# Presupposing acquaintance

## A unified semantics for *de dicto*, *de re* and *de se* belief reports[*]

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September 15, 2009

## Contents

### Abstract

This paper deals with the semantics of *de dicto*, *de re* and *de se* belief reports. First, I flesh out in some detail the established, classical theories that assume syntactic distinctions between all three types of reports. I then propose a new, unified analysis, based on two ideas discarded by the classical theory. These are: (i) modeling the *de re*/*de dicto* distinction as a difference in scope, and (ii) analyzing *de se* as merely a special case of relational *de re* attitudes.

The resurrection of these ideas takes place in a dynamic setting. My formalization of the first idea involves a modification of Van der Sandt's (1992) presupposition resolution algorithm for DRT. The second involves treating acquaintance relations as second-order presuppositions, to be bound in the context by means of higher-order unification, or accommodated if necessary.

The resulting framework requires no syntactic distinctions between different modes of attitude—everything in a report is passed on to the pragmatic resolution module as it appears on the surface. The more sophisticated contextual resolution process nonetheless ensures adequate output truth conditions for a variety of classical and novel puzzles. In particular, I compare the new pragmasemantic system to the classical, syntactic analysis with respect to iterated and quantified reports, and monstrously shifted indexicals.

## 1   Introduction: modes of beliefs and reports

When presented with a bottle of Coke and a Pepsi, John tries both and concludes that Coke is better. We can report this belief of John's in English with a *thinks that* construction:

(1)     John thinks that Coca-Cola tastes best

In this paper I present a novel semantics of belief reports like (1). More specifically, I argue for a unified analysis of the three different *modes* of belief reporting that have been discussed in the literature. The three modes of belief are known as *de dicto*, or propositional, belief; *de re* belief, about external objects one is acquainted with; and *de se* belief, about oneself from a first person perspective. Henceforth I use the term '*de dicto* report' to mean nothing more than a report of a *de dicto* belief, and similarly for *de re* and *de se*.

It is commonly assumed that the *de dicto*/*de re* distinction corresponds to a syntactic distinction in report constructions. More recently, based on data involving quantified reports, unambiguous *de se*, and shifted indexicality, the view that the *de re*/*de se* distinction also corresponds to a syntactic distinction has emerged.

A crucial observation is that it is not always visible from the report's surface what kind of belief it is supposed to report: English *thinks that* constructions can be used to report *de dicto*, *de re* and *de se* beliefs. For *de dicto* and *de re* this phenomenon is well-known as the *de dicto*/*de re* ambiguity. If the belief complement of a report contains a definite description, for instance, it is called ambiguous between a general, *de dicto* reading, and a *de re* one about the actual denotation of the description (cf. section 2). Belief reports with embedded pronouns agreeing with the matrix subject, *John thinks that he is good looking*, are often called ambiguous between a *de re* and a *de se* reading (cf. section 3).

I propose a new semantics of belief reports that does away with these syntactic ambiguities. My principal inspiration is the analysis of *de re* attitudes in terms of acquaintance relations (Kaplan 1969; Lewis 1979; Cresswell and von Stechow 1982). I analyze the distinction between *de dicto* and *de re* as the difference between global and local presupposition resolution, where I modify van der Sandt's (1992) resolution algorithm in such a way that projection out of a belief embedding is accompanied by the introduction of an acquaintance relation. To address a number of serious defects of the inherently unified relational analysis of *de re* and *de se*, I incorporate the context-dependence of acquaintance in my dynamic framework. The resulting theory utilizes the dynamic character of DRT and the flexibility of the presupposition resolution algorithm to handle not only the classic puzzles involving double vision and *de re*/*de se* ambiguities, but also the more recent data involving iterated reports (section 5), quantified reports (section 6), and shifted indexicals (section 7).

The proposed framework sheds new light on some of the data, such as the context-dependent difficulty of non-*de se* interpretation of ambiguous reports. However, the primary gain is theoretical: instead of tinkering with the syntax and morphology, my aim is a simple, uniform syntax and semantics where *de dicto*, *de re* and *de se* reports receive the same compositionally generated preliminary logical representations. On the basis of these representations and the context, an extended, pragmatic mechanism of presupposition resolution is to derive the correct truth-conditions. A specific benefit of such an approach would be that all pronominal features are interpreted directly according to their surface form, rather than requiring occasional deletion under morphological agreement.

## 2   *De dicto* and *de re*

The philosophical literature on the logic of attitudes distinguishes a number of fundamentally different ways of believing things. The best known distinction is that between *de dicto* and *de re* beliefs, i.e. general beliefs about what the world is

like as opposed to beliefs about actual objects external to a belief.

