Propositional attitudes, 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 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 iff Mary danced in w_0

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

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

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

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

Some examples of intensions:

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

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

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

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

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

Question: why do we need the reference to a world at all in the definition of the ‘doxastic alternatives’?

Answer: we need this because x’s beliefs might vary with different worlds!

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.

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

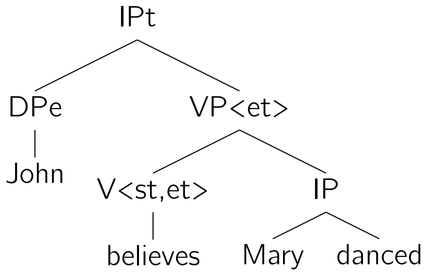
How do we actually compose the meaning of ‘believe’ and sentence following it? There is a special composition rule for that.

(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 and feed it to the function as an argument.

(21)



(22) The application of the rule called IFA

$[\![VP]\!]^{wg}$ = by IFA

$[\![V]\!]^{wg}(\lambda w''.[\![IP]\!]^{w''g})$ = by TN

$\lambda p_{<st>}.\lambda x.\ \forall w'[w' \in Dox(x, w) \rightarrow p(w')]\ (\lambda w''.[\![IP]\!]^{w''g})$ = by the meaning of IP

$\lambda p_{<st>}.\lambda x.\ \forall w'[w' \in Dox(x, w) \rightarrow p(w')]$ ($\lambda w''$. Mary danced in w'') = by lambda conversion

$\lambda x.\ \forall w'[w' \in Dox(x, w) \rightarrow [\lambda w''$. Mary danced in $w''](w')]$ = by lambda conversion

$\lambda x.\ \forall w'[w' \in Dox(x, w) \rightarrow$ Mary danced in $w']$

4. De re and de dicto

4.1 The movement story

Our current semantics makes the following prediction about the meaning of (23).

(23) Mary believes one philosopher was dancing.

(24) $[\![(23)]\!]^{w0}$ =T iff $\forall w'[w' \in Dox(Mary, w_0) \rightarrow \exists x[$<u>x is a philosopher in w'</u> & 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 (23).

The truth conditions in (24) 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. We want the predicate 'philosopher' to be evaluated with respect to the actual world w_0.

The reading of 'one philosopher' in (24) is called 'opaque' and sometimes *de dicto*.

Now how do we actually get the transparent reading?

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 was dancing]]

(26) $[\![(25)]\!]^{w0}$ T iff $\exists$x[x is a philosopher in w_0 & $\forall$w'[w'$\in$Dox(Mary, w_0) $\rightarrow$ 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.

To derive the transparent interpretation, we assumed that the movement of a quantificational DP out of the embedded clause is possible.

We know that in general quantifier movement can lead to a difference in the meaning.

(27) Someone read every book of John.

Reading 1: someone> every book

One person read all John's books.

Reading 2: every book> someone

A potentially different person read every book John wrote (Ann read Book 1, Bill read Book 2, Carl read Book 3 etc)

In the transparent reading is indeed derived via movement of the QP from the embedded clause, 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 (28).

(28) **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. Ann thinks that Book 1 is interesting, Bill thinks that Book 2 is interesting, Carl thinks that Book 3 is interesting

Crucially, there is no one individual that found all of the books interesting!

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

Nevertheless, there seems to be no problem with the transparent evaluation in (28): 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 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 (29).

(29) Mary wants to buy an expensive dress.

Fodor observes that sentences like (29) 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 we consider here. 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.

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

If we leave below 'wants' like in (31), we will get the regular de dicto reading: Mary has to have a desire to buy an expensive dress.

(31) [Mary wants [[an expensive dress] 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) discusses scope paradoxes with conditionals. We will use the example from (Keshet 2011) to illustrate the same point.

We did not discuss the semantics of conditionals in this class, here we will introduce it informally for you to be able to appreciate the argument.

(32) If John were here, the party would be fun.

