzzle, An Advertisement

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Conditionals

Three Interconnected Questions

Three Questions

1. How should language users' competence with conditionals be characterized to best explain the forms of behavior they in fact exhibit?
2. How does this competence, when employed in these ways, achieve certain ends, e.g. successful action, coordinated action, reliable belief?
3. How might this competence be purposively refined to better suit certain specialized tasks such as scientific explanation?

This Project

Explore Question One

Three Questions

1. How should language users' competence with conditionals be characterized to best explain the forms of behavior they in fact exhibit?
2. How does this competence, when employed in these ways, achieve certain ends, e.g. successful action, coordinated action, reliable belief?
3. How might this competence be purposively refined to better suit certain specialized tasks such as scientific explanation?

- Many interesting interactions between questions
- Here, I'm focused on question 1, though I'll attempt to draw less-focused connections to the other questions
- Eventually, I will claim that the answer which emerges has interesting consequences for the other questions

Outline

The Interrogative Link

If in Interrogative Environments

Under Interrogative Verbs

As stressed by Haiman (1978) and Harman (1979):

(1) Albert wondered **if** Mabel loved John

(2) Mabel asked **if** John was going to the party

But, also:

Interrogative Equatives

(3) The future is coming. The question is **if** we will be ready for it.

The Interrogative Link

Across Languages

Beyond English

- Romance Langauges (Kayne 1991: §2.2)
- Bulgarian & Slavics (Bhatt & Pancheva 2006: 653)
- Hebrew (Roger Schwarzschild p.c.)
- Korean (Seunghun Lee p.c.)
- Hua, Mayan Tzotzil, Tagalog (Haiman 1978: 570)
- ASL and LIS (Pyers & Emmorey 2008, Belletti p.c.)

- Wide distribution makes lexical ambiguity implausible and problematically unexplanatory

The Interrogative Challenge

Traditional Theories of *If*

The Problem for Traditional Theories of *If*

- Connective Theories: no relational meaning for *if*
- Restrictor Theories: no restriction of relational operator; non-vacuous meaning for *if*
- Expressive Theories: no expression of belief change dispositions or act of supposition

- Important to qualify this challenge...

The Interrogative Challenge

A Clarification

- Evidence does not support an identification of conditional antecedents with interrogative clauses
- Just think about English conditionals without *if*, e.g. *q given that p*, *supposing that p, q*
- Some languages exhibit less direct convergence between conditional and interrogative morphology
  - Polish (Tabakowska 1997: §4), German (Meola 2001: 134)
- Others exhibit little
  - Kalaallisut (Bittner p.c.), Cheyenne (Murray p.c.)

The Interrogative Challenge
Official Version

The Interrogative Challenge

- How could a language employ a single morpheme to form interrogatives and conditional antecedents?
- Why would so many unrelated languages do this with their conditional-marker?

- Meeting this challenge will require revising the semantic fine-structure posited by current theories of conditionals
- *Claim*: these revisions introduce changes that impact the issues philosophers care about

Bonus Data I
Meeting the Interrogative Challenge

Meeting the challenge would aid a uniform semantics for:

(4)
a. Leland danced **if** Bob danced
b. Leland danced **whether or not** Bob danced
c. Leland danced **when** Bob danced
d. Leland danced **how** Bob danced
e. Leland danced **where** Bob danced

Bonus Data II
Meeting the Interrogative Challenge

Meeting the challenge would help with other puzzling data:

- Advertising Conditionals
  (5) Do you need an efficient car? Then Honda has the vehicle for you
- Conditional Inversion (Embick & Iatridou 1994)
  (6)
  a. Bob had danced
  b. Had Bob danced?
  c. Had Bob danced, Leland would have danced
  - Limited to subjunctives in English, but used in indicatives in many other languages (Embick & Iatridou 1994: 191)

Conditionals
As Encapsulating Interrogative Interactions

Hypothesis: all occurrences of *if* are interrogative

Jespersen (1940: 374), Austin (1956: 212), Grice (1989: 75-6)

q if p offers q in response to a hypothesized affirmative answer to the question $p?$, i.e. p

(7) *A*: If Bob danced, Leland danced

(8) *A*: Did Bob dance?
B: Yes
A: (Then) Leland danced

Hypothetical Inquiry

- (7) encapsulates the interrogative interaction in (8)
- *B* is a hypothetical information source

Conditionals
Variations in Interaction

(9) a. If you have a dog, is it neutered?
b. Is it the case that if you have a dog it is neutered?

- Restrictor & connective semantics for *if* require second argument to be proposition, e.g. $M(\phi, \psi), \phi \rightarrow \psi$
- Thus, they must treat the question operator in (9a) as taking wide scope, a lá (9b)
- This gets the answerhood conditions for (9a) wrong
- Also: many different discourse relations between antecedent and consequent (Lycan 2001: 184-211)

Context
Stalnaker's Picture

Context Set (Stalnaker 1999a: 6)

"A context should be represented by a body of information that is presumed to be available to the participants in the speech situation. A *context set* is defined as the set of possible situations that are compatible with this information — with what the participants in the conversation take to be the common shared background."

