Dynamic semantics seminar, third session: GSV

Wed, 17 Feb, 2021

Plan:

- Groenendijk, Stokhof and Veltman's "Coreference and Modality" (GSV)
  - Pegs & indefinites
  - Epistemic *might* as a test on a context (instead of on a point)
  - The Broken Vase
  - Identity
- Preparatory steps towards a definition of dynamic
  - Separating dynamic content from dynamic context
  - Thinking through the GSV treatment of *might* in light of modern theories of modality
  - [Reversing order of evaluation in the GSV fragment]

GSV on dynamic semantics

"Very generally, the dynamic view on meaning comes to this: the meaning of a sentence is the change an utterance of it brings about, and the meanings of non-sentential expressions consist in their contributions to this change."

"In dynamic semantics the meaning of a sentence is equated with its potential to change information states."

- Let's develop an even more general view. Some ingredients:
- Context: aspects of the discourse situation relevant for interpretation
  - Lewis' scoreboard, including:
  - Speaker, location, the QUD, goals, salient potential referents
- Content: sentence meaning: what utterances express in a context
  - literal meaning, extension, reference, Frege, Kaplan
- Two truisms:
  - The content depends on context (*I am hungry*)
  - Contexts often change in reaction to an utterance
- One way of understanding GSV's program:
  - The meaning of an expression is the change it causes when uttered
  - Content is not what you thought it was (truth values, etc.), it is "information change potential".

Dynamics of content versus dynamics of context

- Simple view about "static" content:
  - Sentences denote functions from contexts to truth values
    - $[\![\text{This is a sentence}]\!]^{g,w}$ = True :: Bool
    - $[\![\text{This is a sentence}]\!]$ :: Assignment -> World -> Bool

        - [Similarly for other scoreboard elements]
        - Parts of sentences contribute what they need to to make this work
    - If you like to think of the content of sentences as propositions, that's compatible
    - Other views of content are fine: centered worlds, truthmakers, situations, actions, etc.
- Simple view of computing content
    - Just as computing a truth value requires syntactic structure that is not part of the semantic content of the expression,
    - There may be semantic structure that we use during the computation of semantic content but which we ultimately discard, which is not part of the content
    - These ancilliary structures may include logical forms, higher-order functions, etc.
    - They may also include modified assignment functions, modified local contexts
    - All of this is fully compatible with the standard "static" view of the meaning of, say, the first order predicate calculus:
        - $M, s \Vdash \exists v\theta$ iff $M, s' \Vdash \theta$ for some assignment s' that agrees with s except possibly at the variable v
- What evidence have we seen so far in favor of adopting the Heim/DPL/GSV view, that content is context change potential?
    - Heim demonstrated that a grammar in which sentences denoted CCPs could make useful predictions about presupposition projection.
        - Did the predictions depend on CCPs being involved? No!
            - In the second Heim fragment, sentences are evaluated wrt to a <g,w> pair, just like on the static conception, and their content is a truth value
            - There are ancilliary semantic structures, clearly and cleanly separated from the content
            - Monad talk: monadic objects are like boxes. Inside the box is a value. The box can contain other machinery for tracking context (assignments, etc.)
        - The results did depend on order of evaluation—evaluating the left conjunct before the right conjunct, etc.
- New evidence in GSV: *might* requires access to the complete local context
- Questions for the discussion today:
    - How does the GSV treatment relate to more standard theories of modality?
    - How closely does the common ground track the local context for *might*?

