

Accessible Referents in “Opaque” Belief Contexts

① Problem(s), proposal, framework

- **Problem(s) (for possible-worlds semantics) discussed:** accessible ref’s in “opaque” context
 - “Hob-Nob sentences” (referential dependence between different people’s believes) →③
 - Benz’s (2000) puzzle concerning common ground →④
 - modal anchoring (Farkas 1993, Roberts 1996:243) →⑤
 - “Huitink’s paradox” (Zeevat 2005:547) →⑥
 - strange cases of (mis)understanding (Alberti 2005b,d) →⑦²
- **Essence of our proposal:** context of interpretation (instead of the consistent model of a pos. world): truth-conditionally heterogeneous (multi-layered) information state (similar to Zeevat (2005))
- **Framework:** ReALIS →②, to be understood as a “psychological extension” of Kamp’s DRT →②

② Theoretical background

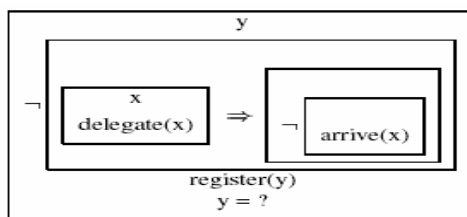
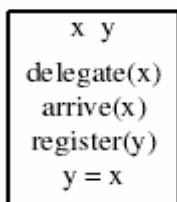
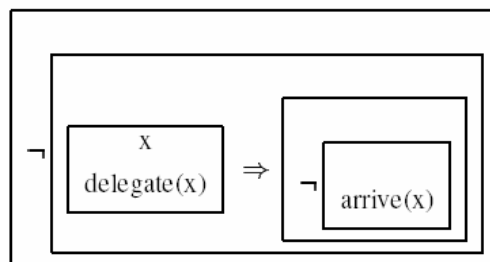
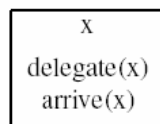
2.1. A “chain” from sentence-level model-theoretical semantics to ReALIS

- Montague’s Grammar (Dowty et al. 1981)
- Karttunen’s (1976) theory of discourse referents
- the Kamp-Heim Theory (Kamp 1981, Heim 1982) and different versions of Kamp and his colleagues’ representationalist dynamic discourse-semantics (DRT) (e.g. 2004);
- alternative representationalist dynamic semantics such as
 - Asher and Lascarides’s (e.g. 1993:438) Segmented DRT, based on a logic that “provides a suitable system of inference for modelling the interactions between the Gricean pragmatic maxims and the world knowledge used to calculate temporal [and spatial and rhetorical] structure during interpretations”
 - LDRT (Alberti 2000), whose decisive feature is its interpreter-based “lifelong” perspective
 - ReALIS: a “REciprocal” And “Lifelong” Interpretation System →②, →● App.2

2.2. Innovations of DRT

(1) “Logical” equivalence?

- a. *A delegate arrived.* $\exists x\Phi$
- b. *It is not the case that every delegate failed to arrive.* $\neg\forall x\neg\Phi$
- c. $\exists x\Phi \Leftrightarrow \neg\forall x\neg\Phi$
- d. *She registered*
- e. ^{OK} [(1a) + (1d)]
- f. * [(1b) + (1d)]
- g. Representations of (1a) / (1b) in DRT: →
- h. Contribution of (1d):
 $\langle \{y\} \{ \text{registered}(y), y=? \} \rangle$
- i. $y = x$: x is *accessible* from y in (1e), but not in (1k) (“up” & “to the left” in the “box hierarchy”):

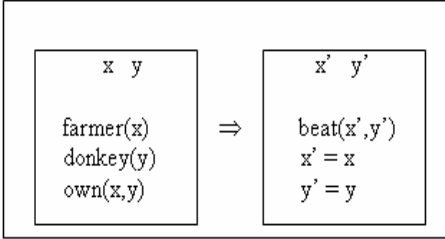
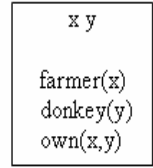


¹ I am grateful to Hungarian National Scientific Research Fund (OTKA T038386) for their contribution to all my costs in connection with my participation in ESSLI 05 (Edinburgh).

² Parts of another handout (● Alberti 2005d) are also relied on: e.g. →②, →● References.

