First Steps Towards an Intensional Semantics

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Chapter 12

- Up to this point we have identified the denotation of sentences with their actual truth-*values*.

- The resulting theory as a whole was able to pair sentences with their truth-*conditions*, so that we could develop a theory of meaning.

- We will see that this extensional system breaks down in ways that Frege was well aware of.

- We will see that a minor change to the system repairs the problem (at least to a certain extent).

12.1 Where the extensional semantics breaks down

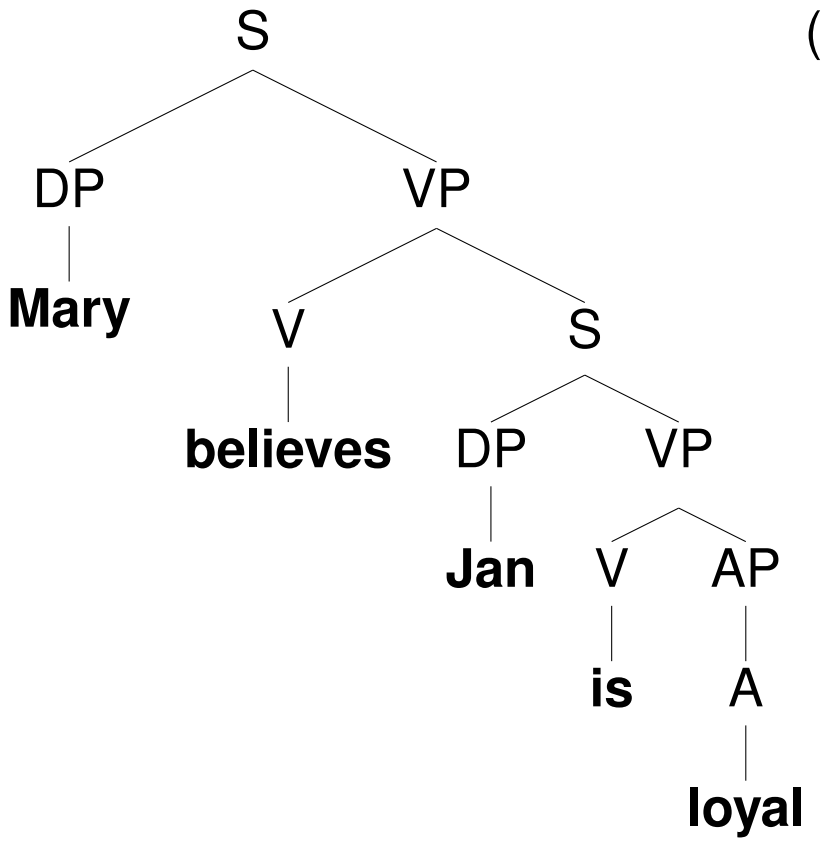
- One of the basic assumptions of the semantics we have been developing is that the extension of a complex expression can be computed from the extensions of its parts.

- This assumption is plain wrong for examples of the following kind:

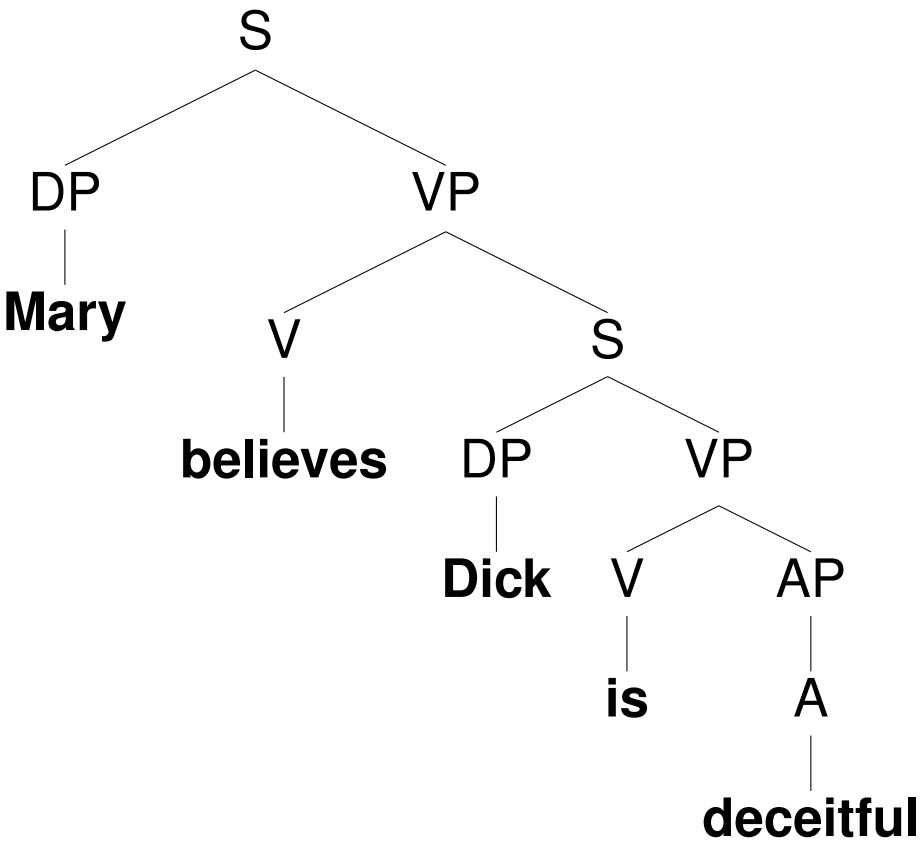
(1) Mary believes Jan is loyal.