## 2.1 The semantics of *de dicto* beliefs and reports

*De dicto* beliefs are those that describe how the subject believes the world to be. If John utters a general statement like *All diet stuff tastes awful*, he thereby expresses the proposition that all diet food and drinks taste awful. Presumably, he would do so because he believes it's true, i.e. he believes that the world is such that diet stuff is awful. Such a propositional belief is called *de dicto*. In possible worlds semantics, propositions are sets of possible worlds ($p \subseteq W$) and we associate with every subject $x$ at a a possible world $w$ a belief set $\mathscr{B}el(x,w)$, the set of worlds compatible with $x$'s beliefs or mental state at $w$. Believing a proposition then means that the proposition holds of every belief alternative, i.e. $\mathscr{B}el(x,w) \subseteq p$.

Now we apply this to the semantics of belief reporting sentences. The LF of a *de dicto thinks that* construction and its interpretation are rather straightforward. We analyze the *that*-clause as expressing a proposition that the matrix subject is then said to believe. The report in (2) gets the following syntactic analysis:

(2)     John thinks that all diet stuff tastes awful

LF:
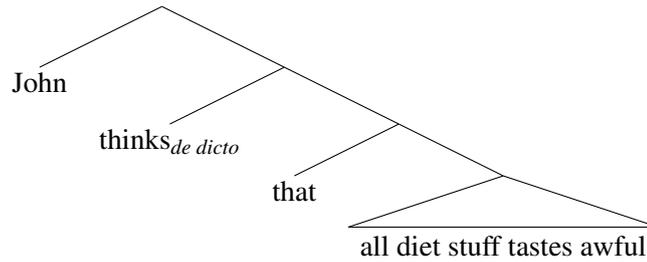


We can state a compositional semantics by providing translation rules mapping terminal nodes to expressions in a higher-order lambda calculus with basic types $e$ (entities) and $t$ (propositions).[1] The translation of a branching node in the tree is then given by functional application of the translations of the daughter nodes (in the direction allowed by the types).

As a first approximation the translation of the proposed lexical entry 'thinks$_{de\ dicto}$' is in terms of a modal operator $\text{Bel}_x$.

(3)     thinks$_{de\ dicto}$ $\longrightarrow \lambda p \lambda x(\text{Bel}_x p)$   type: *tet*                    [to be revised]

Applied to our example report (2), we get the following logical translation of the entire tree:

(4)     $\text{Bel}_j \forall x[\texttt{diet}(x) \rightarrow \texttt{awful}(x)]$

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[1]Analyzing type $t$ as an intensional type, for proposition denoting expressions, is intensional overkill, but it is quite useful for keeping representations simple. It does add some complexity at the level of model-theoretic interpretation, where the basic semantic value of a formula is no longer the truth value but the proposition expressed at a possible world.

The modal operator $\mathsf{Bel_j}$ is interpreted model-theoretically as in (5), where $\mathscr{B}el$ is a function mapping an individual at a world to his belief set at that world, provided by the model:

(5)     $[\![\mathsf{Bel}_\xi\, \varphi]\!] = \{w \in W \mid \mathscr{B}el([\![\xi]\!], w) \subseteq [\![\varphi]\!]\}$

Applied again to our example: $[\![(4)]\!] = \{w \in W \mid \mathscr{B}el([\![\mathsf{j}]\!], w) \subseteq [\![\forall\mathsf{x}[\mathtt{diet(x)} \to \mathtt{awful(x)}]]\!]\}$ $= \{w \in W \mid \mathscr{B}el(John, w) \subseteq \{v \in W \mid \text{diet stuff of } v \subseteq \text{awful tasting stuff of } v\}\}$, i.e. (2) expresses the proposition that all of John's belief alternatives are such that all diet things in them taste awful.

## 2.2  *De dicto* and *de re* as a matter of scope

To bring out the contrast between *de dicto* and *de re* beliefs, beliefs about external objects, consider the following report:

(6)     John thinks the president of PepsiCo is rich

This could mean two very different things. First, it might mean that John believes the proposition that whoever is the president of PepsiCo is rich, on the basis of, say, his general belief that presidents of large corporations are always rich. This is the *de dicto* reading that we've discussed above. Crucially, the *de dicto* belief does not require that John, or the reporter, or us, have any idea who the president of PepsiCo is. Therefore, we cannot substitute *the president of Pepsi* with *Indra Nooyi*, even if Indra Nooyi is in fact the current president of PepsiCo. We can often force this *de dicto* reading of a report by adding a *wh-ever that may be* qualification to the embedded definite description.