(2) Illustration of the “chameleonic quantificational import (existential / universal)” of NPs

- a. A farmer owns a donkey.
 $\exists x \exists y [\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x,y)]$
- b. If a farmer owns a donkey, he beats it.
 $\forall x \forall y [(\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x,y)) \rightarrow \text{beat}(x,y)]$
- b'. The “compositional” formula, which is wrong:
 $\exists x \exists y [\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x,y)] \rightarrow \text{beat}(x,y)$
- c. Every farmer who owns a donkey beats it.
 $\forall x \forall y [(\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x,y)) \rightarrow \text{beat}(x,y)]$
- d. Every donkey owned by a farmer is beaten by him.
 $\forall x \forall y [(\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ \text{own}(x,y)) \rightarrow \text{beat}(x,y)]$
- e. The common DRS expressing the information content of sentences in (2b,c,d):



2.3. Pros and cons of a “psychological extension” of DRT (Kamp et al. 2004)

“[t]here is a natural connection between DRT and the description of propositional attitudes, such as belief, desire or intention. ... Interpretation of an assertion one hears or reads takes the form of constructing a DRS for it. One way to think of this DRS is as a structure which the interpreter forms in his mind and which for him identifies the content of the interpreted statement.”

Because of “the conviction that linguistics should stay clear from assumptions about what goes on in the heads of speakers or hearers”, DRT is cautious about regarding DRSs (‘discourse representation structures’) as structures which the interpreter forms in his mind (Kamp et al. 2004: 5.1),

despite that

“[a]ccording to DRT the anaphoric connection between pronoun and NP α can be established by identifying the discourse referent for the pronoun with the one for α . It is tempting to think that this account of what goes on in establishing indefinite-pronoun links tells us something about how the content of interpreted sentences is represented in the interpreter’s mind: the indefinite α does give rise, at the level of mental representation, to the introduction of an entity representation (corresponding to the discourse referent for α) and this representation can then serve, just as could in principle any other entity representation in the mind of the interpreter, as an antecedent for anaphoric NPs occurring in sentences that are to be interpreted subsequently.” “The fact that cross-sentential anaphora works in the way the theory predicts ..., and that the theory gives such an apparently simple account for it, was one reason for thinking that DRSs capture some genuine aspect of the way in which the mind represents mental content. A further early reason for thinking this was the observation, due to Partee, that pronominal anaphora is sensitive to the form of the preceding sentence, and not just to its “propositional” (i.e. intensional) content [see also (1) in 2.2]: *It is under the sofa* can be understood as a statement about the missing marble when it follows *One of the ten marbles is not in the bag*, but not when it follows the propositionally equivalent *Nine of the ten marbles are in the bag*. ... This distinction is also captured effortlessly by DRT, and it is one which seems to go directly against the fundamental assumptions about semantic content that were dominant within formal semantics at the time [in the 80’s].”

Conclusion: a non-psychological “core DRT” should be separated explicitly from an extension of DRT, in which DRSs are used to identify mental representations of content → **ReALIS as an ext’d DRT**

③ Hob's witch and Nob's witch

The problem that arises in the case of the famous “Hob-Nob sentence(s)”:

Kamp et al. (2004: 5.4): “Geach [1962] pointed out that this sentence could be used truthfully in a report composed by a journalist describing the goings-on in some remote rural backwater, even if the journalist herself is persuaded that witches do not exist. This is a problem for the application of standard logical notation to the representation of truth-conditional content. For in order that the pronoun *she* in the belief attribution to Nob be bound by the “existential quantifier” *a witch* in the belief attribution to Hob, this quantifier would have to take scope over the two belief attributions. But this would, on the standard interpretation of quantification theory, imply that there are witches in the world in which Hob, Nob and the journalist live. That is something to which the journalist would under no conditions want to commit herself. And it is something to which ... [1a] does not commit her.”

Roberts (1996:237): “the problem of intensional identity in [Hob-Nob examples] ... reduces to the more general problem of *intensional identity*, i.e. identity across possible worlds. Such an approach, of course, encounters difficult problems in attempting to specify what it is for two individuals to believe in the existence of the same, possibly mythical entity (see Lewis (1986) and the references therein).”