(2) Mary believes Dick is deceitful.

(1’)



(2’)



- The two upper VP nodes are computed from the denotation of the verb and the denotation of the S node. The V-node are the same, hence will be assigned the same denotation. The two S-nodes denote truth values.

12.1 Where the extensional semantics breaks down (cont.)

- Suppose that in the actual world, Jan is indeed loyal and Dick is indeed deceitful, that is $[\![$**Jan is loyal**$]\!]$ = $[\![$**Dick is deceitful**$]\!]$ = 1.

- Consequently the two embedded S nodes have the same denotation. We then predict that:
  $[\![$**[**$_{VP}$ **believes [**$_{S}$ **Jan is loyal]]**$]\!]$ = $[\![$**[**$_{VP}$ **believes [**$_{S}$ **Dick is deceitful]]**$]\!]$
  and $[\![$**Mary [**$_{VP}$ **believes [**$_{S}$ **Jan is loyal]]**$]\!]$ =
  $[\![$**Mary [**$_{VP}$ **believes [**$_{S}$ **Dick is deceitful]]**$]\!]$

- But Mary may believe that Jan is loyal without believing that Dick is deceitful.

12.1 Where the extensional semantics breaks down (cont.)

- We want to say that the sentences embedded under **believe** are *nonextensional* contexts.

- Nonextensional contexts are also called “oblique”, “opaque” or “indirect”.

- Other words that create nonextensional contexts include the verbs **hope**, **fear**, **look** (as in **look smart**), **seem**, **seek**, the adjectives **alleged** or **fake**, the preposition **about**, the connective **because**, and modal words of various categories like **must**, **may**, **probably**, **obviously**, **provable**, and **permissible**.

12.2 What to do: intensions

- Frege proposed that in opaque contexts, expressions denote their *Sinn* (sense). But what is a Fregean *Sinn*? Frege was a little vague.

- The Fregean sense of an expression is the mode of presentation of its extension (reference), *Bedeutung*. It's a particular means of determining the extension.

- But what kind of formal object is a "means of determining an extension"? It could be an expression of set theory or an algorithm computing the value of a function for arbitrary arguments.

- Different expressions might specify the same set, and different algorithms might compute the same function.

- But there are other, more abstract possibilities. One was proposed by Rudolph Carnap, a student of Frege's.

12.2 What to do: intensions (cont.)

- The truth of a sentence depends on its circumstances. It's now true that you are in Amsterdam, but in a little while that's not going to be true anymore, and if circumstances were different, you might never have left Vancouver.

- The extension of a predicate depends on the circumstances as well. You are a member of the garden club, but you havn't always been and you might never have joined.

- An *intension* in Carnap's sense is something that determines how extensions depend on possible circumstances.

- David Lewis proposes that an intension is a function which yields as output an appropriate extension when given as input a package of the various factors on which which the extension may depend.

12.2 What to do: intensions (cont.)

- The input package of various factors is called an index, and a function from indices to appropriate extensions is an *intension*.

- For simplicity, we will focus on only one kind of index dependence: dependence on possible worlds. We will neglect temporal dependence, speaker dependence, or any other kind.

- The intension of a sentence is a function from possible worlds to truth values. The intension of a 1-place predicate is a function from possible worlds into characteristic functions of sets of individuals, etc.

- David Lewis describes possible worlds. The actual world is everything that is the case. Things might have been different in countless ways, and each different way of putting everything together is a possible world.

12.3 An intensional semantics

- We start out with a recursive definition of an intensional system of semantic types (Montague's), which will be followed by a parallel definition of a typed system of semantic domains.