But there is an additional reading of the sentence. John believes of a certain individual who is the actual president of PepsiCo, that she is rich. On this *de re* construal, the report is felicitous if John just talked to Indra Nooyi at a party about her yacht, and thinks "wow, this woman is rich". It is irrelevant whether John knows that the woman he is talking to is the president of PepsiCo, or that her name is Indra Nooyi, as long as the term used by the reporter picks out the individual his belief is about. In other words, a *de re* belief is a belief about an individual, the *res*, independent of the particular description used by the reporter. Therefore, in a *de re* report, we can always replace the name or description of the *res* with a co-referential one, *salva veritate*. A *de re* reading can be forced with the *believes of ... that ...* construction.

As a first approximation we might try to cash out this difference between *de dicto* and *de re* as a difference in scope. If the embedded definite is interpreted *in situ*, in the scope of the intensional belief operator, that co-reference does not warrant *substitutio salva veritate*, given our standard possible worlds semantics. If the embedded definite takes scope over the belief operator, it will license the substitutions characteristic of *de re*. For concreteness' sake, let's analyze *the* somewhat simplistically as an operator of type $(et)e$, i.e. as denoting a (partial) function pick-

ing out the unique element of the set it takes as argument if that set is a singleton set, and is undefined otherwise. Additionally, we'll model the wide scope interpretation of the description by means of quantifier raising. The *de dicto* and *de re* readings of (6) would then get LFs and logical translations like (7a) and (7b):

(7) John thinks the president of PepsiCo is rich
    a. *de dicto* LF            b. *de re* LF

John     thinks$_{de\ dicto}$     the president of PepsiCo     the president of PepsiCo     is rich

$\lambda i$     John     thinks$_{de\ dicto}$     $i$     is rich

$$\text{Bel}_{\text{j}}(\text{rich}(\text{the}(\text{pres\_pepsi}))) \qquad \text{the}(\text{pres\_pepsi})\lambda \text{y}(\text{Bel}_{\text{j}}(\text{rich}(\text{y})))$$

Unfortunately, this simple analysis of *de re* as a wide scope version of *de dicto* fails in cases of 'double vision', where the subject of the belief is unwittingly acquainted with a single *res*, presented to him under two distinct guises. It is important to see why the scopal account fails and how the relational attitudes solution works, because my proposal for a unified semantics of *de dicto*, *de re* and *de se* combines relational attitudes with elements of the scopal account just sketched.

## 2.3 Double vision and relational attitudes

To argue against the notion of *de re* beliefs as involving actual objects, Quine (1956) illustrates his double vision argument with the example of B.J. Ortcutt with whom Ralph is acquainted as a spy and a 'pillar of the community'. I'll reconstruct the argument by letting John participate in a Pepsi Challenge. I will then introduce the relational account of *de re* and show how it solves the double vision puzzle.

In the Pepsi Challenge there are two cups, marked 'M' and 'Q'. John takes a sip of each and concludes that the drink labeled 'M' is the best, i.e. he forms the *de dicto* belief that M tastes best. Because of the direct perceptual contact with the drink, we may assume that he also has a *de re* belief about it, i.e. (8) is true:

(8)      John believes *de re* of M that it tastes best

As the host knows, but not John, M is actually Pepsi. So the host may felicitously report John's choice to his audience as in (9):

(9)      John believes *de re* of Pepsi that it tastes best

Now recall the example at the beginning of the paper, (1), where we ascribed a seemingly contradictory belief to John. Given that that belief was also based on (this time non-blind!) experience with both brands, we conclude that it too is *de*

*re*, i.e.:

(10)     John thinks *de re* of Pepsi that it's inferior to Coke

So does John believe contradictory things about one and the same substance? In a sense, the answer must be yes. The problem is that there is no easy way to account for this logically, because believing a logical contradiction is certainly too strong (for then it would follow that he believes every absurdity).

The standard solution, which forms the basis for my own account, involves *modes of presentation*. *De re* beliefs are not about bare objects as such, but about objects presented to the believer in a certain way. From the early encounters it follows that John believes of Pepsi *as presented in a Pepsi-branded can* that it has inferior taste, while from the Challenge we learn that John believes *de re* of Pepsi *as presented in a cup labeled 'M' as part of a blind experiment* that it tastes best.[2] Both beliefs are equally *de re* about Pepsi, and hence both (9) and (10) are true, yet they are not directly contradictory because the unpronounced different modes of presentations under which the beliefs are held make them distinct.

Now, if these modes of presentations are not visible at the surface in the reports (9) and (10), where did they come from? To answer this question it is important to see first that not all intensional descriptions count as suitable modes of presentations of *de re* belief. Merely saying you 'like whatever tastes best' does not mean you have a *de re* belief about Pepsi under the mode of presentation 'the best tasting soda'; if it did, even people who have never drunk Pepsi or any other cola would automatically believe *de re* of Pepsi that it tastes best, rendering the whole notion of *de re* as 'about an actual object' vacuous. The upshot of this argument, sometimes referred to the 'shortest spy problem' after the original example involving the trivial belief that the shortest spy is a spy, is that modes of presentations must be restricted.