[turn on screen sharing]

Pegs

- GSV complicate their assignment function machinery.
- The main job of an assignment function is to assign values to variables
- Heim 1983: assignment functions are sequences of individuals,
  - interpreted as a function from natural numbers to individuals
  - I.e., the sequence [Ann, Bill, ...] is interpreted as the function mapping a variable with index 1 to Ann, a variable with index 2 to Bill, and so on.
- DPL: an assignment is a function assigning an individual to each variable
- GSV: two steps: mapping variables to pegs, and pegs to individuals
  - A "referent system" is a function from variables to pegs
  - There is also a function from pegs to individuals
  - Evaluation points are now triples: <r,g,w>: referent system r, fn g, world w
  - So the composition of r and g maps variables to individuals

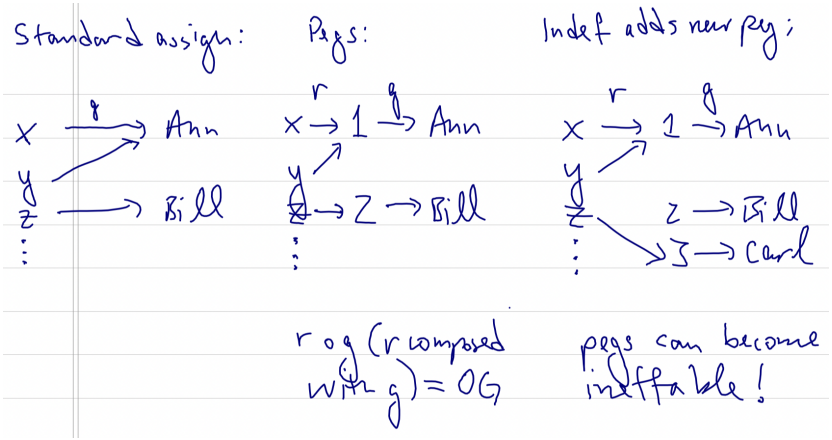

Figure 1: Peg diagrams

Poetry: "Pegs are formal objects. One can think of them as addresses in memory, for example. But it does not really matter what pegs are. The only thing that counts is that they can be kept apart, and that there are enough of them, no matter how many things are introduced in a discourse. In what follows, natural numbers will be used as pegs."

- Indefinites introduce a new, never before used peg (the system tracks which pegs have been used)
- This allows an indefinite to re-use a variable without clobbering the information previously associated with that variable

Pryor, James. 2017. De Jure Codesignation. In Bob Hale, Alex Miller, and Crispin Wright (eds). *A Companion to the Philosophy of Language, 2nd edition.* Blackwell. 1033-1079. Sophisticated thinking about different ways that variables can have the same values.

See also notes from a seminar co-taught by me and Jim Pryor from 2015, also linked into the syllabus entry for this week: http://lambda.jimpryor.net/topics/week10_gsv/

- The difference between pegs and standard assignment functions is not relevant to any of the main issues of the seminar.
  - In particular, they are not essential to any of the key examples explored in the paper
    - Not essential for the Broken Vase
    - Not essential for puzzles about identity
  - I'll use old-school assignment functions that map directly from variables to objects.

Subsists

However, pegs and referent systems are relevant for defining the technical notion *subsists*

- Basically, for a possibility (an assignment/world pair) to *subsist* in an updated context means it survived update, possibly with an extended referent system due to the evaluation of indefinites
- There may be new variables, there may be new pegs

Information states, update rules

- An information state (a context) is a set of possibilities; a possibility is tuple containing an assignment function and a world (same as Heim 83, modulo pegs)
- Update of a context s with a formula ϕ is written as $s[\phi]$

i. $s[Rt_1 \dots t_n] = \{i \in s \mid \langle i(t_1), \dots, i(t_n)\rangle \in i(R)\}$.
ii. $s[t_1 = t_2] = \{i \in s \mid i(t_1) = i(t_2)\}$.
iii. $s[\neg\phi] = \{i \in s \mid i \text{ does not subsist in } s[\phi]\}$.
iv. $s[\phi \wedge \psi] = s[\phi][\psi]$.
v. $s[\exists x\phi] = \cup_{d\in D}(s[x/d][\phi])$.
vi. $s[\Diamond\phi] = \{i \in s \mid s[\phi] \neq \emptyset\}$.