ReALIS: simply avoids this serious philosophical question by dispensing with “possible worlds”: the worldlets with different reality labels of different interpreters will serve as the “actually possible” “possible worlds” —which have ever been regarded as *possible* by an interpreter at least to the extent of a speculative experiment — in the course of a special generalization of truth-conditional interpretation ($\rightarrow \textcircled{4}$, $\rightarrow \bullet$ App.2), which enables us to compare the content of two arbitrary worldlets.

(3) Illustration of the referential dependence of representations of different (persons') attitudes

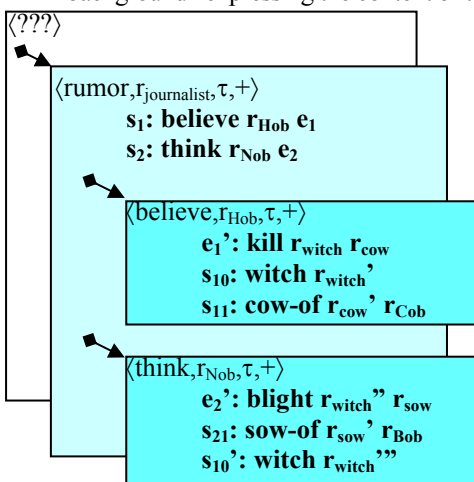
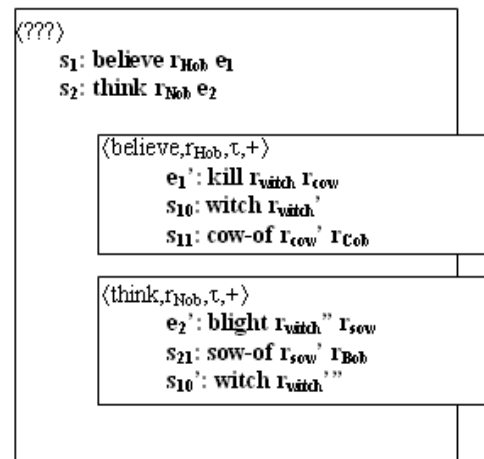
a. *Hob believes that a witch has killed Cob's cow and Nob thinks that SHE has blighted Bob's sow.*

b. The question in ReALIS: is r_{witch} ' (Hob's witch's ref.) accessible from the position of r_{witch} ''?

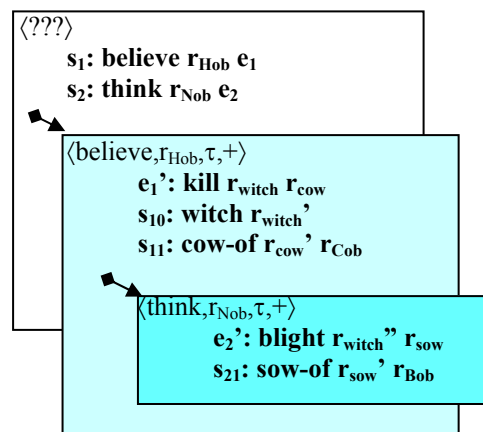
c. The answer is *no* in an *underspecified* phase of representation (to be developed then by accommodation-like steps): \rightarrow

d. *Specified* ReALIS-style representations of the relevant part of an interpreter's information state in the case of the “Hob-Nob sentence” in (3a): $\leftarrow(3d^*)$ vs. $(3d^{**})\downarrow$

Cf. Zeevat (2005: p549): “Now the literature contains many explanations... Hob may have told Nob about his belief [$\rightarrow(3d^{**})$], there may be a rumour in the village about a witch that has played a causal role in the formation of Hob's and Nob's beliefs [$\rightarrow(3d^*)$], there may have been an article in the local newspaper that Hob and Nob have each read [$\rightarrow(3d^*)$].” What is represented by $(3d^*)$ in the framework of ReALIS would be paraphrased by Zeevat (2005: p540) as follows: Nob's relevant belief is *over* Hob's belief. In the other case, the two belief states are both *over* a certain “background” expressing the content of the rumor / the article.



accessibility: $r_{\text{witch}}' = r_{\text{witch}}''$, $r_{\text{witch}}'' = r_{\text{witch}}'''$



$r_{\text{witch}}'' = r_{\text{witch}}'''$

④ Benz’s (2000) puzzle concerning common ground

The problem: in phase (4a.6) of the story below both interlocutors know about *two* young girls attacked by a dog; how can be known then that the singular definite NP *the young girl* unambiguously refers to Melanie?

