Introduction: intentions, possible world variables, third readings

1. The need for intensions

In this class we are going to talk about attitude reports: the sentences of the general form ‘x verb p’, where p is a proposition denoting element. Some relevant examples of the sentences that we are going to discuss are given below.

(1) John believes that Mary danced.
(2) John knows that Mary danced.
(3) John wants Mary to dance.
(4) John hopes Mary will dance.

It has been observed early on that simple extensional semantics can’t work for those examples (the observation goes back to Frege’s ‘Über Sinn und Bedeutung’). Their truth-value seems to depend upon what is going on in other hypothetical worlds.

Let’s start from a very intuitive assumption that *believes* in (1) is a relation between John and some entity denoted by *Mary danced*.

- This entity cannot be the truth-value of the sentence. There are a lot of sentences that share their truth value. Let’s assume that Mary danced in the actual world. This would wrongly predict that if (1) holds, John believes in all true sentences.
- This entity cannot be the sentence ‘Mary danced’. Imagine that John is speaker of Russian and he has never heard a sentence of English. Then he cannot have an attitude to the sentence ‘Mary danced’.

We want to say that *believe* is a relationship between an individual and truth conditions or a proposition.

2. Intensions

Now we want to formalize this idea and introduce the notion of intension.
We are going to assume that ‘actual world’ is the sum of all facts that happened, are happening or will happen. Following the standard practice, we are going to label it at w_0.

Many of the facts about the actual world could have been otherwise.

We are going to assume that for every fact about the actual world that could have been different, there is a possible alternative universe, where this alternative fact holds.

We are going to label the set of all possible worlds as W. The actual world is a member of this set.

Now we are going to relativize our denotations to possible worlds.

(5) $[\![\text{Mary danced}]\!]^{w0}$ = T in w_0 iff Mary danced in w_0

(6) $[\![\text{danced}]\!]^{w0} = \lambda x.\ x \text{ danced in } w_0$

(7) $[\![\text{Mary}]\!]^{w0} = \text{Mary}$

(8) $[\![\text{president}]\!]^{w0} = \lambda x.\ x \text{ is a president in } w_0$

So in general, we are going to say, for any expression X

(9) $[\![X]\!]^{w}$= the extension of X at world w

(10) $\lambda w. [\![X]\!]^{w}$= the intension of X

Some examples:

(11) $\lambda w. [\![\text{danced}]\!]^{w} = \lambda w.\ \lambda x.\ x \text{ danced in } w$

(12) $\lambda w. [\![\text{Mary}]\!]^{w} = \lambda w.\ \text{Mary}$

(13) $\lambda w. [\![\text{president}]\!]^{w} = \lambda w.\ \lambda x.\ x \text{ is a president in } w$

The object that we are looking for is a proposition. It is a function of type <st>:

(14) $\lambda w. [\![\text{Mary danced}]\!]^{w} = \lambda w.\ \text{Mary danced in } w$

We want to present 'believe' in (1) as a relation between John and (14). What kind of relationship is this?

3. Hintikka's semantics for attitudes

Let's suppose that in the real world I believe in only one thing, namely, that the Earth is flat, I have no other beliefs. Now if I were presented with a world where the Earth is round and was asked if this could be the actual world, I would say 'no'. And if I were presented with the world where the Earth is flat, I would say, yes, this could be the actual world. Since I have only one belief whatever else going on in a possible world, as long as the Earth is flat in it, I would say 'yes' to it. In some of those worlds the grass is green. In some others the grass is white. This is because I do not have an opinion about the color of the grass.

We can say that all those worlds I said 'yes' to are all compatible with my beliefs. Everything I believe in holds in those worlds. For other things, since I do not have an opinion about them, they will hold in some worlds and will not hold in some others.

We can gather all the worlds I said 'yes' to and put them in one set. This set we will call 'doxastic alternatives'.