Figure 2: GSV update rules

- For the indefinite rule, the definitions underwriting the modified information state notation ("$s[x/d]$") guarantee that x gets mapped to a new peg.

- For the epistemic possibility rule, the entire context is passed through unchanged if even one point makes the prejacent true.

Basic rules versus derived rules

- GSV remark that "Other logical constants can be introduced in the usual way." But they don't say what the usual way is!

Fact 3.2

i. $s[\phi \rightarrow \psi] = \{i \in s \mid$ if i subsists in $s[\phi]$, then all descendants of i in $s[\phi]$ subsist in $s[\phi][\psi]\}$.
ii. $s[\phi \vee \psi] = \{i \in s \mid i$ subsists in $s[\phi]$ or i subsists in $s[\neg\phi][\psi]\}$.
iii. $s[\forall x\phi] = \{i \in s \mid$ for all $d \in D$: i subsists in $s[x/d][\phi]\}$.
iv. $s[\Box\phi] = \{i \in s \mid s$ subsist in $s[\phi]\}$.

It is not possible to make a different choice of basic and defined constants which leads to the same overall results. This can be seen as follows. From the

Figure 3: Some derived update rules in GSV

- The update for disjunction will be relevant for Schlenker next week
- We can define disjunction in terms of conjunction and negation:

$$\phi \vee \psi \equiv \neg(\neg\phi \wedge \neg\psi)$$

  This is Beaver's rule for disjunction, btw
- A possibility $i \in s$ will be in the update of $s[\phi \vee \psi]$ iff i does not subsist in $s[\neg\phi \wedge \neg\psi]$. This will be the case if either:
  - i subsists in $s[\phi]$, in which case it won't survive update with the left conjunct, or
  - i subsists in $s[\neg\phi][\psi]$, in which case it won't survive update with the right conjunct
- The asymmetry is due to the dynamics of conjunction

1. Either there is no bathroom in this building, or it's in a funny place.

- The dynamics guarantee that the existence presupposition of the pronoun are evaluated only against worlds in which *there is no bathroom in this building* is false

- Defining conjunction in terms of, say, negation and disjunction will not work correctly, because the extra negations will make the result dynamically closed in ways that don't match intuitions.

Consistency vs. coherence

- A sentence ϕ is *consistent* iff there is some c such that $c + \phi \neq \{\}$.
- A sentence ϕ is *coherent* iff there is some non-empty c such that c subsists in $c + \phi$ (i.e., all possibilities in c have corresponding extended possibilities in $c + \phi$).
- Coherence implies consistency.
- "A speaker can only assert a sentence correctly if it does not constitute a 'real' update in her information state."

1. It might be raining outside. [...] It isn't raining outside.
2. It isn't raining outside. [...] *It might be raining outside.

(2) is flat out inconsistent: the first sentence eliminates every raining possibility, and the second sentence requires the presence of at least one raining possibility. So update with (2) always results in the empty context.

(3) is consistent but incoherent. The reason is that in order for an information state c to subsist in $c +$ *It might be raining outside*, there must be at least one possibility $i \in c$ in which it is raining; but i cannot subsist in the updated context of *It isn't raining outside*. So no information state c can subsist in $c + (1)$.

"An utterance of a sentence is incoherent if no *single* information state can support it... (1) is only acceptable if the two sentences are uttered by different speakers in different information states, or by ... [a] speaker who has gained additional information in between uttering the two sentences."

"One way to look up this, is that epistemic modal statements such as *might-ϕ* are not primarily meant as providing information about the world as such; they rather provide **information about the information** of the speaker."

The Broken Vase

I forgot how beautifully devious this grammar is!

- Starting context:
  - There are three children: Alice, Bob, and Carl.
  - One of them broke a vase.
  - Alice is known to be innocent.
  - Noises are coming from the closet.