In the true *de re* examples above, we already saw that the descriptions were intimately related to the particular circumstances that led us into calling the beliefs in question *de re* about something external in the first place. Following Kaplan (1969) (with Lewisian (1979) terminology) we'll say that *de re* belief requires the subject to be *vividly acquainted* with a *res*, and that it is this acquaintance relation that supplies the *res*' mode of presentation in the belief. Moreover, we can then reduce *de re* to *de dicto*, or, in order not to confuse terminology, to *propositional* belief as in (5), by simply substituting the mode of presentation (in the form of an individual concept/definite description) for the *res* inside the belief.

The above discussion brings us to the following, relational semantics of *de re* belief:

(11)     *x* believes *de re* of *y* that *y* is *P* iff there is a relation *R* with:

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[2]As it turns out, it's precisely this label 'M' that makes the Pepsi Challenge work. No matter which cup contains the Coke, the 'M' is chosen significantly more often than the 'Q' (cf. `en.wikipedia.org/wiki/Pepsi_Challenge`).

    a.    *R* is a vivid relation of acquaintance between *x* and *y* in the actual world

    b.    *x* believes (*de dicto*) the proposition that the object he is *R*-acquainted with is *P*.

Before turning this into a real semantics of the standard English *de re* report construction, we can already see that under this definition, our John indeed has the two semi-contradictory *de re* beliefs discussed above by taking: $x$ = John; $y$ = Pepsi; $P(x) = x$ tastes best; $R_1(x,y) = x$ drinks cola $y$ from the cup marked M (for the Challenge scenario); and $R_2(x,y) = x$ drinks cola $y$ from a Pepsi-branded can (for the non-blind scenario). This shows a way out of both the traditional Ortcutt dilemma of conflicting *de re* beliefs, and the 'tallest spy' problem of descriptive modes of presentation. The essence of the solution is that different acquaintance relations engender different modes of presentation and thus different propositional beliefs.

Now let's implement (11) in the syntax and semantics of the *de re* readings of *thinks that*. For (11) to work, we need the semantic separation between *res* (*y*) and ascribed predicate (*P*) that is brought out by the *believes of* paraphrase. Crucially, this separation is not apparent in the more natural propositional attitude construction, where the straightforward parse yields only *de dicto*. As we saw in section 2.2 however, a belief complement with a definite often allows a real *de re* interpretation, alongside *de dicto*. If we want to maintain compositionality of translation and model-theoretic interpretation, we can only achieve the separation required by the *de re* reading by means of a syntactic movement operation. I'll cash out this '*res* movement' (von Stechow and Zimmermann 2005) by moving the DP denoting the *res* to an extra argument position on the attitude verb:

(12)    [. . .] thinks the president of PepsiCo is rich
        a. *de dicto* LF                b. *de re* LF



The subscript on *thinks* reflects the fact that attitude verbs are now lexically ambiguous between denoting a propositional attitude operator, (3), and a more complex relational operator, whose interpretation is based on (11). More specifically, the translation of $think_{de\ re}$ takes as arguments (a representation of) the moved *res* term, an ascribed property, and a subject:

(13)    $think_{de\ re} \longrightarrow \lambda y \lambda P \lambda x \exists R[R(x,y) \wedge Bel_x(P(the(\lambda v(R(x,v)))))]$ [to be revised]

Thus, we arrive at the following logical translation of the *de re* LF:

(14)    $\exists R[R(j, the(pres\_pepsi)) \wedge Bel_j(rich(the(\lambda v(R(x,v)))))]$

In words, the *de re* reading of (12) is true iff there is an acquaintance relation between John and the president of PepsiCo and John believes that the person he is so acquainted with is rich. In section 3.1 below, I'll modify this definition somewhat by replacing the underlying propositional belief operator to one of property self-ascription.

## 3   *De re* and *de se* beliefs and reports

### 3.1   From propositions to properties

Besides *de dicto* and *de re* beliefs, philosophers and linguists have argued for a third mode: *de se* (Castañeda 1966; Perry 1977; Lewis 1979; Kaplan 1989). Consider the following example.[3] In an experiment some male speakers of different sexual orientations are recorded after reporting their sexual orientation. They are then asked to rate all recorded passages, including their own, on a scale from gay to straight. Frank is gay, he knows it and deliberately tries to 'sound gay'. When approached for the experiment he said: "I sound gay." Frank thereby expresses a *de re* belief about himself (one is after all very vividly acquainted with oneself), that he sounds gay. Chris, who would never describe his own voice as gay, also participates in the experiment. Now he's listening to the recordings and when he gets to #12 he marks it as 'very gay', not realizing that this is his own voice. Thus, Chris also expresses a *de re* belief about himself, because listening carefully to recording #12 brings him into a perceptual acquaintance relation with himself. The difference between the beliefs is that Frank's is not only *de re* about himself, but (pure) *de se*: he believes he himself sounds gay from his own first person point of view, while Chris' belief is about himself from a third person perspective. More specifically, beliefs that the believer would express with a first person indexical (*I*) correspond to first person pure *de se* beliefs, or *de se* beliefs for short, as we shall restrict ourselves to first and third person beliefs.