The standard analysis assumes that such sentences involve quantification over possible worlds, this quantification is introduced by a modal, in this case it is 'would' (Lewis (1975) and Kratzer (1981, 1991). This meaning can be represented very roughly as follows:

(33) In all worlds w (similar enough to w_0), where John is here, the party is fun.

A conditional clause invites us to look at all the worlds alternative to the actual world, where the content of the 'if'-clause holds. The whole sentence says that in those worlds, the consequent ('the party is fun') also holds.

The first observation: things cannot move from an 'if'-clause:

(34) John will be happy if everyone gives him a present.
(35) *What will John be happy if everyone gives him?

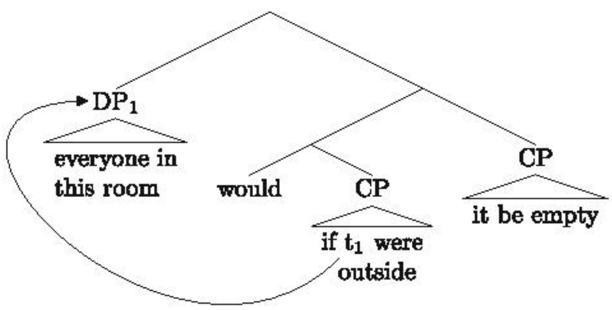
Now we are ready to look at the argument against the movement theory of transparent readings.

(36) If everyone in this room were outside, the room would be empty.

Interpreting 'everyone in this room' with respect to the same situation as the predicate 'outside' makes the content of the 'if'-clause contradictory: we are invited to look at worlds where 'everyone in this room is outside'.

Relaxing the movement requirement does not help:

(37)



Predicted meaning:

(38) Every individual in this room is such that if she were outside, this room would be empty.

Of course, this is not what the sentence actually means: it is not true that if just one individual leaves, the room would be empty!

We need: the absence of the totality of people will make the room empty. We want to consider the possible scenarios where everyone who is **actually** in this room is outside.

(39) In all the worlds w' similar enough to w_0 such that **everyone in this room in $\mathbf{w_0}$** is outside in w', the room is empty in w'.

"Everyone in this room" takes scope below "would", but the predicate "ones in this room" is evaluated relative 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.

(40) $[\![\text{danced}]\!]^g = [\lambda w.\ \lambda x.\ x \text{ danced in } w]$
(41) $[\![\text{believes}]\!]^g = \lambda w.\ \lambda p_{<st>}.\lambda x.\ \forall w'[wR_x w' \rightarrow p(w')]$
(42) $[\![\text{semanticist}]\!]^g = [\lambda w.\ \lambda x.\ x \text{ is a semanticist in } w]$

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

(43) [1 [The semanticist w_1] danced w_1]

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

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

Note that the output of this system is a proposition and not the truth value. We can apply w_0 the actual world post-syntactically or we can make the LFs more complex and add a pronoun referring to the actual world at the top of the tree.

The solution to Percus' puzzle with conditionals:

(45) [**1** [[would $\mathbf{w_1}$ [2 every one $\mathbf{w_1}$ is outside w_2]] [3 the room is empy w_3]]]

- 'everyone' remains inside the 'if'-clause
- the world variable that comes with the predicate 'one' is w_1, it is bound by the matrix

abstractor.
- thus, this predicate will be evaluated with respect to the actual world.

The resulting proposition:

(46) $[\![(45)]\!]^g$ = **λw**. in all the worlds w' similar enough to w such that **everyone in this room in w** is outside in w', the room is empty in w'

If we apply w_0 as the argument to this proposition:

(47) $[\![(45)]\!]^g(w_0)$ = T iff in all the worlds w' similar enough to w_0 such that **everyone in this room in w_0** is outside in w', the room is empty in w'

The solution to Fodors's example:

(48) [1 Mary wants w_1 [2 [an expensive dress w_1] 3 [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).

