Intensional semantics: worlds, modals, conditionals

1 Limitations of the actual world

Recall some assumptions we have followed in this class:

- Sentences are conditional truth values ("1 iff [truth condition]"), whose truth value is fixed when evaluated in a particular model.
- **The Principle of Compositionality:** The meaning of a linguistic expression is built of the meaning of its constituent parts, in a systematic fashion.

(1) **An example from Quine (1956, p. 179):**
"There is a certain man in a brown hat whom Ralph has glimpsed several times under questionable circumstances on which we need not enter here; suffice it to say that Ralph suspects he is a spy. Also there is a gray-haired man, vaguely known to Ralph as rather a pillar of the community, whom Ralph is not aware of having seen except once at the beach. Now Ralph does not know it, but the men are one and the same. Can we say of this man (Bernard J. Ortcutt, to give him a name) that Ralph believes him to be a spy?"

a. Ralph believes that [the man in the brown hat is a spy]. *true*

b. Ralph believes that [the man seen at the beach is a spy]. *false*

We expect the meanings of (1a) and (1b) to based on the meanings of (2a) and (2b), but we know that (2a) and (2b) should have the same truth values!

(2) a. The man in the brown hat is a spy.

b. The man seen at the beach is a spy.

Our current semantics is *extensional*: expressions denote their actual referents in the real world. An extensional semantics cannot model the data in (1).

(3) **Another puzzle:**

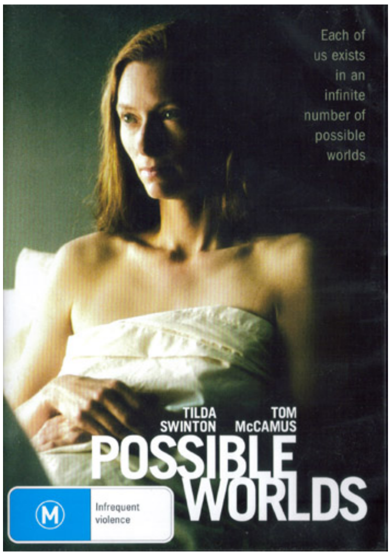
a. I hope that [tomorrow is a public holiday].

b. I hope that [the final exam is cancelled].

(4) a. Tomorrow is a public holiday. *false*

b. The final exam is cancelled. *false*

Intuition: Both of these puzzles above are problematic in our current semantics because *believe* and *hope* describe *how the world might be*, not just *how the world actually is*.
Therefore: We need to describe other worlds.



> "But things might have been different, in ever so many ways. This book of mine might have been finished on schedule... Or I might not have existed at all — neither myself, nor any counterpart of me. Or there might never have been any people... There are ever so many ways that a world might be: and one of these many ways is the way that this world is." Lewis (1986)

(5) **Possible worlds:**

a. Worlds are type s

b. $W = D_s = \{w_1, w_2, w_3, ...\}$; w^* is the actual world

c. We enrich our denotation function with an *evaluation world* parameter: $[\![\cdot]\!]^w$

d. Names are fixed across worlds: for example, $\forall w, w' \in W \left[[\![\text{Tilda}]\!]^w = [\![\text{Tilda}]\!]^{w'} \right]$

e. Contradictions (like $2 + 2 = 5$) are false in all possible worlds.

f. Tautologies (like $1 + 1 = 2$) are true in all possible worlds.

Let's revisit the problematic examples above:

(6) **Beliefs in (1), revisited:**

a. $[\![\text{the man in the brown hat}]\!]^{w*} = [\![\text{the man at the beach}]\!]^{w*}$ but there are other worlds where these descriptions do not give us the same referent.

b. $[\![(1a)]\!] = 1$ iff for all worlds w compatible with Ralph's beliefs,
$\left[[\![\text{the man in the brown hat is a spy}]\!]^w = 1 \right]$

c. $[\![(1b)]\!] = 1$ iff for all worlds w compatible with Ralph's beliefs,
$\left[[\![\text{the man at the beach is a spy}]\!]^w = 1 \right]$

(7) **Hopes in (3), revisited:**

a. $[\![(3a)]\!] = 1$ iff for all worlds w where my hopes come true (or, ideal worlds),
$\left[[\![\text{tomorrow is a public holiday}]\!]^w = 1 \right]$

b. $[\![(3b)]\!] = 1$ iff for all worlds w where my hopes come true (or, ideal worlds),
$\left[[\![\text{the final exam is cancelled}]\!]^w = 1 \right]$

Semantics where we can refer to and quantify over possible worlds are called *intensional*. (Not "intentional" with a *t*.)

2 Modals

Modals are a way to *quantify over (some) possible worlds*.