- The context set c is a set of possible worlds
- It is the set of worlds compatible with the agents' mutual conversational presuppositions

(Stalnaker 1978, 1998, 2002)

Interactions with Context
Dynamic Picture: Meaning as Context-Change

Programs, States, Morphemes and Contexts

- The execution of a program π on a machine m brings about a change in the state of m
- Pratt (1976): the meaning of π is the characteristic change its execution brings about
  - I.e. a **relation** between input and output states
- Heim (1982): morphemes are programs, contexts are machine states & meanings are interactions w/context

Relational Meaning $c[\phi] = c'$ (an interaction w/context)
'the result of updating c with ϕ is c''

(Gärdenfors 1984; Veltman 1996)

Interactions with Context
Dynamic Picture: Meaning as Update

Worlds, Atomic Propositions

$W : \mathcal{A}t \mapsto \{1, 0\}$ $\quad [\![\mathsf{p}]\!] = \{w \in W \mid w(\mathsf{p}) = 1\}$, if $\mathsf{p} \in \mathcal{A}t$

Update Semantics (Relational Meanings)

(1)	$c[\mathsf{p}]$	$=$	$\{w \in c \mid c \cap [\![\mathsf{p}]\!]\}$
(2)	$c[\neg\phi]$	$=$	$c - c[\phi]$
(3)	$c[\phi \wedge \psi]$	$=$	$(c[\phi])[\psi]$
(4)	$c[\phi \vee \psi]$	$=$	$c[\phi] \cup c[\psi]$

Semantic Concepts

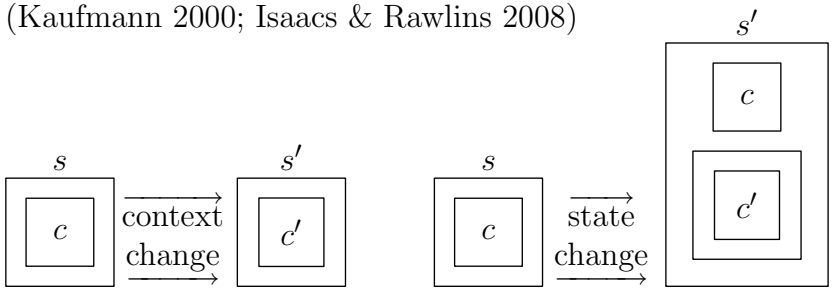
Acceptable $c[\phi] \neq \varnothing$ Truth in w $w \vDash \phi \Leftrightarrow \{w\}[\phi] = \{w\}$
Supported $c \vDash \phi \Leftrightarrow c[\phi] = c$ Sem. Content $[\![\phi]\!] = \{w \mid w \vDash \phi\}$
Speaker Content $[\![\phi]\!]_c = \{w \in c \mid c[\phi] = c' \ \& \ w \in c'\}$
Consequence $\phi_1, \ldots, \phi_n \vDash \psi \Leftrightarrow \forall c : c[\phi_1] \cdots [\phi_n] \vDash \psi$

Hypothetical Interactions

State Interactions and Subordinate Contexts

- Next Step: model hypothetical interactions w/context
- Idea: hypothetical interactions don't change c, they introduce a sub-context derived from c and change it
- For $c \subseteq W$: $\langle c \rangle$ is a state, and $\langle c, s \rangle$ is a state if s is

(Kaufmann 2000; Isaacs & Rawlins 2008)



Interrogatives

Hamblin's Picture

Hamblin (1958) on Answerhood Conditions

To know the meaning of an interrogative sentence is to know what would count as an answer to it, i.e. its answerhood conditions

On Answerhood Conditions (Hamblin 1973)

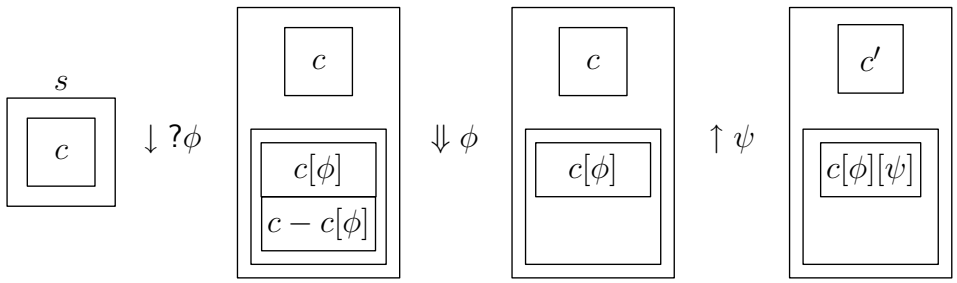
- Interrogatives denote sets of propositions (its answers)
- Yes/no interrogatives: $[\![?\mathsf{p}]\!] = \{[\![\mathsf{p}]\!], [\![\neg\mathsf{p}]\!]\}$