- NAIVE APPROACH: intersection of i’s and s’s information states (see the problem above)
- BENZ’S (2000) PROPOSAL: their *shared* DRS in a multi-agent system³ (created in (4a.3), see (4b))
- REALIS: (asymmetrical) internal worlds with fictive worldlets

The problem with Benz’s proposal (at least as it is described in his short 2000 *GötaLog* paper): His representation of the common ground is too “symmetrical”, which implies empirical problems in (4c):⁴

- the sentence in question is less felicitous in (4)a.6’ than in (4)a.6; it is *misleading* in (4)a.6’
- its *thus* version will make the modified story felicitous whilst its use is excluded in the original story

For in Benz’s approach, the common ground shared by Chris and Bob is still to be represented as in (4b).

(4) Illustration of interpreters’ common ground

a. Benz’s (2000:182) story on two young girls bitten by a dangerous Doberman:

1. At 7:00 am **Anna** and **Debra** see how a Doberman bites the young girl Melanie.
2. **Anna** must leave Debra with the girl. Therefore she can’t see that the dog again attacks and bites another girl, Stefanie, some minutes later.
3. Then **Anna** meets **Bob** and **Chris** and tells them that she has seen how a Doberman attacked a young girl.
4. The next day, **Debra** meets **Bob**, and she tells him that the dog attacked also another young girl.
5. Later, she [**Debra**] meets also **Chris** and tells him the same.
6. **Chris**, who does not know that Bob knows already the whole story, meets **Bob** again and says to him: “*THE YOUNG GIRL* was not the only one who was attacked by the dangerous Doberman.”
- 6’. She also mentions that she has already told Bob the whole story. ~~Chris, who does not know that Bob knows already the whole story,~~ meets **Bob** again and says to him: “*The young girl* (thus) was not the only one who was attacked by the dangerous Doberman.”

b. The local state of Bob, according to Benz (2000:184), “after his talk with Debra [see phase a.4 above]. The first column represents his total knowledge about the biting situation, the second his protocol for what he heard in common with Anne and Chris, and the third for what he has in common with Debra.”:

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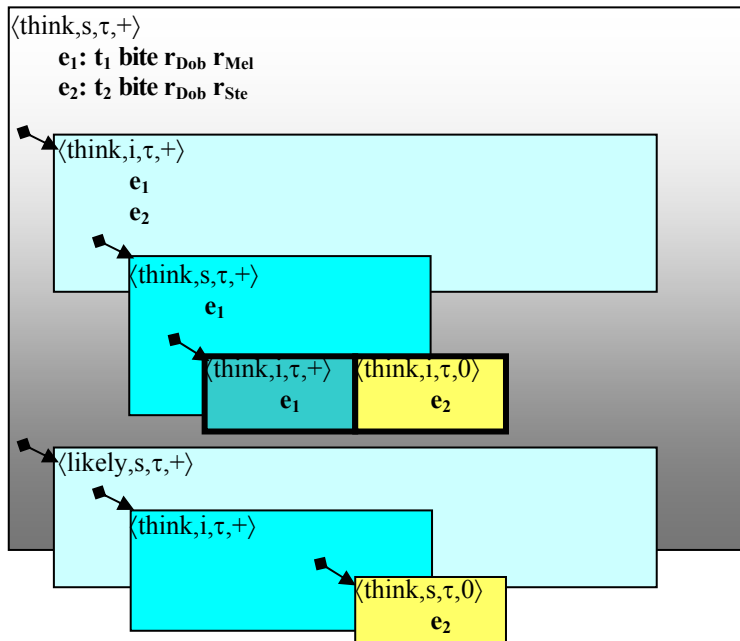
³ Benz (2000) has proposed a *multi-agent system* (Fagin et al. 1995) which is DRT-based (see also Dekker 1997).

Benz’s (2000:181) central problems are to “provide a description of how the iterated specific use of an indefinite NP [and then coreferential definite ones] can lead to the establishment of referential chains across dialogues and dialogue participants..., ... how they introduce discourse referents, how they are related to the common ground, and how this common ground can be represented by the dialogue participants.”