(8) ***Modal bases*** **= worlds to quantify over, a partial list:**

- *Epistemic*: worlds compatible with our knowledge
- *Deontic*: worlds that are compatible with laws and regulations
- *"Root"*: worlds compatible with the circumstances or individuals' abilities

(9) ***Modal force*** **= the quantifier:**

- possibility: existential $\exists$ (traditionally $\Diamond$)
- necessity: universal $\forall$ (traditionally $\Box$)

Exercise: Classify modals in terms of their modal base and force.

Some other English modals, with complications: *ought*, *would*, *will*, *likely*, *probably*, *is expected*...

(10) **"Weak" vs "strong" necessity:**

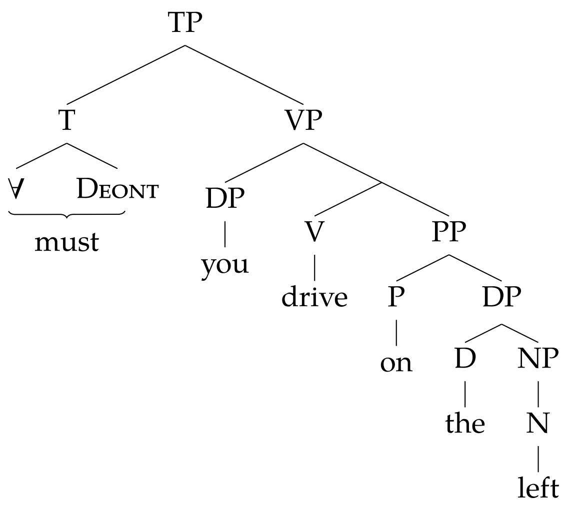
You **should** do the reading, but you don't **have to** Δ.

(11) **A modal base joke:**

a. Teacher: You **can**'t sleep in class.

b. Student: I know. You're talking too loud.

Intuition: Let's actually model modals as *the combination of a modal quantifier and a modal base*.[1]



(12) a. $[\![\text{EPIST}]\!] = \lambda w_s \,.\, w$ is compatible with the speaker's knowledge[2]

b. $[\![\text{DEONT}]\!] = \lambda w_s \,.\, w$ is compatible with relevant laws and regulations

(13) a. $[\![\forall]\!] = \lambda p_{\langle s,t\rangle} \,.\, \lambda q_{\langle s,t\rangle} \,.\, \forall w\, [p(w) = 1 \rightarrow q(w) = 1]$

b. $[\![\exists]\!] = \lambda p_{\langle s,t\rangle} \,.\, \lambda q_{\langle s,t\rangle} \,.\, \exists w\, [p(w) = 1 \text{ and } q(w) = 1]$

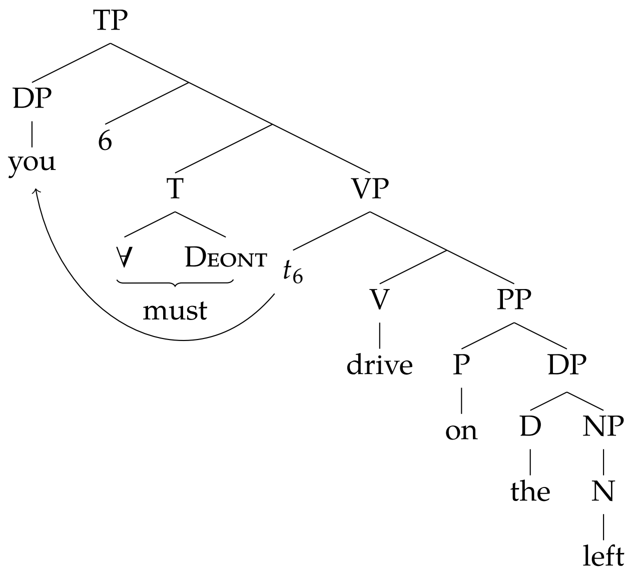
[1] This is a simplification, in many ways, from the state of the art; see von Fintel and Heim (2011).

[2] or sometimes other people's knowledge

We will generally continue to compute things extensionally—for example S/TP/VP will still generally be type t—although we carry the world variable w on the denotation function $[\![\cdot]\!]^w$. However, just when we need to, we will use a special rule that will turn a type t argument into its type $\langle s, t \rangle$ *intension*:

(14) **Intensional Functional Application:** (based on von Fintel and Heim, 2011)
If α is a branching node and $\{\beta, \gamma\}$ is the set of its daughters, then, for any world w and assignment g: if $[\![\beta]\!]^{w,g}$ is a function whose domain contains $\lambda w'_s \,.\, [\![\gamma]\!]^{w',g}$, then $[\![\alpha]\!]^{w,g} = [\![\beta]\!]^{w,g} \left(\lambda w'_s \,.\, [\![\gamma]\!]^{w',g}\right)$.

Again, in reality, the subject would move out:



3 Conditionals

(15) If I am in class, I am healthy.