1. Someone^x is in the closet. They$_x$ might be guilty.
   - $(\exists x.\text{closet}(x)) \wedge (\Diamond\text{guilty}(x))$
2. Someone^x is in the closet who$_x$ might be guilty.
   - $\exists x(\text{closet}(x) \wedge \Diamond\text{guilty}(x))$
3. $(\exists x.\phi) \wedge \Diamond\psi \not\equiv \exists x(\phi \wedge \Diamond\psi)$

In slow dynamic motion:

Let's look at local contexts:

1. (a) Someone^x (b) is in the closet. (c) They$_x$ might be guilty. (d)

a. Initial context with empty assignment function, six live possibilities $w_{c,g}$ depending on c (who's in the closet) and g (who's guilty):

$$[([], w_{a,b}), ([], w_{b,b}), ([], w_{c,b}), ([], w_{a,c}), ([], w_{b,c}), ([], w_{c,c})]$$

b. The rule for the indefinite:

$$c + \exists x\phi = \bigcup_{d \in D} c[x/d] + \phi$$

Paraphrase: run ϕ with a different local context for each choice of value for x, unify the results. Here are the three local contexts:

a. $[([x/a], w_{a,b}), ([x/a], w_{b,b}), ([x/a], w_{c,b}), ([x/a], w_{a,c}), ([x/a], w_{b,c}), ([x/a], w_{c,c})]$
b. $[([x/b], w_{a,b}), ([x/b], w_{b,b}), ([x/b], w_{c,b}), ([x/b], w_{a,c}), ([x/b], w_{b,c}), ([x/b], w_{c,c})]$
c. $[([x/c], w_{a,b}), ([x/c], w_{b,b}), ([x/c], w_{c,b}), ([x/c], w_{a,c}), ([x/c], w_{b,c}), ([x/c], w_{c,c})]$

After update with "x is in the closet", the three local updates are:

a. $[([x/a], w_{a,b}), ([x/a], w_{a,c})]$
b. $[([x/b], w_{b,b}), ([x/b], w_{b,c})]$
c. $[([x/c], w_{c,b}), ([x/c], w_{c,c})]$

c. After union, we get the local context at location (c):

$$[([x/a], w_{a,b}), ([x/a], w_{a,c}), ([x/b], w_{b,b}), ([x/b], w_{b,c}), ([x/c], w_{c,b}), ([x/c], w_{c,c})]$$

d. Update with "They$_x$ might be guilty": test to make sure there is some point that verifies the prejacent "They$_x$ be guilty"—yes, for instance, $([x/b], w_{b,b})$—there is another such point—so the entire local context is copied onto the output:

$$[([x/a], w_{a,b}), ([x/a], w_{a,c}), ([x/b], w_{b,b}), ([x/b], w_{b,c}), ([x/c], w_{c,b}), ([x/c], w_{c,c})]$$

This is what we know after the discourse in (1): it could be any of the children in the closet, and either Bob or Carl is guilty. Same worlds we started with...

Second half of the minimal pair

2. (a) Someone^x (b) (x is in the closet (c) and x might be guilty) (d)

At location (b), the indefinite provides the same three local contexts. This time, however, we update each local context with "x is in the closet (c) and x might be guilty".

a. $[([x/a], w_{a,b}), ([x/a], w_{b,b}), ([x/a], w_{c,b}), ([x/a], w_{a,c}), ([x/a], w_{b,c}), ([x/a], w_{c,c})]$+ "$x$ is in the closet" $= [([x/a], w_{a,b}), ([x/a], w_{a,c})]$

We're now executing one case of the existential, and we're at location (c).