Benz (2000:183) claims that “the general apparatus for multi-agent system provides us with a natural representation of the mutual information of dialogue participants. But in view of our problem to explain the anaphoric referential use of a definite description we need a representation which provides us more directly with information about which subjects with which properties are common. For this reason we introduce the notion a *common DRS*.” The DRS in the second column in (4)b is a *maximal common DRS* for the group consisting of Anne, Bob and Chris. Benz (2000:183) argues, further, that “the uniqueness condition for the referential anaphoric use of a definite description is sensitive to the number of discourse referents in the maximal common DRSs. ... But how can the participants have access to this DRS? The most intuitive way seems to be that they keep track of the discourse referents which have been introduced to each group, and about the properties of those referents. I.e. a participant will not only update his own DRS, if he gets some new information, but he will also update a DRS representing the knowledge of the group which *commonly* got this information.”

⁴ Chris is supposed to have come to know from Debra after phase a.5 of the story that Bob also knows about both attacks.

c. The ideal speaker’s relevant input knowledge before (4)a.6’ in (4)a1-5+6’.⁵



The proposal in ReALIS: we should be able to attribute a “strategy” to the speaker legitimizing the sentence in question in (4a.6’):

- *primary strategy:* s knows about both young girls attacked → provides no legitimacy
- *secondary strategy:* i knows about both young girls attacked, s knows → provides legitimacy to *thus* ✓
- *tertiary strategy:* s knows about only the first young girl attacked, at least s *may* assume this about i’s knowledge on s → provides some legitimacy to the single definite NP *the young girl*
- *fourth-level strategy:* i knows about only the first young girl attacked, at least s can be sure that i thinks that s assumes this concerning s’s knowledge on i → provides legitimacy to the single def. NP ✓

THESIS ON INCONSISTENT MODELS OF INTERPRETATION (ThIMI):

In certain cases a sentence, or an *anaphorically coherent* bigger unit of text, is to be interpreted in a *truth-conditionally heterogeneous* (multi-layered) information state (where the layers are permitted to contain *conflicting* pieces of information); so the model of interpretation can be regarded as *inconsistent* in the sense above.

Example: according to the fourth-level, but not the second-level, strategy, there is only one girl attacked, whilst legitimizing the *thus* version of the given sentence requires these conflicting assumptions simultaneously.

Example 2 (→the “Hob-Nob” sentence in (3a)): according to a certain reading it is to be considered simultaneously that there exists a witch and no witches exist.

A comment on belief revision: it is carried out, in ReALIS, by *dynamic interpretation*; the interpreter is assumed to simultaneously develop (and modify) the content of more of his/her internal world-lets in the course of interpreting discourses from sentence to sentence: e.g.

- “what does s know (or at least intend to convey)?”
- “what has s known about the relevant part of i’s knowledge?”
- “what does s know, now (after parsing a sentence), about the relevant part of i’s knowledge?”
- “what has s known particularly about i’s knowledge on s’s knowledge?”
- ...

⁵ The ideal *interpreter’s* relevant input knowledge before(4)a.6’ is the same as that before (4)a.6, because Bob’s relevant conversations are precisely the same as in the original story.

⑤ Modal anchoring

The problem: “a noun phrase [*the castle*] is modally subordinated to a constituent occurring in previous discourse, while the sentence the noun phrase is part of is not modally subordinated” (Farkas (1993), quoted by Roberts (1996:243)). This contradictory case means a serious problem to semantic theories based on the elimination of possible worlds, as different parts of the sentence in question would require distinct ways of eliminating possible worlds.

The second sentences in (5a) and (5d) are excellent illustrations of THIMI:

- r’ is a castle whilst r” is an oak tree
- the sources of conflicting pieces of information to be allowed for simultaneously:
 - (5a): Mary’s (earlier) belief – s’s observation
 - (5d): s’s earlier belief – s’s current observation (see the function of “...”)