- Equivalently: $?\phi$ partitions logical space (Groenendijk & Stokhof 2001)
- Here: $c[?\phi]$ partitions c into $c[\phi]$ & $c - c[\phi]$
- Formal Tweak: take c to be a set of pairs of worlds (Groenendijk 1999); tweak suppressed in this presentation

The Theory

In Pictures

$s[(\mathsf{if}\ \phi)\ \psi] = ((s \downarrow ?\phi) \Downarrow \phi) \uparrow \psi$ (preliminary version)



$$c' = \{w \in c \mid \langle c[\phi] \rangle \vDash \psi\}$$

$s \downarrow \phi = \langle c, \langle c_0, \ldots \langle c_n, \langle c \rangle[\phi] \rangle \ldots \rangle \rangle$, $\quad s \Downarrow \phi = \langle c, \langle c_0, \ldots \langle c_n \rangle[\phi] \ldots \rangle \rangle$

$s \uparrow \psi = \langle c', \langle c_0, \ldots \langle c_n, \langle c_n \rangle[\psi] \rangle \ldots \rangle \rangle$, $\quad c' = \{w \in c \mid s_n \vDash \psi\}$

The Theory

Official Version

- This semantics ends up in a familiar place
  - $(\mathsf{if}\ \phi)\ \psi$ requires that all ϕ-worlds in c are ψ-worlds
  - I.e. it is a strict conditional over c
- Bad features can be neutralized with dynamic $\vDash$ and a semantic presupposition: ϕ is possible in c ($c[\phi] \neq \varnothing$) (Gillies 2009: §7)

Official Semantics

$$s[(\mathsf{if}\ \phi)\ \psi] = \begin{cases} ((s \downarrow ?\phi) \Downarrow \phi) \uparrow \psi & \text{if } c[\phi] \neq \varnothing \\ \text{Undefined} & \text{otherwise} \end{cases}$$

Conditional Propositions
Truth and The Presuppositional Void

Key Definitions

Truth in w $w \vDash \phi \Leftrightarrow \langle\{w\}\rangle[\phi] = \langle\{w\},\ldots\rangle$ Sem. Content $[\![\phi]\!] = \{w \mid w \vDash \phi\}$

Speaker Content $[\![\phi]\!]_s = \{w \in c \mid s[\phi] = s' \;\&\; w \in c'\}$

- If ϕ is false in w, $\langle\{w\}\rangle[(\text{if } \phi)\, \psi]$ is undefined
  - Thus, $[\![(\text{if } \phi)\, \psi]\!]$ is not a well-defined proposition
- Does $[\![(\text{if } \phi)\, \psi]\!]_s$ give truth-conditions (relative to s)? No.
  - Still not well-defined for some s
  - Delusion makes $(\text{if } \phi)\, \psi$ 'true in w relative to s'
  - Also $[\![(\text{if } \phi)\, \psi]\!]_s = c$ or $[\![(\text{if } \phi)\, \psi]\!]_s = \varnothing$
- Yet, conditionals have context-independent TVs at some worlds
- $w \vDash (\text{if } \phi)\, \psi$ if $w \vDash \phi \wedge \psi$, and $w \nvDash (\text{if } \phi)\, \psi$ if $w \vDash \phi \wedge \neg\psi$

Conditional Propositions
Truth and The Presuppositional Void Cont'd

- The content of an indicative conditional is not a classical proposition
  - Perhaps a 'partial proposition' (a lá Belnap 1973, a.o.)
- This proposition can be done without in the present framework
  - The framework provides procedures for co-ordinating on a shared body of information other than updating the context with a proposition (as in Stalnaker 1999b)
  - The concepts that model speaker's intuitions (support, acceptance, acceptability) are not semantic content or truth
- Still, these procedures fix some truth-conditions & for some sentences familiar, propositional semantic contents

Subjunctive Conditionals
What about Subjunctives?

Jason's Challenge

This story is hopeless for subjunctives.

(10) If Bob had danced, Leland would have danced

- Even if one could tweak things to say something about worlds where the antecedent is false, this looks like an in-principle difficulty
- What question does *if Bob had danced* raise?
- If it isn't a question isn't the proposal that all *if*'s are interrogative sunk?
- Indeed, it seems impossible to embed counterfactual *if*-clauses under interrogative verbs

Subjunctives & Interrogative Attitudes
A Missing Reading

- Subjunctive attitude ascriptions:

  (11) Bob never danced, but I **wish** he **had** danced
- Not possible with interrogative verbs:

  (12) #Bob never danced, but I wonder [if he had danced]
- There is a purely past reading in:

  (13) I wonder if he had danced (by 2am yesterday)

  (14) Had Bob danced (by 2am yesterday)?
- Why isn't there a 'counterfactual' reading available in interrogatives?
- What would such a reading *be*?