(49) $[\![(48)]\!]^g(w_0)$ = T iff $\forall$w'[w'$\in$Desire(Mary, w_0) $\rightarrow$ $\exists$x[x is an expensive dress in w_0 & Mary buys x in w']

Introducing the world variable in syntax allows us to capture the intensional independence of DPs: the predicate inside of them does not have to be interpreted with respect to the same world with respect to which the main predicate is evaluated.

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

4.4 Restrictions on the world variables

Percus 2000:

(50) Mary thinks that my brother is Canadian.

We predict that the following LF is a possibility:

(51) [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 true in the following scenario:

(52) 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 the speaker is American — that Pierre too is American.

This reading is not available. **The world variable system overgenerates!**

Thus, there is Generalization X.

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

Another restriction on the world pronouns:

Intersective Predicate Generalization (Keshet 2008): Any two intersectively interpreted predicates have to be evaluated relative to the same situation (or the same time and world).

(54) #In 1964, every U.S. senator at Harvard got straight A's.

(55) #Mary thinks the married bachelor is confused.

(The example in (54) concerns the temporal independence of DPs Enç 1981: Every fugitive is in jail. Sometimes these cases are treated together with the cases of intensional independence)

5. Searching for the solution for the overgeneration problem.

There have been two types of solutions to this problem. One influential idea is to reconsider the movement story.

Another idea is to propose that the world variables only occur with DPs and not with every predicate.

5.1 The new movement theory

There are various proposal reviving the movement idea. To solve the existing problems with the movement theory we discussed above, these new theories propose that the movement required for the transparent reading is much more local than what was standardly assumed. (Keshet 2011, Elliott 2023).

We will briefly look at the influential proposal by Keshet (2011) called 'Split intensionality'

Keshet's proposal:

- There are no world variables, the interpretation function comes with the world parameter.

- Every intensional operator (such as propositional verbs 'thinks') comes with an operator ^ (after the ''up'' operator in Montague 1970) that sits below it in the LF. This operator shifts the type of its sister from extensional to intensional.

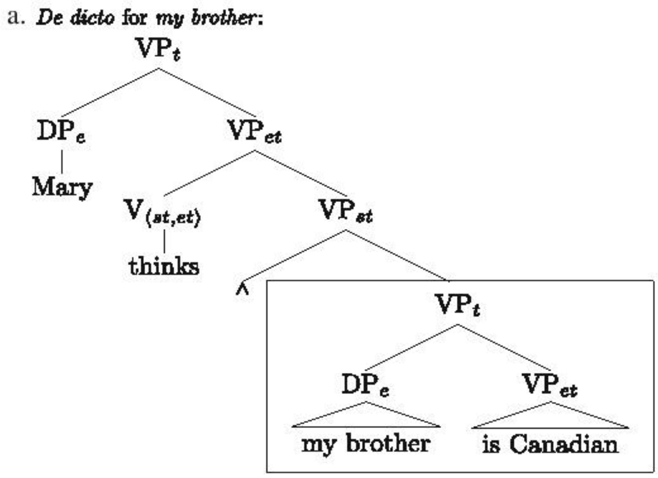
- We need a new interpretation rule to know how to interpret structures with this operator:

(56) **Intensional Abstraction:** if α is a branching node and {β, γ} is the set of its daughters, where β dominates only an ^ operator, then, for any situations s and variable assignment g $[\![\alpha]\!]^{w,g} = \lambda w' \in D_s.\ [\![\gamma]\!]^{w', g}$.