(15) Dox(x,w) the set of worlds, where everything x believes in w holds

And here is Hintikka's (Hintikka 1969) semantics for the *belief*-reports: John believes that Mary danced iff 'Mary danced' is true in all worlds compatible with John's beliefs in the world of evaluation (we need this because his beliefs might vary with different worlds).

(16) $[\![\text{John believes that Mary danced}]\!]^{w}= T \text{ iff } \forall w'[w' \in Dox(John, w) \rightarrow \text{Mary danced in } w']$

Now we can give *believe* the following denotation:

(17) $[\![\text{believe}]\!]^{w} = \lambda p_{<st>}.\lambda x.\ \forall w'[w' \in Dox(x, w) \rightarrow p(w')]$

In the literature you will find also some other notation that is used to represent the same idea. Instead of appealing to doxastic alternatives we could say 'worlds compatible with the holders' beliefs'.

(18) $[\![\text{believe}]\!]^{w} = \lambda p_{<st>}.\lambda x.\ \forall w'[w' \text{ is compatible with x's beliefs in w} \rightarrow p(w')]$

People also use this for shortness, where $wR_x w'$ stands for 'w' is compatible with what x believes in w' :

(19) $[\![\text{believe}]\!]^{w} = \lambda p_{<st>}.\lambda x.\ \forall w'[wR_x w' \rightarrow p(w')]$

You will find all these notations in the literature: (17), (18) and (19) say the same thing.

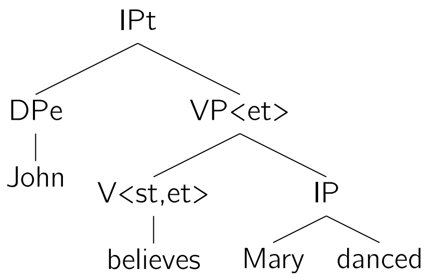
How do we actually compose the meaning of 'believe' and sentence following it? There is a special composition rule for that.

(20) **Intensional Functional Application**

If α is a branching node and $\{\beta,\gamma\}$ are the set of its daughters, then for any world w and assignment g: if $[\![\beta]\!]^{wg}$ is a function whose domain contains $\lambda w.\ [\![\gamma]\!]^{gw}$, then $[\![\alpha]\!]^{wg} = [\![\beta]\!]^{wg}(\lambda w.\ [\![\gamma]\!]^{gw})$

Paraphrase: if you are trying to compose two things, one of which is a function that is looking for an intension of the second thing, just compute this intension.

(21)



4. De re and de dicto

4.1 The movement story

Our current semantics makes the following prediction about the meaning of (22).

(22) Mary believes that one philosopher was dancing.

(23) $[\![(22)]\!]^{w0}$ =T in w_0 iff $\forall w'[w_0 R_{Mary} w' \rightarrow \exists x[\underline{x \text{ is a philosopher in } w'}$ & x was dancing in w']

However, there is a reading of this sentence that is not captured by these truth conditions.

Imagine Mary is at a party and all the people other than Mary are philosophers. Mary does not know about this. She saw a person dancing and the next day she told me that one person was dancing at the party. I know that everyone was a philosopher there and I report Mary's belief as in (22).

The truth conditions in (23) predict that the sentence is false, because it is not the case that in all of Mary's *belief*-words there is a philosopher dancing.

This reading of a DP is called 'transparent', sometimes the term *de re* is used. The truth conditions we want for that are as shown in (24), where the predicate 'philosopher' is evaluated with respect to the actual world w_0.

(24) $[\![(22)]\!]^{w0}$ =T in w_0 iff $\forall w'[w_0 R_{Mary} w' \rightarrow \exists x[\underline{x \text{ is a philosopher in } w_0}$ & x was dancing in w']

The reading of 'one philosopher' in (23) is called 'opaque' and sometimes *de dicto*.

Now how do we actually get (24)? In the system we are working in, the only available option for us is to take 'one philosopher' and move it out or the scope of the intensional verb as shown in (25).