Subjunctives
The So-Called Fake Past

- 'Past tense' gets co-opted for counterfactual purposes

(15) a. If Bob danced, Leland would dance
b. If Bob had danced, Leland would have danced
c. If Bob were dancing, Leland would be dancing

- When it is co-opted it is one of the ingredients of counterfactual meaning (Iatridou 2000; Ippolito 2003)
- Bittner (2008): Kalallisut which has grammatical mood morphology, has hypothetical mood on antecedent and declarative on consequent — just like indicatives — but has a modal auxiliary in both clauses
- Project: model the meaning of this co-opted past tense as a modal operator which generates only a trivial partition when placed under ? operator, but also extends the semantics for indicative conditionals above to a plausible semantics for counterfactuals when inserted in the antecedent

Subjunctives
Light Bulb Case

Light Bulb (Lifschitz via Schulz 2007)

I'm giving you a quiz to test basic comprehension
There are two light switches of the familiar sort, S_1 and S_2, that control a light bulb L. Flipping both switches down causes the bulb to turn off. Every other setting leaves the bulb on. Currently, S_1 is down and S_2 is up, and so L is on. If S_2 were flipped down, would L turn off?

- The answer seems to be *yes*
- Lewis (1973)/Stalnaker (1968) semantics: no prediction either way
- Lewis (1979): false, since it requires holding fixed the particular fact that S_1 is down

Light Bulb Case
The Menu, The Claim

- Light Bulb is like Morgenbesser's case w/o the indeterminism (Slote 1978)
- As with Morgenbesser's case, similarity accounts must build causal dependence into their calculation of similarity (Bennett 2003: §90, Schaffer 2004)
- *Claim*: once one has the notion of causal dependence or more generally lawful dependence, one has everything necessary to state the truth-conditions of counterfactuals
- Similarity is the ghost of lawful dependence
- I'll defend this by sketching a semantics along the lines of Pearl (1998, 2000: Ch.7) and Hiddleston (2005)

Classical Possible Worlds
Familiar Territory

$\bullet = 0, \circ = 1$; Idealizing $\mathcal{A}t = \{\mathsf{p}, \mathsf{q}, \mathsf{r}\}$

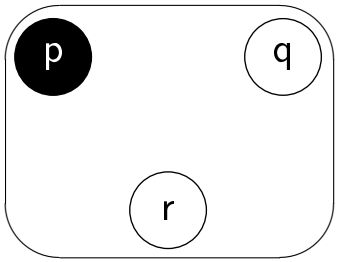


Figure: Classical possible world w

$$w(\mathsf{p}) = 0$$
$$w(\mathsf{q}) = 1$$
$$w(\mathsf{r}) = 1$$

Figure: System of equations for w

Pearl's Proposal

Overview

- Pearl's proposal: counterfactuals exploit a special kind of structure *within* possible worlds that is absent from classical semantics
- The structure: certain invariant relationships, like the switches and the bulb in Light Bulb
- Recall: in w, S_1 is down, S_2 is up and L is on
  - Crucially, there's more: the switches control the light such that the truth of $\mathsf{S_1} \vee \mathsf{S_2}$ brings about the truth of L and the falsity of $\mathsf{S_1} \vee \mathsf{S_2}$ brings about the falsity of L (L: light on, $\mathsf{S_n}$: switch n up)
- Let's draw w in a way that incorporates this crucial addition

Structured Worlds

Invariance and Dependence: DAG'n It

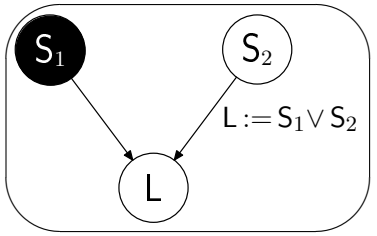


Figure: Structured w

$$
\begin{aligned}
i_w(\mathsf{S_1}) &= 0 \\
i_w(\mathsf{S_2}) &= 1 \\
d_w(\mathsf{L}, i_w) &= (i_w(\mathsf{S_1}) + i_w(\mathsf{S_2})) \\
&\quad - (i_w(\mathsf{S_1}) \cdot i_w(\mathsf{S_2})) \\
&= 1
\end{aligned}
$$

Figure: Equations for w

- i_w assigns TVs to independents $I \subseteq \mathcal{A}t$
- d_w assigns TVs to $\mathcal{A}t - I$ as Boolean functions of i_w
- Equations required to define a directed acyclic graph

Structured Worlds

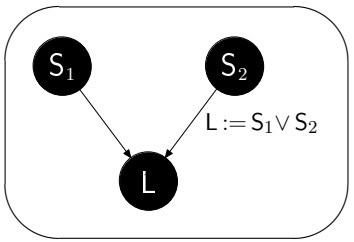
Evaluating Counterfactuals

- Evaluating the counterfactual $\neg\mathsf{S_2} > \neg\mathsf{L}$ in w is a two step process.
  1. *Action*: change w minimally to make $\neg\mathsf{S_2}$ true; call this world $w\langle\neg\mathsf{S_2}\rangle$.
  2. *Projection*: project the consequences of this change through the dependencies and check the truth-value of $\neg\mathsf{L}$. If it's 1, the conditional is true in w. If it's 0, the conditional is false in w.
- What exactly is this change, how exactly does projection work and what's the verdict?