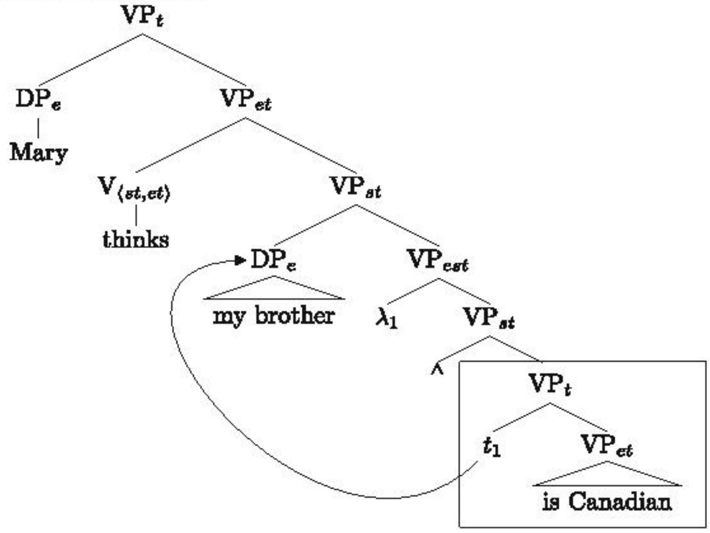
This operator basically is doing the job of the IFA rule (Intensional Functional Application) (the rule that allows to compose an operator that requires an argument of an intensional type with an argument of an extensional type by type-shifting the type of this argument from an extension to an intension).

The difference is that this operator is in syntax and in order to get a de re reading a DP must move out of the scope of this operator.

(57) Mary thinks my brother is Canadian.



b. *De re* for *my brother*:



Note that the movement is very local and we do not need to move 'my brother' out of the scope of the intensional verb 'thinks'.

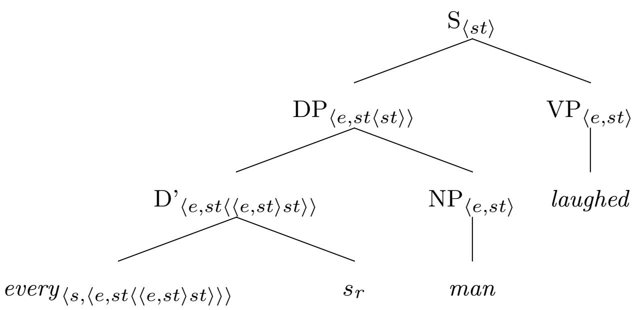
The reason why 'Canadian' cannot get the transparent reading is that main predicates do not move.

5.2 Restrictions on the position of the world variables

Schwarz 2012 argues that we still need world variables, however, they do not occur with every predicate. They are only introduced by (some) determiners.

He uses situation rather than world variables, but it is not crucial for our purposes. Situations are spatio-temporal parts of possible worlds (Kratzer 2007).

(58)



(59) $[\![\text{laughed}]\!]^g = \lambda x.\ \lambda s.$ x laughed in s

(60) $[\![\text{man}]\!]^g = \lambda x.\ \lambda s.$ x is a man in s

(61) $[\![\text{every}]\!]^g = \lambda s.\lambda Q_{<e,st>}.\lambda P_{<e,st>}.\lambda s'.\ \forall x[Q(x)(s) \rightarrow P(x)(s')]$

(62) $[\![\text{a}]\!]^g = \lambda s.\lambda Q_{<e,st>}.\lambda P_{<e,st>}.\lambda s'.\ \exists x[Q(x)(s)\ \&\ P(x)(s')]$

As a consequence of this, a DP is always intentionally independent of the situation with respect to which the main predicate is evaluated.

A special operator Σ is introduced at LFs to generate the transparent interpretations.

(63) John thinks a professor danced.

(64) LF: [John thinks [Σ_1 [a s_1 professor] danced]]

(65) $[\![\Sigma_n\ \varphi]\!]^g = \lambda s' [\![\varphi]\!]^{g[n\text{->}s']}(s')$
(66) $[\![\ [\Sigma_1$ [a s_1 professor] danced] $]\!]^g = \lambda s'. \exists x$[x is a professor in s' & x danced in s']

This theory captures:

- **Generalization X**
  Only DPs carry worlds/situation variables
- **The intersective predicate generalization:** All NPs inside one DP much be interpreted with respect to the same situation! (# 'the unmarried bachelor is confused')

6. Hard cases of third readings
Schwager (2011)

Burj Khalifa:

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

(68) **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 (69) 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 (70), 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).

(69) [1 Mary wants in w_1 [2 PRO to buy in w_2 a [building with 192 floors in w_2]]

(70) [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 (70) 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).

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

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