(25) [[one philosopher] [1 Mary believes t_1 that was dancing]
(26) $[\![(22)]\!]^{w0}$ T in w_0 iff $\exists x[x$ is a philosopher in w_0 & $\forall w'[w_0 R_{Mary} w' \rightarrow$ x was dancing in w']

We correctly capture this transparent reading!

4.2 The problems of the movement story

4.2.1 Quantifiers do not like to move out of embedded clauses.

In order to derive the transparent interpretation, we assumed that the movement of a quantificational DP out of the embedded clause is possible. Then we should expect that a DP that appears inside an embedded clause can take scope over a quantificational element in the main clause. The relevant example is given in (27).

(27) Someone believes that every book of John is interesting

The reading we expect is as follows: there is a list of books written by John. One book is liked by Ann. Another one – by Sue. The third one – by Bill. Crucially, there is no one individual that likes all of the books!

The reported judgment is that this reading is not available (May 1977).

Nevertheless, there seems to be no problem with the transparent evaluation in (27): it is possible to construct a scenario where Mary likes one specific series of books and the author listed on the cover page is always different. Unbeknownst to Mary all of these books are written by John (and no other book is written by John).

4.2.2 'Third readings' and scope paradoxes

Third readings

Fodor (1970) discussed examples like (28).

(28) Mary wants to buy an expensive dress.

Fodor observes that sentences like (28) have three readings, which she labels "specific *de re*," "non-specific *de re*," and "non-specific *de dicto*."

(i) "specific *de re*": Mary wants to buy a particular dress which happens to be expensive. She does not know the price of the dress, she shows me this dress at a store window, only I know the dress is expensive.

(ii) "non-specific *de dicto*": Mary likes expensive things. She wants to buy a dress, she does not care which as long as it is expensive.

And there is the so-called **'Third reading'**:

(iii) "non-specific *de re*": Mary is standing in front of a store window and looks are dresses presented there. She wants to buy one of them, she does not care which one; she likes all of them, but does not want to buy more than one. I know that this is a very expensive store and the dresses are actually expensive.

This reading is not captured by the movement story. If we move 'an expensive dress' out of the scope of the intensional verb, we will get the first reading: it would require for Mary to have a specific hat in mind.

(29) [an expensive dress] $\lambda 1$ [Mary wants [PRO to buy t_1]]

If we leave below 'wants' like in (30), we will get the regular de dicto reading: Mary has to have a desire to buy an expensive dress.

(30) [Mary wants [[an expensive dress] $\lambda 1$ PRO to buy t_1]]

What we want is to evaluate the predicate 'expensive dress' in the actual world (transparently), but the quantificational force introduced by 'an' should be below the verb 'wants.

Scope paradoxes

Percus 2000: scope paradoxes with conditionals.

(31) If *every* semanticist owned a villa in Tuscany, there would be no field of semantics at all.

Let's assume that we are making a general statement about semanticists and assume that a person who has a villa in Tuscany has no reason to work and be a semanticist at all.

Let's try to give 'every semanticist' a de dicto interpretation.

(32) In all worlds where for everyone who is semanticist in that world it holds that he owns a villa in Tuscany in that world, there is no field of semantics at all in that world.

That is a contradiction: there cannot be one world where there is no field of semantics, but there are people who are semanticists.

Now, let's try to give 'everyone who is semanticist' a scope out of the conditional.

(33) For everyone who is semanticist in w_0 it holds that: in all worlds where that person owns a villa in Tuscany in that world, there is no field of semantics at all in that world.

That is too strong! Of course, one person leaving the field will not make the field of semantics empty.

What we want here is to keep 'everyone who is semanticist' inside the conditional, but interpret 'who is semanticist' with respect to the actual world.

4.3 The standard solution: overt world variables

- We abandon the IFA rule;
- The interpretation function does not have a world parameter anymore;
- We change the denotation of every predicate in such a way that they are looking to combine with a world variable.