The example brings out the importance of the indexical point of view in the analysis of belief. At a propositional level Chris' thought "#12 sounds gay" is indistinguishable from "I sound gay", though he might utter the former, but not the latter. This prompted Lewis (1979) to switch from propositions as objects of belief, to properties that the believer self-ascribes: Frank's first person utterance means he self-ascribes the property of sounding gay, while Chris self-ascribes the distinct property of listening to a recording #12 that sounds gay. Propositional belief, as used in the semantics of *de dicto* and *de re* above, is just a special case of property self-ascription. Believing proposition *p* amounts to self-ascription of the property of inhabiting a world where *p* holds. For uniformity we now revise the semantics of *de dicto* and *de re* reports from the previous section accordingly.

First, we assume that the model associates with a believer is not a set of worlds, but a set of *centered worlds*: the belief set of John, $\mathscr{B}el(j,w)$ is the set of pairs

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[3] http://itre.cis.upenn.edu/~myl/languagelog/archives/001799.html

$\langle w', a \rangle$, where $w'$ is a world compatible with what John believes and $a$ is an individual John believes to be. In Haas-Spohn's (1994) terminology: $\langle w', a \rangle$ is a belief alternative of John ($\langle w', a \rangle \in \mathscr{B}el(j, w)$) iff after placing John's mind in $a$ and letting him thus explore $w'$ through the eyes of $a$, he would not be able to distinguish that situation from the real world as seen through his own eyes. Then we replace the propositional belief operator Bel with a self-ascription operator. Officially, the interpretation of a predicate $\Pi$ maps individuals to propositions, but by assuming the notational convention that $\langle w, a \rangle \in [\![\Pi]\!]$ iff $w \in [\![\Pi]\!](a)$, we will often think of it as a set of centered worlds, just like our new belief sets. The semantics of the new Bel operator thus remains almost unchanged:

(15) $\quad [\![\text{Bel}_{\xi}\Pi]\!] = \{w \in W \mid \mathscr{B}el([\![\xi]\!], w) \subseteq [\![\Pi]\!]\}$

In the new translation of *de dicto* belief, to replace (3), we turn the propositional complement into the property of inhabiting a world where the proposition holds by simply adding a vacuous abstraction:

(16) $\quad \text{thinks}_{de\ dicto} \longrightarrow \lambda p \lambda x (\text{Bel}_x \lambda u.p)$

And finally, *de re*. Here the extra abstraction introduced by the property framework is not vacuous. The second conjunct in the translation proposed in (13) said that the subject believes the proposition that the subject is acquainted with a unique individual, and that that individual has a certain property. We replace that with the subject self-ascribing the property of being someone who is acquainted with a unique individual, who has that property:

(17) $\quad \text{think}_{de\ re} \longrightarrow \lambda y \lambda P \lambda x \exists R[R(x, y) \wedge \text{Bel}_x \lambda u(P(\text{the}(\lambda v(R(u, v)))))]$

The motivation for building genuine property dependence into the relational semantics by means of (17) is that it enables a unification of *de re* and *de se*, as we will see in the next subsection.

## 3.2 *De se* as *de re*

Under the current definition, *de se* belief comes out as a special case of *de re*, viz. the case where $R$ is the relation of equality (substituting $=$ for $R$ above collapses the complex property to the property of being $P$) (Lewis 1979:156). Applied to our *de re/de se* example, it is easily verified that under this definition both Frank and Chris believe *de re* of themselves that they sound gay, but only Frank does so under the acquaintance relation of equality, i.e. *de se*.

This unified analysis of *de se* as *de re* corresponds precisely to what we find in English reports with *res* pronouns referring to the matrix subject. Concretely, a report like (18) is predicted to be compatible with both a *de se* and a genuine *de re* scenario:

(18) $\quad$ Frank thinks he sounds gay

To see this consider the *de re* LF that our current theory assigns to (18):