(1) **Recursive definition of semantic types**

(a) e is a type.

(b) t is a type.

(c) If a and b are types, then $<$ a,b $>$ is a type.

(d) If a is a type then $<$ s,a $>$ is a type.

(e) Nothing else is a type.

12.3 An intensional semantics (cont.)

(2) **Semantic domains**

Let W be the set of all possible worlds. Associated with each possible world w is the domain of all individuals existing in w. Let D be the union of the domains of all possible worlds. That is D contains all individuals existing in the actual world, but also all individuals existing in any of the merely possible worlds. It is the set of all possible individuals. The set of intensional domains is now defined as follows.

(a) D_e = D.

(b) $D_t = \{0, 1\}$.

(c) If a and b are semantic types, then $D_{<a,b>}$ is the set of all functions from D_a to D_b.

(d) If a is a type then $D_{<s,a>}$ is the set of all functions from W to D_a.

12.3 An intensional semantics (cont.)

- We now have intensions. For example, $D_{<s,t>}$ contains all functions from W to $\{0, 1\}$.

- These are the formal construals of *propositions*.

- Construing propositions as characteristic functions of sets of possible worlds is natural, as the quote from Robert Stalnaker explains.

- A proposition is a way of dividing a set of possible worlds into two parts: the ones that are ruled out by the truth of the proposition, and the ones that are not.

- NH: When you add a proposition to the common ground, you eliminate the worlds in which the proposition is false from the set of "live possibilities".

12.3 An intensional semantics (cont.)

- Following Montague, we will relativize the interpretation function to a possible world and to an assignment function.

- As before, we can drop reference to an assignment when the choice of assignments doesn't matter, since we define for any possible world w, and any expression α:

(3) $[\![\alpha]\!]^{w} := [\![\alpha]\!]^{w,\emptyset}$.

12.3 An intensional semantics (cont.)

(4) **Names**

For any possible world w:

$[\![\textbf{Jan}]\!]^w$ = Jan.

$[\![\textbf{Ann}]\!]^w$ = Ann.

etc.

- Following Saul Kripke, we treat proper names as *rigid designators*.

- Their reference is picked out in the actual world, and they denote the same individual that was so picked out in every possible world.

- Proper names, then, differ from definite descriptions like **the coldest winter**, which may denote different winters in different possible worlds.

12.3 An intensional semantics (cont.)

- The extensions of predicates may vary depending on the circumstances as well:

(5) **Easy predicates**

For any possible world w:

$[\![\textbf{smoke}]\!]^w = \lambda x \in D$. x smokes in w.

$[\![\textbf{love}]\!]^w = \lambda x \in D$. [$\lambda y \in D$. y loves x in w]

$[\![\textbf{car}]\!]^w = \lambda x \in D$. x is a car in w.

etc.

12.3 An intensional semantics (cont.)

- The extension of quantifiers does not depend on the circumstances, but for reasons of generality, we carry the world parameter along, as we did with proper names.

(6) **Determiners**

For any possible world w:

$[\![\textbf{every}]\!]^w$ = λf $\in$ $D_{<e,t>}$. [λg $\in$ $D_{<e,t>}$. for all x such that f(x) = 1, g(x) = 1]

etc.

12.3 An intensional semantics (cont.)

- The fragment we have been building does not require any new composition rules. The interpretation now depends not just on an assignment, but also on a possible world.

- Both parameters must be schlepped along as the interpretation mechinery works its way through a given tree.

- Assignments, too, are what they used to be: partial functions from the set of natural numbers to D (but D has changed).

12.3 An intensional semantics (cont.)

- Consider now the attitude verbs **believe**, **know**, **hope**, etc.

- We will pursue an approach in the sprit of Hintikka that has it that the content of an attitude can be characterized by a set of possible worlds, those that are compatible with the attitude.

- As Lewis says, the content of someone's knoweldge of the world is given by the class of *epistemically accessible* worlds. These are the worlds that might, for all he knows, be his world.

- The content of someone's beliefs about the world is given by his *doxastically accessible* worlds.

- Since only truths can be known, the hearer's own world always must be among his epistemically accessible worlds. Not so for doxastic accessibility.

12.3 An intensional semantics (cont.)

Attitude verbs

For any possible world w:

$[\![\textbf{believe}]\!]^w$ = λp $\in$ $D_{<s,t>}$. [λx $\in$ D . p(w') = 1, for all w' $\in$ W that are compatible with what x believes in w.]