Structured Worlds

The Verdict

For $w\langle\neg\mathsf{S_2}\rangle$:



$$
\begin{aligned}
i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_1}) &= i_w(\mathsf{S_1}) \\
&= 0 \\
i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_2}) &= \cancel{i_w(\mathsf{S_2})} \\
i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_2}) &= 0 \\
d_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{L}, i_{w\langle\neg\mathsf{S_2}\rangle}) &= d_w(\mathsf{L}, i_{w\langle\neg\mathsf{S_2}\rangle}) \\
&= (i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_1}) + i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_2})) \\
&\quad - (i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_1}) \cdot i_{w\langle\neg\mathsf{S_2}\rangle}(\mathsf{S_2})) \\
&= 0
\end{aligned}
$$

- *Action*: make $\mathsf{S_2}$-node black
- *Projection*: use the law to fix the color of the L-node in concert with change to $\mathsf{S_2}$-node
- *Verdict*: $\neg\mathsf{L}$ is true in $w\langle\neg\mathsf{S_2}\rangle$, so $\neg\mathsf{S_2} > \neg\mathsf{L}$ is true in w

Pearl Conditionals
Summary

Dependency Semantics for Subjunctives

- $[\![\phi > \psi]\!] = \{w \mid w\langle\phi\rangle \in [\![\psi]\!]\}$
- $\phi > \psi$ is true iff either ψ is independent of ϕ and true, or else ϕ is sufficient for bringing about ψ when holding fixed all those facts that do not depend upon ϕ.

- $w\langle\phi\rangle$ is the world that differs at most from w in that $w\langle\phi\rangle \in [\![\phi]\!]$

(Intuitive Paraphrase from Cumming 2009)

A New Modal Operator
Restructuring Worlds

Remote Possibility $\Diamond_r$

$c[\Diamond_r\phi] = \{w\langle\phi\rangle \mid w \in c\} \cup (c - c[\phi])$

- Expands c with a ϕ-world for each $\neg\phi$-world
- In general, $c \subseteq c[\Diamond_r\phi]$

- $c[?\Diamond_r\phi]$ partitions: $c[\Diamond_r\phi]$ and $c - c[\Diamond_r\phi]$
- But $c - c[\Diamond_r\phi]$ is empty!

$$\begin{aligned} c - c[\Diamond_r\phi] &= \{w \in c \mid w \notin c[\Diamond_r\phi]\} && \text{Df. of } A - B \\ &= \varnothing && \text{Since } c \subseteq c[\Diamond_r\phi] \end{aligned}$$

Meeting Jason's Challenge
Questions and Interrogative Attitudes

- *Assumptions*:
  1. The act of asking a question induces a non-trivial partition on the context
  2. Ascribing an agent an interrogative attitude to $?\psi$ presupposes that $?\psi$ induces a non-trivial partition on that agent's belief-state
- *Consequences*:
  1. $?\Diamond_r\phi$ cannot be used to ask a question
  2. Ascribing an agent an interrogative attitude to $?\Diamond_r\phi$ will never be felicitous
- Thus, it can be explained why counterfactuals cannot be intuitively described as having antecedents that raise a 'hypothetical question'

The Theory
Official Semantics

Official Semantics

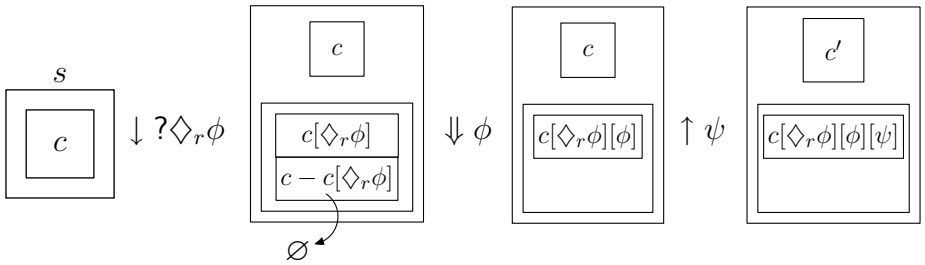
$$s[(\text{if } \Diamond_r\phi)\,\psi] = \begin{cases} ((s \downarrow ?\Diamond_r\phi) \Downarrow \phi) \uparrow \psi & \text{if } c[\Diamond_r\phi] \neq \varnothing \\ \text{Undefined} & \text{otherwise} \end{cases}$$

- $\Diamond_r$ neutralizes the presupposition
  - $c[\Diamond_r\phi]$ is always non-empty
- So, unlike indicatives, there's no 'presuppositional void'
- $[\![(\text{if } \Diamond_r\phi)\,\psi]\!]$ is a well-defined proposition