(34) $[\![\text{danced}]\!]^g = [\lambda w.\ \lambda x.\ x \text{ danced in } w]$

(35) $[\![\text{believes}]\!]^g = \lambda w.\ \lambda p_{<st>}.\lambda x.\ \forall w'[wR_x w' \rightarrow p(w')]$

(36) $[\![\text{semanticist}]\!]^g = [\lambda w.\ \lambda x.\ x \text{ is a semanticist in } w]$

- We introduce world variables in syntax and we bind them by lambda abstractors

(37) [1 The semanticist w_1 danced w_1]

  - Then we use our regular rules to compute the meanings of sentences, but we will get intensions as the result.

(38) $[\![(37)]\!]^g = \lambda w.$ the semanticist in w danced in w

This is in the spirit of Cresswell (1990): "natural language has the expressive power of a language with 'explicit quantification over worlds'."

The solution to Percus's example:

(39) [1 [would w_1 [2 every semanticist w_1 owns a villa in Tuscany w_2] [3 there is no field of semantics w_3]]

- ‘every semanticist’ remains inside the ‘if’-clause
- the world variable that comes with the predicate ‘semanticist’ is w_1, it is bound by the matrix abstractor.
- thus, this predicate will be evaluated with respect to the actual world.

The solution to Fodors’s example:

(40) [λ1 Mary wants w_1 [λ2 [an expensive dress w_1] λ3 [PRO to buy w_2 t_3]]

- ‘an expensive dress’ remains inside the embedded clause, so we are not talking about a specific dress
- the world variable that comes with the predicate ‘expensive dress’ is w_1, it is bound by the matrix abstractor.
- thus, this predicate will be evaluated with respect to the actual world (thus, from my speaker’s perspective).

4.4 Restrictions on the world variables

Percus 2000:

(41) Mary thinks that my brother is Canadian.

We predict that the following LF is a possibility:

(42) [1 Mary thinks w_1 [that 2 my brother w_2 is Canadian w_1]

In this LF, ‘my brother’ gets an opaque interpretation: w_2 is bound by the nearest abstractor 2. However, the predicate ‘Canadian’ gets a transparent evaluation the variable w_1 is bound by the matrix abstractor.

What this reading would be:

(43) The sentence is predicted to be true whenever there is some *actual* Canadian who *Mary thinks* is my brother. In reality, this person does not have to be my brother and Mary might mistakenly think that he is American, not Canadian. For instance, the sentence is predicted to be true if Mary thinks that Pierre (the actual Canadian) is my brother and naturally concludes — since she knows that I am American — that Pierre too is American.

This reading is not available. Thus, there is Generalization X:

(44) **Generalization X:**
The situation variable on the main predicate (the verb) must be bound by the nearest abstractor above it.

5. What world variables cannot do.

5.1. De re interpretations of proper names

Quine (1956) observed that an attitude report containing a referential term (say, a proper name), like the one in (45), cannot be captured by a simpleminded semantic analysis. Specifically, Quine argued that the intensional verb *believe* in (45) cannot be represented as a relation between Ralph and the proposition [λw. Ortcutt is a spy in w].

(45) Ralph believes that Ortcutt is a spy.

(46) **The scenario**: Ralph knows Ortcutt under two different guises. Ralph saw Ortcutt several times 'under some questionable circumstances' and decided that the guy was a spy. Later that day Ralph met Ortcutt at the beach, did not recognize him, and decided that he was an important and respectable man and not a spy.

In this scenatio, it has to be the case that both sentences (45) and (47) are true at the same time.

(47) Ralph believes that Ortcutt is not a spy.

However, intuitively it does not seem that Ralph is irrational and that he holds contradictory views. Scenarios like the one described above are called *double-vision scenarios* and reports like (45) and (47) are known as *de re* reports.

This problem cannot be solved with worlds variables because proper name are not sensitive to worlds, they are referential expressions that pick the same object in every world (Kripke 1980)

5.2 Hard cases of third readings

Schwager (2011)

Burj Khalifa:

(48) Mary wants to buy a building with 192 floors.