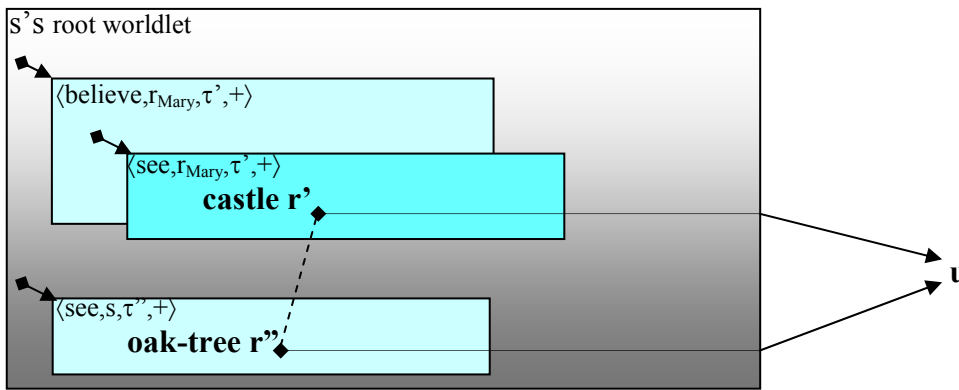
Our analysis: see (5b,c,e,f) below (based on the possibility of representing “inconsistent models”)

(5) Illustration of modal anchoring (Farkas 1993, Roberts 1996:243)

a. *Mary thought that there was a castle behind the trees.*

THE CASTLE turned out to be a huge oak tree.

b. The relevant part of the {e,t}-reduced representation of the speaker’s information state:

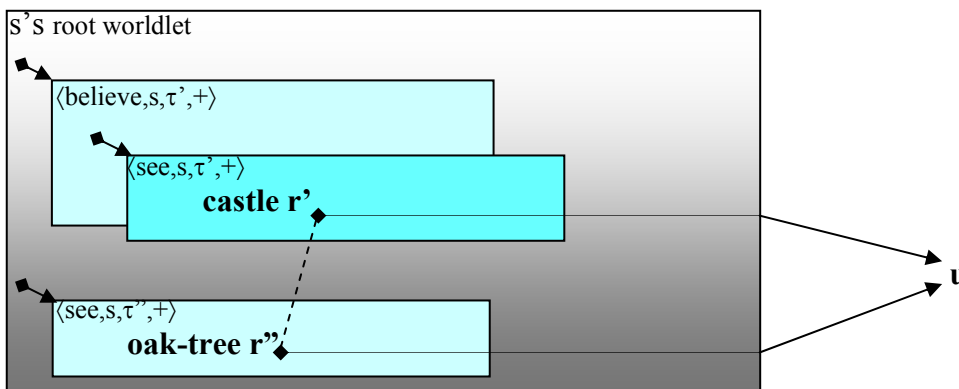


c. “co-anchoring”: $\alpha r'' = \alpha r'$ → (a kind of accommodation) $r'' = r'$

d. *I thought that there was a castle behind the trees.*

But a bit later “**THE CASTLE**” turned out to be a huge oak tree.

e. The relevant part of the {e,t}-reduced representation of the speaker’s information state:



f. “co-anchoring”: $\alpha r'' = \alpha r'$ → (a kind of accommodation) $r'' = r'$

g. Another illustration (due to J. Kleiber p.c.) of successful reference by means of a false piece of information: *A man arrives at a motel in the company of a girl who is not his wife at all in a country where the porter (who, what’s more, is likely to know the girl well...) ought to prevent them, lawfully, to live in the same room. This is against his financial interest, however. Hence, the girl in question will be referred to as the guest’s wife by both the guest himself and the porter in spite of the fact that neither thinks this “presupposition” to be true and, moreover, neither thinks that the other considers it to be true either.*

⑥ “Huitink’s paradox”

The problem: anaphorical coherence due to *again* vs. conflicting information on pizza dinners:

“Conventional wisdom has it that *again* presupposes another event of the same kind as the one described in the clause in which *again* occurs which happened before it. In this case it is an event of the kind ‘I eat pizza’ and the antecedent is clear: it is me having pizza with you yesterday evening. The problem is where my two pizza dinners precede one another. There are two subDRSs where this might happen: Mary’s desires (or her beliefs) and the common ground between me and you. The first context does not contain yesterday’s pizza eating, since Mary does not know about it or want it. The second context does not contain my pizza eating with Mary, because you and me agree it is not going to happen. So neither of them can have a condition to the effect that $e < e_0$. And there is no other subDRS where a condition of this kind may be inserted.” Zeevat (2005:547)