$[([x/a], w_{a,b}), ([x/a], w_{a,c})]$ + "x might be guilty" $= []$

After all, we know that Alice isn't guilty!

b. $[([x/b], w_{a,b}), ([x/b], w_{b,b}), ([x/b], w_{c,b}), ([x/b], w_{a,c}), ([x/b], w_{b,c}), ([x/b], w_{c,c})]$+ "$x$ is in the closet" $= [([x/b], w_{b,b}), ([x/b], w_{b,c})]$

This time update with the *might* clause succeeds:

$[([x/b], w_{b,b}), ([x/b], w_{b,c})]$+"$x$ might be guilty" $= [([x/b], w_{b,b}), ([x/b], w_{b,c})]$

c. $[([x/c], w_{a,b}), ([x/c], w_{b,b}), ([x/c], w_{c,b}), ([x/c], w_{a,c}), ([x/c], w_{b,c}), ([x/c], w_{c,c})]$+ "$x$ is in the closet" $= [([x/c], w_{c,b}), ([x/c], w_{c,c})]$

Once again, update with the *might* clause succeeds:

$[([x/c], w_{c,b}), ([x/c], w_{c,c})]$+"$x$ might be guilty" $= [([x/c], w_{c,b}), ([x/c], w_{c,c})]$

Union over the three cases gives the final update for location (d):

$[([x/b], w_{b,b}), ([x/b], w_{b,c}), ([x/c], w_{c,b}), ([x/c], w_{c,c})]$

`We've learned that Alice is not in the closet!`

Crucially, *might* has access to the entire local context, but the local context does not contain the full range of values for each variable introduced by an indefinite. Each value for the indefinite is run in its own separate thread.

Identity

(26) Someone has done it. It might be Alfred. It might not be Alfred.
- $\exists x Px \wedge \Diamond(x = a) \wedge \Diamond(x \neq a)$

(27) Someone has done it who might be Alfred and who might not be Alfred.
- $\exists x(Px \wedge \Diamond(x = a) \wedge \Diamond(x \neq a))$

(I interpolated the natural language version of (29).)

(26) is consistent, (29) is inconsistent.

The dynamics of epistemic modality

- For the first time, an argument the semantics needs to track entire contexts
- Not a state of the art theory of epistemic modality
- Simple Kripke relational semantics for modality: wRw' just in case w' is an epistemic possibility at w.

- Kratzer classic: f is a conversational background, a set of propositions that characterize the modal base.
  - wRw' just in case $w' \in \bigcup f(w)$. Epistemic (and circumstantial) modal bases must be *realistic*: wRw.
- For GSV, wRw' just in case w and w' are members of the same information state
- Other approaches: Yacin, Kratzer modern, Gilles, etc.

The case for internal context update

1. a. Amy might be in New York.
   b. Amy might be in Boston.
   c. If Amy is in New York, she might be in Boston.

- If the truth value of (c) ought to be False (in view of how people and locations work), then the consequent of (1c) had better be evaluated only with respect to worlds in which Amy is in New York. One way or another,

we have to construct a hypothetical local context that reflects the content of the antecedent.

Either

- The evaluation of the conditional manipulates the local context wrt the consequent is evaluated (GSV), or
- The compositional semantics modulates the epistemic accessibility relation in an elaborate way that tracks composition closely

Footnote: update with negation in Heim's dissertation

As we learned in discussion last week, the rule for Heim's dynamic semantics in her dissertation is dynamically closed (p. 245 in the Routledge edition, available at semanticsarchive.net):

> (IV) Let ϕ be an operator-headed molecular formula, consisting of a negator and the formula ψ. Then:
> $\textsc{Sat}(F + \phi) = \{a_N \in \textsc{Sat}(F)$: there is no $b_N \widetilde{\textsc{Dom}(F)}\ a_N$ such that $b_N \in \textsc{Sat}(F + \psi)\}$;
> $\textsc{Dom}(F + \phi) = \textsc{Dom}(F)$.
>
> The notation "$a_N \widetilde{M}\ b_N$" that I have employed here abbreviates: "a_N agrees with b_N on all $i \in M$."

Figure 4: The rule for negation in chatper 3 of Heim

Paraphrase: Update of a context c with ϕ = "not ψ" contains all the sequences in c that can't be extended to satisfy ϕ.

Here, satisfaction of a file F (roughly, a context) is relative to a sequence of individuals, without worlds being taken into account.