The Theory

In Pictures: Subjunctives

$$s[(\text{if } \Diamond_r\phi)\,\psi] = ((s \downarrow ?\Diamond_r\phi) \Downarrow \phi) \uparrow \psi$$



$$c' = \{w \in c \mid \langle c[\Diamond_r\phi][\phi]\rangle \vDash \psi\}$$

Bonus I

Simplification of Disjunctive Antecedents

(16) a. If Bob had danced or Leland had cried, Donna would have left the party
b. If Bob had danced, Donna would have left the party
c. If Leland had cried, Donna would have left the party

- (16a) intuitively entails (16b) and (16c)
- But Lewis/Stalnaker semantics does not capture this

Fact: $(\text{if } \Diamond_r\phi_1 \vee \Diamond_r\phi_2)\,\psi \vDash (\text{if } \Diamond_r\phi_1)\,\psi \wedge (\text{if } \Diamond_r\phi_2)\,\psi$

- Why? $c[\Diamond_r\phi_1 \vee \Diamond_r\phi_2] = c[\Diamond_r\phi_1] \cup c[\Diamond_r\phi_2]$

(Nute 1975; Loewer 1976)

Bonus I

Simplification of Disjunctive Antecedents Cont'd

McKay & van Inwagen (1977):

(17) a. If Spain had fought for the Axis or the Allies, she would have fought for the Allies
b. If Spain had fought for the Axis, she would have fought for the Allies

- (17a) does not entail (17b)
  - Counterexample to SDA? No!
- (17a) is $(\text{if } \Diamond_r(\mathsf{X} \vee \mathsf{L}))\,\mathsf{L}$, not $(\text{if } \Diamond_r\mathsf{X} \vee \Diamond_r\mathsf{L}))\,\mathsf{L}$
  - (17a) is not equivalent to *if Spain had fought for the Axis or if Spain had fought for the Allies, she would have fought for the Allies*, which sounds clearly false
- Quite happily, $(\text{if } \Diamond_r(\mathsf{X} \vee \mathsf{L}))\,\mathsf{L} \nvDash (\text{if } \Diamond_r\mathsf{X})\,\mathsf{L}$!

Bonus II

Reverse Sobel Sequences

Acceptable Discourse:

(18) a. If Bob had danced, he would have had fun
b. But, if Bob had danced and broken his leg, he wouldn't have had fun

Unacceptable Discourse:

(19) a. If Bob had danced and broken his leg, he wouldn't have had fun
b. But, if Bob had danced, he would have had fun

- **Modal subordination**: *A wolf might have walked in. It would have eaten me.* (Roberts 1989)
- **Key**: *it* is not interpreted in the real context, but in a counterfactual context created by the first sentence

The Basic Idea

The most natural interpretation of (19) is to read (19b) as elaborating on a counterfactual context where Bob danced, broke his leg and didn't have fun, i.e. replace *Bob* in (19b) with *he*. In this context (19b) is clearly contradictory and so (19) seems unacceptable

Bonus II
Reverse Sobel Sequences

(19) a. If Bob had danced and broken his leg, he wouldn't have had fun
b. But, if Bob had danced, he would have had fun

- This idea can be captured in this framework by representing the interpretation of (19) as (21) rather than (20)

(20) $(s[(\mathsf{if} \Diamond_r(\mathsf{D} \wedge \mathsf{B}))\, \neg\mathsf{F}])[(\mathsf{if} \Diamond_r \mathsf{D})\, \mathsf{F}]$
(21) $(s[(\mathsf{if} \Diamond_r(\mathsf{D} \wedge \mathsf{B}))\, \neg\mathsf{F}]) \uparrow (\mathsf{if} \Diamond_r \mathsf{D})\, \mathsf{F} = s''$

- This interpretation evaluates (19b) in the subordinate state created by (19a) by testing that that sub-state supports (19b)
- That sub-state is $s' = \langle c[\Diamond_r(\mathsf{D} \wedge \mathsf{B})][\mathsf{D} \wedge \mathsf{B}][\neg\mathsf{F}]\rangle$
- So $s'' = \langle c'', \ldots\rangle$, where $c'' = \{w \in c' \mid s' \vDash (\mathsf{if} \Diamond_r \mathsf{D})\, \mathsf{F}\}$
- But $s' \nvDash (\mathsf{if} \Diamond_r \mathsf{D})\, \mathsf{F}$, so $c'' = \varnothing$. Hence (19) is unacceptable!

Bonus II
Reverse Sobel Sequences

- This proposed analysis of (19) treats the unacceptability as partly pragmatic
- It exploits an assumption about the intended relation between (19a) & (19b)
- This relation effects a sort of anaphoric connection between the sentences
- On these points it differs from the accommodation-based accounts offered by von Fintel (2001) and Gillies (2007)
- Since accommodation-based accounts of modal subordination are inferior to anaphoric accounts, this should count as a unifying improvement (Stone 1999; Brasoveanu 2007)
- In some cases the unacceptability of discourses like (19) wanes, suggesting that the added flexibility of the present approach is an improvement

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References I

Austin, J. L. (1956). 'Ifs and Cans'. *Proceedings of the British Academy*, **42**: 109–132.