LF:

$$\exists R[R(\mathtt{f},\mathtt{f}) \wedge \mathrm{Bel}_{\mathtt{f}}\lambda\mathtt{u}(\mathtt{sounds\_gay}(\mathtt{the}(\lambda\mathtt{v}(R(\mathtt{u},\mathtt{v})))))]$$
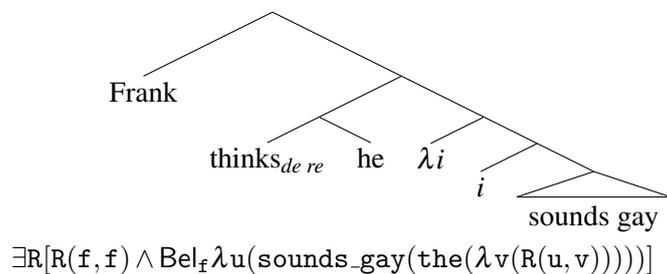
So, we predict that (18) is true iff there is a vivid relation of acquaintance between Frank and himself such that Frank self-ascribes being so acquainted with a unique person that sounds gay. And this is true in our scenario because Frank believes himself to sound gay, so we can take the relation of equality. In other words, the relational *de re* LF is compatible with a *de se* scenario.

Given the same *de re* analysis, we also predict that (19) is true:

(19)     Chris thinks he sounds gay

Since Chris doesn't even recognize his own voice, this prediction may seem problematic at first, but I follow the current (philosophers') consensus that it is nonetheless correct. Of course it would be considered *misleading* to word Chris' predicament in this way if the circumstances of his mistaken identity weren't already mentioned or otherwise firmly established in the context (e.g. by adding "..., but he doesn't realize it", or visually, as when the reporter and her audience are watching the whole mistaken identity scene unfold).

One of the main selling points of the relational semantics is that for sentences like (18) and (19) it can do without postulating any kind of ambiguity as a linguistic correlate to the *de re/de se* distinction.[4] The flip side is that such unified theories cannot explain the obvious difference in acceptability between (18) and (19) in the given context, even if they are both strictly speaking true. In section 3.3 we first discuss a related but more serious argument against the relational unification of *de re* and *de se*, involving natural language report constructions that are unambiguously *de se*.

## 3.3   Unambiguously *de se* reports

Besides using a co-referential third person pronoun to refer back to the subject of the belief, many languages have other ways to report someone's beliefs about himself. In English, one may for instance drop the embedded subject pronoun and use an infinitive or a gerund. As Chierchia (1989) observes, this construction

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[4]The same is true for a Kaplanian quantified character analysis, but von Stechow and Zimmermann (2005) uncover a fatal flaw in that account (cf. also Maier (2006) for discussion), so I'll disregard it here.

cannot be used in a mistaken, *de re* case:[5]

(20)    a.    Frank believes to have a gay voice
       b.    #Chris believes to have a gay voice [*though he doesn't realize it]

Chierchia uses this contrast to motivate a new, dedicated *de se* LF. If (20a) can only be read *de se*, *de se* beliefs must correlate with a special LF and interpretation. Chierchia proposes an analysis of the infinitival construction in which the embedded subject is a silent PRO that is obligatorily bound by a property abstractor introduced into the syntax by the *de se* attitude verb:

(21)     Frank believes PRO to have a gay voice
       LF:
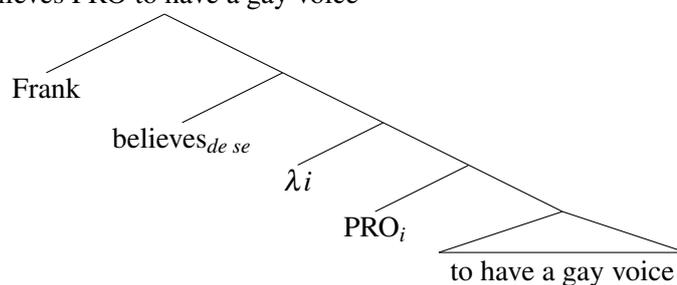


$$\text{believes}_{de\ se} \longrightarrow \lambda P \lambda x (\text{Bel}_x P) \quad \text{type: } (et)et$$
$$(21) \longrightarrow \text{Bel}_f \lambda u (\texttt{have\_gay\_voice}(u))$$

According to Chierchia, the overt pronoun construction discussed in the previous subsection is actually ambiguous between a *de re* and *de se* LF. While PRO is a '*de se* pronoun', an element that has to be bound by the attitude verb's $\lambda i$, regular pronouns are ambiguous between a general *res*-moved interpretation, and a *de se* one where they are bound like PRO above by the intervening property abstractor that comes with *thinks/believes*<sub>de se</sub>.