(49) **The scenario:** Mary is looking at the Burj Khalifa the building in Dubai that has 191 floors. No other currently existing building has more floors that that number. However, Mary doesn't know this. She also doesn't know how many floors Burj Khalifa has. She says, 'Wow, I want to buy a building that's even one floor higher!'

There are two possible LFs that the Standard solution can give to this sentence. In the one given in (50) the DP "building with 192 floors" comes with the world variable that is bound by the embedded lambda abstractor. Schwager rejects this LF because Mary does not know the height of the building. The other option is the LF given in (51), where the world variable on the predicate "building with 192 floors" is bound by the matrix lambda abstractor. This ensures that the predicate is evaluated transparently (with respect to the actual world).

(50) [1 Mary wants in w_1 [2 PRO to buy in w_2 a [building with 192 floors in w_2]]

(51) [1 Mary wants in w_1 [2 PRO to buy in w_2 a [building with 192 floors in w_1]]

The problem with the LF in (51) is that the predicate "building with 192 floors" has an empty set as its extension in the actual world (because no such building exists in the actual world). There will be no worlds where the existential claim holds true, therefore the entire sentence can be true only if the set of Mary's desire-alternatives is empty. (This is due to the properties of the universal quantifier that is involved in the interpretation of the intensional verb "want" that yields true if its restrictor is empty).

Malte's Jacket

(52) Adrian wants to buy a jacket like Malte's.

The context that makes this example problematic is as follows.

(53) **The scenario**: Malte has a green Bench jacket. The attitude holder, Adrian, also wants a green Bench jacket but he does not know what kind of jacket Malte has.

Native speakers of English report that (52) is acceptable in this context.

The reading that (52) has in the context given above is a third reading: Adrian is not specific and what he wants to buy is described from the point of view of the speaker.

Since Adrian does not know what kind of jacket Malte has, evaluating "jacket like Malte's" with respect to Adrian's doxastic alternatives does not give us the right interpretation. However, as (Schwager, 2011) points out, evaluating this predicate with respect to the actual word does not help us either. In order to see this, let us consider the LF in (7), where the world variable on the predicate "jacket like Malte's" is bound by the matrix lambda abstractor.

(54) [1 Adrian wants w_1 [2 PRO to buy-w_2 a [jacket like Malte's-w_1]]]

Interpreting this LF results in the truth-conditions given in (55).

(55) $[\![(22)]\!]^g(w_0)$ =T iff $\forall$w'[w' $\in$Desire-Alt (Adrian, w_0)$\rightarrow\exists$x[x is a jacket like Malte's in w_0 & Adrian buys x in w']

The problem that Schwager notices here is that (55) predicts that, in his desire alternatives, Adrian has to choose from the actual green Bench jackets (under the reasonable assumption that "like" stands for "being of the same type and color"). This does not seem to be right.

Since colors are not essential properties of objects, a jacket can have one color in one world and a different color in another world. The truth conditions in (55) predict that Adrian in his doxastic alternatives will buy a red Bench jacket as long as it is a green Bench jacket in the actual world. Thus, in the case of example (52), the Standard Solution seems to overgenerate.

On the other hand, intuitively, if some jacket happens to be a green Bench jacket in one of Adrian's bouletic alternatives but is a red Bench jacket in the actual world, Adrian should be able to buy this jacket in that alternative world. This, however, is not captured by the truth-conditions in (55). According to (55), Adrian, in his bouletic alternatives, has to be buying one of those jackets that happen to be green Bench jackets in the actual world. Thus, the Standard Solution seems to undergenerate as well as overgenerate at the same time.

We can conclude that the predicted interpretation of the LF given in (54) does not reflect the fact that the sentence in (52) is intuitively true in the given context.

Schwager (2011) argued that the challenging cases discussed above require us to abandon the Standard solution.

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