$[\![\textbf{know}]\!]^w$ = λp $\in$ $D_{<s,t>}$. [λx $\in$ D . p(w') = 1, for all w' $\in$ W that are compatible with what x knows in w.]

$[\![\textbf{hope}]\!]^w$ = λp $\in$ $D_{<s,t>}$. [λx $\in$ D . p(w') = 1, for all w' $\in$ W that are compatible with what x hopes in w.]

12.3 An intensional semantics (cont.)

- What a person believes, knows or hopes can vary from one possible world to another. The world parameter in the lexical entries for attitude verbs matters. We must make explicit what world we are talking about: “w’ is a world where Mary’s hopes in w come true”.

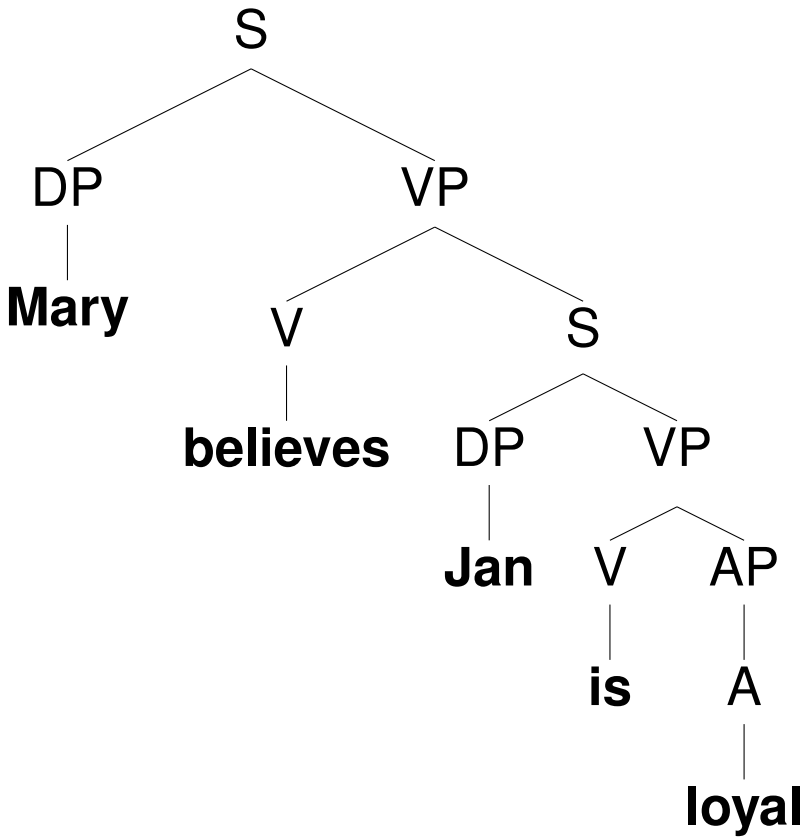
- For Mary to believe that p, it is not sufficient that p be true in *some* world that is compatible with what she believes. If her belief worlds include worlds where p is true as well as worlds where p is false, that would make her agnostic as to the truth of p.

- We can’t say “Mary believes that she is in w” or “the world according to Mary”. We have to make it clear that actual desires, beliefs etc. pick out *sets* of worlds. We can say, “w is a world that conforms to everything that Mary believes”.

12.3 An intensional semantics (cont.)

(8) Mary believes Jan is loyal.

(8’)



12.3 An intensional semantics (cont.)

For any possible world w:

(a) $[\![$[$_S$ **Mary** [$_{VP}$ **believes** [$_S$ **Jan is loyal**]]] $]\!]^w$ = (by FA)
(b) $[\![$ [$_{VP}$ **believes** [$_S$ **Jan is loyal**]] $]\!]^w$ ($[\![$**Mary**$]\!]^w$) = (by lexical entry **Mary**)
(c) $[\![$ [$_{VP}$ **believes** [$_S$ **Jan is loyal**]] $]\!]^w$ (Mary)

- Now we are stuck. The denotation of **believe** applies to a proposition, an intension of type $< s, t >$. But $[\![$**[Jan is loyal]**$]\!]^w$ is a denotation of type t.

- Here is the proof:

$[\![$**Jan is loyal**$]\!]^w$	= (by FA)
$[\![$**is loyal**$]\!]^w([\![$**Jan**$]\!]^w)$	= (by lexical entry **Jan** and emptiness of **is**)
$[\![$**loyal**$]\!]^w$ (Jan)	= (lexical entry **loyal**)
[λx $\in$ D . x is loyal in w] (Jan)	

By the definition of the λ-notation, [λx $\in$ D . x is loyal in w] (Jan) = 1 iff Jan is loyal in w.