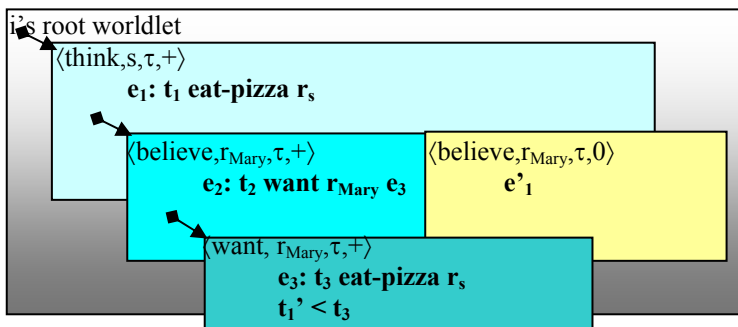
Zeevat’s proposal: “On the context notion that I have been developing in this paper, there is no problem. The relevant context is ... [(6d)]. It contains both pizza eatings and (desire is future oriented) entails that yesterday’s pizza is before the pizza with Mary.”

(6) Illustration of “Huitink’s paradox” (Zeevat 2005:547)

a. *Mary wants me to eat pizza AGAIN.*

The reading intended by Zeevat: “I say [(6a)] to you in a context where Mary is unaware of the fact that you and me had pizza yesterday. Mary and me agreed to meet soon, but I am not so fond of pizza that I will agree to her plan of going for some more of it when we meet. And you know all of this.”⁶

b. The relevant part of the representation of the interpreter’s information state:



c. Due to accessibility: $t_1' = t_1$, and *again* is legitimate (cf. e_3, e_1)

d. The relevant context according to Zeevat (2005):

‘Mary’s desires *over* Mary’s beliefs *over* the interlocutors’ common ground’

⑦ (Mis)understanding each other

→ **3** Alberti (2005d): the response of interpreter k in (1g) can be accounted for on the basis of the “inconsistent model” of his relevant knowledge on Joe’s boss’s wife and Joe’s beliefs on his boss’s wife.

→ **4** Alberti (2005b), (48c) in 5.1.2: an analysis of the co-operation of actors and stunt men in films: see **4** App.

5 Conclusion

The model of *information state* offered by ReALIS can be regarded as a realization of what Zeevat (2005) writes about in his article aiming at “...a non-technical account of accessibility that generalises to belief contexts, counterfactuals, negations and corrections” (p550). He says: “I would still welcome a less syntactic approach to my *over* –operation” – and that is just what ReALIS offers.⁷