Belnap, N. (1973). 'Conditional Assertion and Restricted Quantification'. In H. Leblanc (ed.) *Truth, Syntax and Modality*, 48–75, Amsterdam: North-Holland Publishing Co.

Bennett, J. (2003). *A Philosophical Guide to Conditionals*. Oxford: Oxford University Press, ISBN 0-19-925887-2.

Bhatt, R. & Pancheva, R. (2006). 'Conditionals'. In M. Everaert & H. van Riemskijk (eds.) *The Blackwell Companion to Syntax*, vol. 1, chap. 16, 638–687, Malden, MA: Blackwell. URL `http://www-rcf.usc.edu/~pancheva/bhatt-pancheva_syncom.pdf`

Bittner, M. (2008). 'Counterfactuals as Real Attitudes', ms. Rutgers University. URL `http://www.rci.rutgers.edu/~mbittner/pdf%20files%20for%20web/bittner08_jos.pdf`

Brasoveanu, A. (2007). *Structured Nominal and Modal Reference*. Ph.D. thesis, Rutgers University, Department of Linguistics, New Brunswick, NJ. URL `http://abrsvn.googlepages.com/diss_brasoveanu_2007.pdf`

Cumming, S. (2009). 'On What Counterfactuals Depend', ms. UCLA.

References II

Embick, D. & Iatridou, S. (1994). 'Conditional Inversion'. In M. Gonzáles (ed.) *Proceedings of the North Eastern Linguistic Society 24*, 189–203, Amherst, MA: Graduate Linguistics Association.

von Fintel, K. (2001). 'Counterfactuals in a Dynamic Context'. In M. Kenstowicz (ed.) *Ken Hale: a Life in Language*, 123–152, Cambridge, Massachusetts: The MIT Press.
URL `http://mit.edu/fintel/www/conditional.pdf`

Gärdenfors, P. (1984). 'The Dynamics of Belief as a Basis for Logic'. *British Journal of the Philosophiy of Science*, **35**: 1–10.

Gillies, A. (2007). 'Counterfactual Scorekeeping'. *Linguistics & Philosophy*, **30**(3): 329–360.
URL `http://www-personal.umich.edu/~thony/counterfactualscorekeeping_landp.pdf`

Gillies, A. (2009). 'On Truth-Conditions for *If* (but Not Quite Only *If*)'. *Philosophical Review*, **118**(3): 325–349.
URL `http://www-personal.umich.edu/~thony/note_on_if_april-2008.pdf`

Grice, H. P. (1989). 'Indicative Conditionals'. In *Studies in the Way of Words*, chap. 4, 58–85, Cambridge, MA: Harvard University Press.

References III

Groenendijk, J. (1999). 'The Logic of Interrogation: Classical Version'. In T. Matthews & D. Strolovitch (eds.) *Proceedings from Semantics and Linguistic Theory IX*, 109–126, Ithaca, NY: Cornell University.

Groenendijk, J. & Stokhof, M. (2001). 'Partitioning Logical Space', annotated Handout v1.02, Second European Summer School on Logic, Language and Information. Leuven, August 1990.
URL `http://staff.science.uva.nl/~stokhof/pls.pdf`

Haiman, J. (1978). 'Conditionals are Topics'. *Language*, **54**(3): 564–589.

Hamblin, C. (1973). 'Questions in Montague English'. *Foundations of Language*, **10**(1): 41–53.

Hamblin, C. L. (1958). 'Questions'. *Australasian Journal of Philosophy*, **36**: 159–168.

Harman, G. (1979). '*If* and Modus Ponens'. *Theory and Decision*, **11**: 41–53.

Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases*. Ph.D. thesis, Linguistics Department, University of Massachusetts, Amherst, Massachusetts.

Hiddleston, E. (2005). 'A Causal Theory of Conditionals'. *Noûs*, **39**(4): 632–657.

Iatridou, S. (2000). 'The Grammatical Ingredients of Counterfactuality'. *Linguistic Inquiry*, **31**(2): 231–270.

References IV

Ippolito, M. (2003). 'Presuppositions and Implicatures in Counterfactuals'. *Natural Language Semantics*, **11**(2): 145–186.

Isaacs, J. & Rawlins, K. (2008). 'Conditional Questions'. *Journal of Semantics*, **25**: 269–319.

Jespersen, O. (1940). *A Modern English Grammar on Historical Principles, Part V: Syntax*, vol. 4. 1st edn., Copenhagen: Ejnar Munksgaard.

Kaufmann, S. (2000). 'Second-Order Cohesion'. *Computational Intelligence*, **16**(4): 511–524.

Kayne, R. (1991). 'Romance Clitics, Verb Movement and PRO'. *Linguistic Inquiry*, **22**: 647–686.