12.3 An intensional semantics (cont.)

- We need an additional composition principle.

(9) **Intensional Functional Application (IFA)**
If α is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any possible world w and any assignment a, if $[\![\beta]\!]^{w,a}$ is a function whose domain contains λw' .$[\![\gamma]\!]^{w',a}$, then $[\![\alpha]\!]^{w,a}$ = $[\![\beta]\!]^{w,a}$(λw' .$[\![\gamma]\!]^{w',a}$).

- We can now continue our computation at the point where we got stuck:

(c) $[\![$ **[**$_{VP}$ **believes [**$_{S}$ **Jan is loyal]]** $]\!]^{w}$ (Mary) = (by IFA)
(d) $[\![$**believes**$]\!]^{w}$ (λw' . $[\![$**Jan is loyal**$]\!]^{w'}$) (Mary) = (by previous computation)
(e) $[\![$**believes**$]\!]^{w}$ (λw' . Jan is loyal in w') (Mary) = (by lexical entry **believe**)

(f) λp $\in$ $D_{<s,t>}$. [λx $\in$ D . p(w') = 1, for all w' $\in$ W
that are compatible with what x believes in w.]
(λw' . Jan is loyal in w') (Mary) = (by definition of λ-notation)
(g) [λx $\in$ D . [λw' . Jan is loyal in w'](w') = 1, for
all w' $\in$ W that are compatible with what x
believes in w] (Mary) = (by definition of λ-notation)
(h) [λx $\in$ D . Jan is loyal in w' for all w' $\in$ W
that are compatible with what x believes
in w] (Mary)

[λx $\in$ D . Jan is loyal in w' for all w' $\in$ W that are compatible with what x believes in w] (Mary) = 1 iff
Jan is loyal in w' for all w' $\in$ W that are compatible with what Mary believes in w.

- We have the right truth-conditions for sentence (8). (8) is true in the actual world iff Mary's actual beliefs exclude all possible worlds in which Jan is not loyal.

12.3 An intensional semantics (cont.)

- In an analogous way, we obtain the right truth-conditions for (10):

(10) Mary believes Dick is deceitful.

- (10) comes out true in the actual world iff there is no world that is compatible with Mary's actual beliefs in which Dick is not deceitful.

- Given an intensional semantics, we do not run into any difficulties any more when we asume that all of the sentences 11(a-d) might be true together.

(11) (a) Jan is loyal.
(b) Dick is deceitful.
(c) Mary believes that Jan is loyal.
(d) Mary does not believe that Dick is deceitful.

12.3 An intensional semantics (cont.)

- The problem we started with in this chapter is now gone. The solution is very much in the spirit of Frege.

- The usual denotations are extensions, but for nonextensional contexts, IFA allows a switch to intensions.

- The switch is triggered by particular lexical items. Whether a lexical item does or does not create a nonextensional context is part of the information conveyed by its denotation.

12.4 Limitations and prospects

- Carnap insists that sentences embedded under attitude verbs are neither extensional nor intensional contexts. And he is right. Take two sentences that are true in the same possible worlds but do not have to be believed together.

(1) (a) Robin will win.
(b) Everyone who does not compete, or loses, will have done something that Robin will not have done.

(2) (a) Marian believes that Robin will win.
(b) Marian believes that everyone who does not compete, or loses, will have done something that Robin will not have done.

- (1a) and (1b) are true in the same possible worlds. They express the same proposition, then.

12.4 Limitations and prospects (cont.)

- But if what we believe are propositions, then anyone who believes (1a) should also believe (1b). This is not right. (2a) and (2b) can have different truth values.

- We are in trouble again. Propositions are still not good enough as objects of beliefs and other attitudes.

- Carnap proposed the concept of “intensional isomorphism” or “intensional structure” as a remedy.

- David Lewis identifies “meanings” with “semantically interpreted phrase markers minus their terminal nodes: finite ordered trees having at each node a category and an appropriate intension.”

- Cresswell and von Stechow propose “structured propositions”.

12.4 Limitations and prospects (cont.)

- There is no agreement on this issue yet.
- But the uncertainty in the area of propositional attitudes does not seem to have repercussions on the way that linguists do semantics every day.
- A slight change led us from an extensional system to an intensional system. The switch to a hyperintensional system should not be much more eventful.
- Barbra Partee observes that many of the most fundamental foundational issues in semantics remain open questions, and that most work these days is done by linguists rather than philosophers, so empirical linguistic questions get most of the attention now.
- This book has focused on such empirical issues.
- THE END!!!