In this paper I want to argue against a syntactic *de re/de se* ambiguity, and in favor of the relational view of *de se* as merely a special case of *de re*, at least for the English co-referential *he* reports. I propose a new, dynamic version of the relational analysis where acquaintance relations are not existentially quantified over, but represented as presuppositions that search the context for a suitable antecedent. Given this goal, it will be important to address the arguments for dedicated *de se* LFs. Besides the PRO based argument of this section there is a number of argu-

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[5]Some native speakers report that in English *believe*+infinitive reports are bad. Others think it's fine, and Google supports the latter view with more than 100kGhits on `http://www.google.com/search?q="believes+to+have+a"+-which+-who+-whom`. I've excluded wh-pronouns from this search, but some of these hits still involve moved objects. Most appear to be genuine examples of the type required, though. Skeptics should just view my (20) as a pseudo-English gloss of Dutch or Italian where the same *de re/de se* contrast holds and where *believe/think*+infinitive is generally considered felicitous. Alternatively, in English the point can also be made with *hopes to*+infinitive vs *hopes that*, but that would introduce a number of additional complications to the semantics.

ments for *de se* LFs, based on quantifiers, logophoricity and shifted indexicality.[6] In section 6 I consider the behavior of reports under quantifiers in some detail and show how my dynamic relational approach holds up against the standard relational approach and Chierchia's syntactic *de se* separatism. In section 7 we return to PRO and the related phenomena of logophoricity and shifted indexicality.

# 4 A dynamic semantics of belief reports

In this section I lay out my novel account of *de dicto*, *de re*, and *de se* belief reports. Its two main ingredients are, (i) an analysis of the *de dicto/de re* ambiguity in terms of an enhanced presupposition resolution mechanism, and (ii) a unification of *de re* and *de se* based on the idea of acquaintance relations being provided by the context rather than being existentially quantified over.[7] Both of these ideas crucially rely on the dynamic, representational framework of Discourse Representation Theory (DRT), a framework designed to accommodate context-dependence in a principled fashion, and especially suited for the current task because of the powerful notion of presuppositions-as-anaphora resolution associated with it.

## 4.1 DRT and presupposition

I adopt the dynamic framework provided by Kamp's (1981) Discourse Representation Theory (DRT) combined with van der Sandt's (1992) theory of Presupposition-as-Anaphora (PA). The reason I choose dynamic over static semantics is that I want to model how the interpretation of a report depends on the information available in the context: given a co-referential report (*Frank thinks he sounds gay*), for instance, most contexts should allow a *de se* reading, but a mistaken identity context may force a particular *de re* perspective. I choose DRT+PA over non-representational dynamic analyses of presupposition because of the principled account of context-

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[6]In this paper I ignore the arguments for *de se* LFs involving ellipsis (Chierchia 1989), and *only* (Percus and Sauerland 2003a). The ellipsis argument is refuted by Reinhart (1990), the *only* argument, to which we briefly return in 6.1 below, by Anand (2006). A proper alternative analysis of the data involved, within my dynamic framework, is however beyond the scope of this paper. Maier (2006) discusses both arguments and some counterarguments, and outlines a dynamic analysis.

I further ignore here Percus and Sauerland's (2003b) arguments for a syntactic analysis of *de se* based on dream reports like Lakoff's (1972) *I dreamed I was Brigitte Bardot and I*$_{\text{B.B./*G.L.}}$ *kissed me*$_{\text{G.L./*B.B.}}$. In this paper I focus on belief, and Percus and Sauerland's crucial data are tied to the rather special cases of dreaming and imagining. In fact, even within that restricted domain, Anand (2006:41) found that only 15 of his 25 informants shared the relevant intuitions.

Finally, my discussion of cross-linguistic data touching on the *de re/de se* distinction in section 7 will remain very limited. A proper evaluation of my analysis in light of the arguments and data of Anand (2006) must be left for future research.

[7]This general idea of context-dependent *de re* acquaintance is not new, cf. e.g. Abusch (1997:fn.9) and Aloni (2000:fn.2 p.35 & fn.34 p.57), who traces the idea back to Hintikka (1967). What is new is my formalization and its incorporation into a dynamic semantics of belief reports. Entirely new are also the extensions to quantified reports (section 6), iterated reports (section 5) reports, and shifted indexicality (section 7).

dependence as presupposition binding and accommodation, both of which mechanisms will play a crucial role in my analysis below.

An example will suffice to illustrate the framework and the terminology. In dynamic semantics, a discourse is interpreted against the background of a context. Let's assume that the part of our scenario where Chris is participating in an experiment where some recorded voices are being played back to him is common knowledge between the speaker and her audience. In DRT we represent such contextual information as follows:

(22)    Chris is hearing a voice

$$
\begin{array}{|c|}
\hline
\texttt{x y} \\
\hline
\texttt{chris(x)} \\
\texttt{hear(x,y)} \\
\texttt{voice(y)} \\
\vdots \\
\hline
\end{array}
$$

Technically, such a DRS box depicts a pair $\langle U(\varphi), Con(\varphi) \rangle$ of a set of discourse referents (the *U*niverse of the DRS $\varphi$) and a set of *Con*ditions, which can be either atomic (e.g. $\texttt{chris(x)}$) or complex (e.g. $\neg \psi$). In (22), $U(\varphi) = \{\texttt{x,y}\}$ and $Con(\varphi) = \{\texttt{chris(x)}, \texttt{hear(x,y)}, \texttt{voice(y)}\}$. I use the vertical ellipsis dots in representations of contexts to signify that the given representation is only an incomplete approximation of the information actually available in the context.