Lewis, D. K. (1973). *Counterfactuals*. Cambridge, Massachusetts: Harvard University Press.

Lewis, D. K. (1979). 'Counterfactual Dependence and Time's Arrow'. *Noûs*, **13**: 455–476.

Loewer, B. (1976). 'Counterfactuals with Disjunctive Antecedents'. *Journal of Philosophy*, **73**(1‘6): 531–537.

Lycan, W. G. (2001). *Real Conditionals*. Oxford: Oxford University Press, ISBN 0-19-924207-0.

References V

McKay, T. J. & van Inwagen, P. (1977). 'Counterfactuals with Disjunctive Antecedents'. *Philosophical Studies*, **31**: 353–356.

Meola, C. D. (2001). 'Synchronic Variation as a Result of Grammaticalization: Concessive Subjunctions in German and Italian'. *Linguistics*, **39**(1): 133–149.

Nute, D. (1975). 'Counterfactuals and the Similarity of Worlds'. *The Journal of Philosophy*, **72**(21): 773–8.

Pearl, J. (1998). 'Actions, Causes, and Counterfactuals: Lessons from Mechanism-Based Theories'. In C. L. Ortiz, Jr. (ed.) *Working Notes of the AAAI Spring Symposium on Prospects for a Commonsense Theory of Causation*, 55, Menlo Park, CA: American Association for Artificial Intelligence, abstract.

Pearl, J. (2000). *Causality: Models, Reasoning, and Inference*. Cambridge, England: Cambridge University Press, ISBN 0521773628 (hardback).

Pratt, V. R. (1976). 'Semantical Considerations on Floyd-Hoare Logic'. In *Proceedings of the 17th IEEE Symposium on Foundations of Computer Science*, 109–121.

Pyers, J. & Emmorey, K. (2008). 'The Face of Bimodal Bilingualism'. *Psychological Science*, **19**(6): 531–6.

References VI

Roberts, C. (1989). 'Modal Subordination and Pronominal Anaphora in Discourse'. *Linguistics and Philosophy*, **12**(6): 683–721.

Schaffer, J. (2004). 'Counterfactuals, causal independence and conceptual circularity'. *Analysis*, **64**(4): 299–309.
URL `http://rsss.anu.edu.au/~schaffer/papers/Counterfactuals.pdf`

Schulz, K. (2007). *Minimal Models in Semantics and Pragmatics: free choice, exhaustivity, and conditionals*. Ph.D. thesis, University of Amsterdam: Institute for Logic, Language and Information, Amsterdam.
URL `http://www.illc.uva.nl/Publications/Dissertations/DS-2007-04.text.pdf`

Slote, M. (1978). 'Time in Counterfactuals'. *Philosophical Review*, **7**(1): 3–27.

Stalnaker, R. C. (1968). 'A Theory of Conditionals'. In N. Rescher (ed.) *Studies in Logical Theory*, 98–112, Oxford: Basil Blackwell Publishers.

Stalnaker, R. C. (1978). 'Assertion'. In P. Cole (ed.) *Syntax and Semantics 9: Pragmatics*, 315–332, New York: Academic Press, references to reprint: Stalnaker (1999b).

Stalnaker, R. C. (1998). 'On the Representation of Context'. *Journal of Logic, Language, and Information*, **7**(1): 3–19, reprinted as Stalnaker (1999c).

References VII

Stalnaker, R. C. (1999a). *Context and Content: Essays on Intensionality Speech and Thought*. Oxford: Oxford University Press, ISBN 0-19-823708-1 (hardback), 0-19-823707-3 (paperback).

Stalnaker, R. C. (1999b). *Context and Content: Essays on Intentionality Speech and Thought*, chap. 4, 78–95. Oxford University Press.

Stalnaker, R. C. (1999c). *Context and Content: Essays on Intentionality Speech and Thought*, chap. 5, 96–113. Oxford: Oxford University Press.

Stalnaker, R. C. (2002). 'Common Ground'. *Linguistics and Philosophy*, **25**(5–6): 701–721.

Stone, M. (1997). 'The Anaphoric Parallel between Modality and Tense'. *Tech. Rep. 97-06*, University of Pennsylvania Institute for Research in Cognitive Science, Philadelphia, PA.
URL `http://www.cs.rutgers.edu/~mdstone/pubs/ircs97-06.pdf`

Stone, M. (1999). 'Reference to Possible Worlds'. *Tech. Rep. 49*, Rutgers University Center for Cognitive Science, updated version of Stone (1997).

Tabakowska, E. (1997). 'Conceptualization: Conditionals as an Instance of Figure/Ground Alignment'. In A. Athanasiadou & R. Dirven (eds.) *On Conditionals Again*, 273–288, John Benjamins Publishing Co.

Veltman, F. (1996). 'Defaults in Update Semantics'. *Journal of Philosophical Logic*, **25**(3): 221–261.
URL `http://staff.science.uva.nl/~veltman/papers/FVeltman-dius.pdf`