3.1 Material implication

The classic analysis for "if p (then) q" is $p \to q$, which is equivalent to $p = 0$ or $q = 1$

(16) $[\![\text{if}]\!] = \lambda p_s \,.\, \lambda q_s \,.\, p = 0$ or $q = 1$

There are a number of problems with this view.

(17) von Fintel and Heim (2011):

a. If there is a major earthquake in Cambridge tomorrow, my house will collapse. $p \to q$

b. It's not true that [if there is a major earthquake in Cambridge tomorrow, my house will collapse]. not $(p \to q)$

c. ≠ There will be a major earthquake in Cambridge tomorrow, and my house will fail to collapse. $p = 1$ and $q = 0$

Some additional problems with reasoning with conditionals as material implication:[3]

(18) Cantwell (2008, p. 331):

a. If you don't buy a lottery ticket, you can't win. $(\text{not } p) \rightarrow (\text{not } q)$

b. You can win. q

c. You do buy a lottery ticket. $\text{not}(\text{not } p) = p$

(19) Yalcin (2012, p. 1003):

a. If there is a break-in, the alarm always sounds. $p \rightarrow q$

b. It is not the case that the alarm always sounds. $\text{not } q$

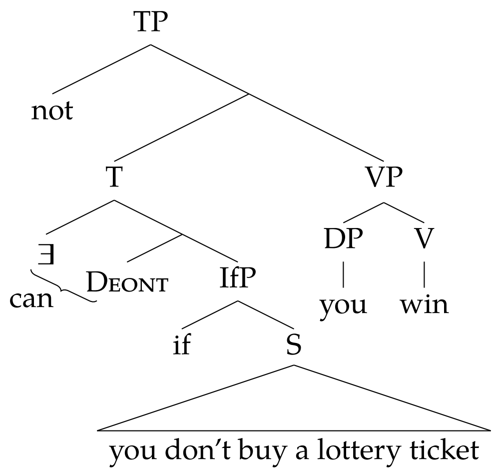
c. There is no break-in. $\text{not } p$

3.2 The modal restrictor view

These paradoxes disappear if we think of the *if*-clause as *restricting the base* of a nearby modal.

> "The history of the conditional is the story of a syntactic mistake. There is no two-place *if...then* connective in the logical forms for natural languages. *If*-clauses are devices for restricting the domains of operators." Kratzer (1986)

LF for (18a), pretending everything has reconstructed:

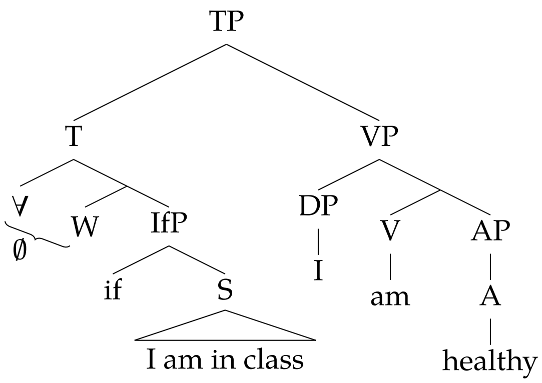


(20) $[\![\text{if}]\!] = \lambda p_{\langle s,t\rangle} \,.\, \lambda q_{\langle s,t\rangle} \,.\, \lambda w_s \,.\, p(w) = 1 \text{ and } q(w) = 1$

[3]These examples come from a collection of apparent counterexamples in the philosophical literature, compiled by Theresa Helke.

Then what about conditionals without modals? Kratzer (1986) continues: "Bare indicative conditionals have unpronounced modal operators." Specifically, covert universal(-like) modals.

LF for (15), ignoring subject movement and the position of the conditional:



...where W is the $\langle s, t \rangle$ predicate true of all worlds, W = λw_s . 1 (the characteristic function of the set of all worlds)

References

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Kratzer, Angelika. 1986. Conditionals. In *Papers from the Parasession on Pragmatics and Grammatical Theory*, 115–135. Chicago Linguistic Society.

Lewis, David. 1986. *On the plurality of worlds*. Blackwell.

Quine, Willard Van Orman. 1956. Quantifiers and propositional attitudes. *Journal of Philosophy* 53:177–187.

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Appendix

We can't see outside. It **might** be raining right now.

John lives alone and I see that the lights are on in his house. John **must** be home.

In America, you **can** chew gum wherever you want.

You **must** drive on the left in Singapore.

David says he's never met Jesse but I saw their picture together! He **has to** be lying!

You **should** do the readings for class.

I just heard something. **Maybe** there's a bird in that tree.

John lives with roommates and I see that the lights are on in their house. John **may** be home.

Because penguins are birds, some people think they **can** fly.

On a clear day, you **can** see Bukit Timah from the top floor.

Because you were sick, you **are allowed** to submit the pset late.

Everyone **needs** to come to class on time.