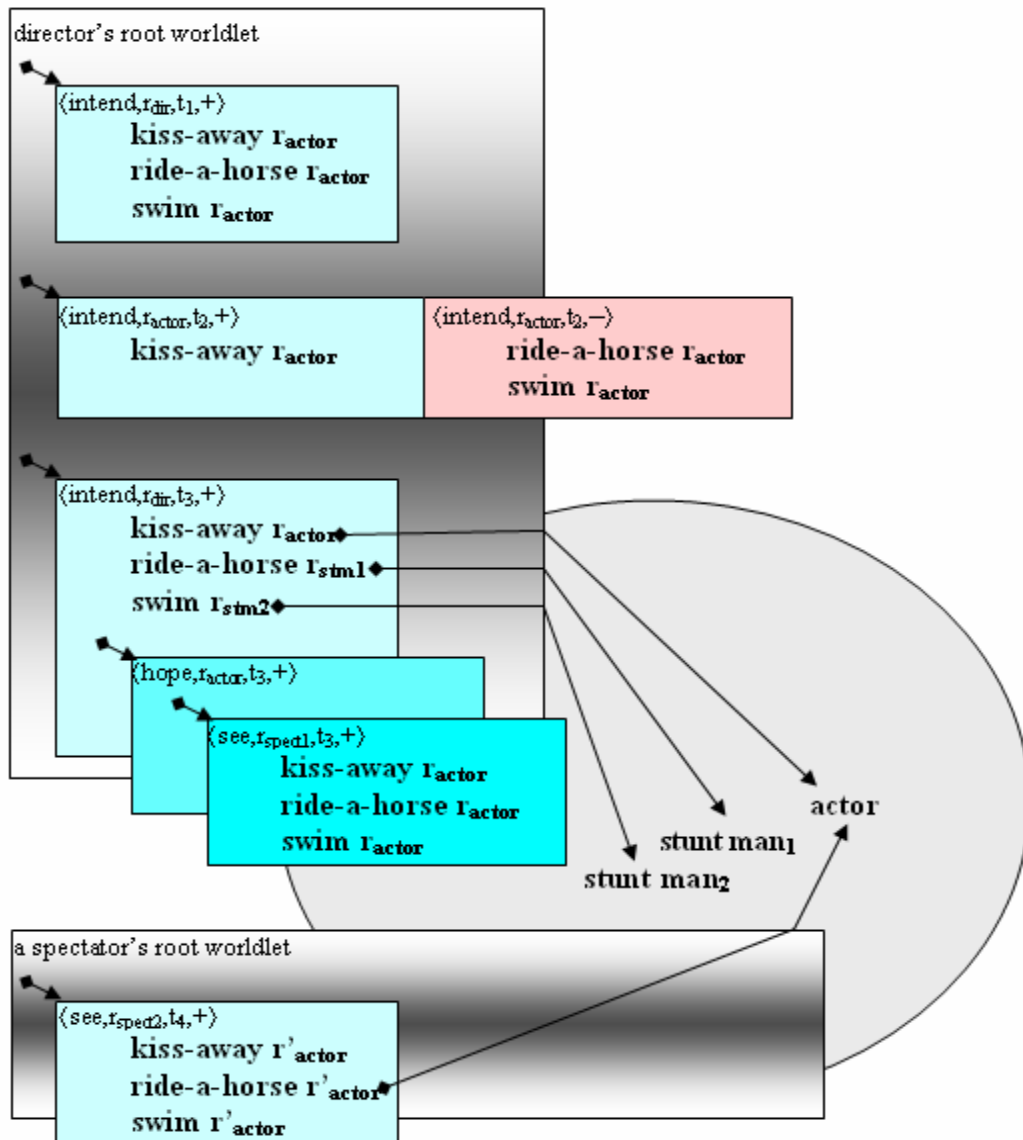
⁶ There is obviously a less problematic reading (according to which Mary’s will is based on her belief): Mary believes that I had pizza yesterday, but this fact does not avoid her to want me to eat pizza again, with her. It is often held that plans and intentions rely on beliefs (and not necessarily on reality): e.g. *John believes that Mary is coming, and he wants Susan to come TOO* (Karttunen 1974, Roberts 1996).

⁷ “...information states may have a [recursive (see p544)] foreground-background division” in connection with the fact that “secondary contexts conflicting with the primary context can be brought in by negations, modal statements, belief reports, plans and others” (p539). ... “My main conclusion is that the concept of a context of interpretation as a simple information state (with internal structure) can be maintained and that it is helpful not to give up on this intuitive conception in favour of unintuitive mathematical constructions.

References: ● References + items below

- Alberti, G. 2005d: Generalized Truth-Conditional Interpretation in ReAL Interpretation System, talk at the 9th *International Pragmatics Conference*, Riva del Garda, 10-15 July 2005.
- Dekker, P. 1997: On First Order Information Exchange, *MunDial'97*, CIS LN 106, München, 21–39
- Fagin, R. – J.Y. Halpern – Y. Moses – M.Y. Vardi 1995: *Reasoning about Knowledge*, Cambridge: MIT
- Farkas, D. 1993: *Modal Anchoring and Noun Phrase Scope*, ms., Univ. of California at Santa Cruz.
- Geach, P. T. 1962: *Reference and Generality: An Examination of Some Medieval and Modern Theories*, Cornell Univ. Press, Ithaca
- Heim, I. 1982: *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. thesis, University of Massachusetts, Amherst, published in 1989 by Garland, New York.
- Karttunen, L. 1974: Presuppositions and Linguistic Context, *Theoretical Linguistics* 1, 181–194.
- Lewis, D. 1986: *On the Plurality of Worlds*, Oxford: Blackwell.
- Roberts, C. 1996: Anaphora in Intensional Contexts, in *Hb. Cont. Semantic Th.*, Oxford: Blackwell, 215–246.

Appendix: how stunt men can mediate directors' genuine intentions to spectators



To my surprise, non-monotonicity is not much an extra complication. ... I do not see it as my mission in life to come up with a new semantics for counterfactuals, but I would still welcome a less syntactic approach to my *over*-operation.”