In dynamic terminology, the DRS in (22) forms the *input context* for the interpretation of the next sentence in the discourse. The first step in the interpretation of a sentence is to construct a *preliminary representation* (henceforth PrelDRS) based on the syntactic structure of the sentence. This so-called construction phase can be formalized in the same vein as we've been doing in the static framework of the previous sections. We assume a simple grammar to generate phrase structures. Then we translate the leafs into lambda terms, which are then combined by function application. Only now the formal language is the language of DRT+PA. Characteristic of this language is that the contribution of pronouns and other definites is marked as presuppositional in a PrelDRS. For instance, the translation of a definite like *the president of PepsiCo* involves the creation of a presupposition that there is a uniquely salient individual satisfying the predicate *president of PepsiCo*. Apart from definite descriptions, many other types of expressions and constructions, such as pronouns, factive complements, and *it*-clefts, are analyzed as presupposition triggers. Below, I represent presuppositions as dashed DRS box conditions, as illustrated in (23), which shows how to translate a pronoun in DRT+PA.

(23)     he $\longrightarrow \lambda$P
$$
\boxed{\begin{array}{c}
\\ \hline
\texttt{P(x)} \\
\left[\begin{array}{c}
\texttt{x} \\ \hline
\texttt{he(x)}
\end{array}\right]
\end{array}}
$$

We use the same non-logical inventory as in the static higher-order system employed in the previous sections, except that proper names are now associated with 1-place predicates rather than individual constants, because we analyze names as presupposition triggers on a par with other definite noun phrases.

Officially, the PrelDRS language needs three distinct types to replace the static type $t$, one for DRS conditions ($t_c$), one for DRSs ($t_d$), and one for presuppositions ($t_p$). I will return to the model-theoretic interpretation of DRSs in 4.2. For now, note only that in DRT+PA, presuppositions in PrelDRSs are not interpreted semantically, i.e. $t_p$ terms only play a role in the construction and resolution process and will be absent from the final output representation. Function application in the construction phase is therefore a purely syntactic affair, i.e. beta-reduction of lambda terms. After all possible beta-reductions have been carried out, we arrive at a PrelDRS, which concludes the construction phase:

(24)     He doesn't recognize it
$$
\boxed{\begin{array}{c}
\\ \hline
\neg \boxed{\begin{array}{c}
\\ \hline
\texttt{recognize(z,w)} \\
\left[\begin{array}{c} \texttt{z} \\ \hline \texttt{he(z)} \end{array}\right] \left[\begin{array}{c} \texttt{w} \\ \hline \texttt{it(w)} \end{array}\right]
\end{array}}
\end{array}}
$$
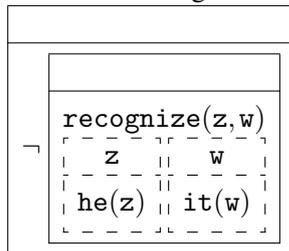
The next step of the DRT+PA interpretation procedure, resolution, starts with *merging* ($\oplus$) the input context and sentence representation:

(25)     (22)$\oplus$(24) =
$$
\boxed{\begin{array}{c}
\texttt{x y} \\ \hline
\texttt{chris(x)} \\
\texttt{hear(x,y)} \\
\texttt{voice(y)} \\
\vdots \\
\neg \boxed{\begin{array}{c}
\\ \hline
\texttt{recognize(z,w)} \\
\left[\begin{array}{c} \texttt{z} \\ \hline \texttt{he(z)} \end{array}\right] \left[\begin{array}{c} \texttt{w} \\ \hline \texttt{it(w)} \end{array}\right]
\end{array}}
\end{array}}
$$

Then we *resolve* the presuppositions. We try to bind presupposed discourse ref-

erents to already established ones by matching the associated contents. In our example, the content of the presupposition of *he* matches the content associated with *Chris*, and *it* matches with *voice*. Both of these antecedents correspond to discourse referents available in the global DRS, which is *accessible* for presuppositions from any trigger location. This allows us to bind the presuppositions by unifying the discourse referents and getting rid of the dashed boxes:

(26)

$$
\boxed{
\begin{array}{c}
\text{x y} \\
\hline
\text{chris(x)} \\
\text{hear(x,y)} \\
\text{voice(y)} \\
\vdots \\
\neg \boxed{\begin{array}{c} \\ \hline \text{recognize(x,y)} \end{array}}
\end{array}
}
$$
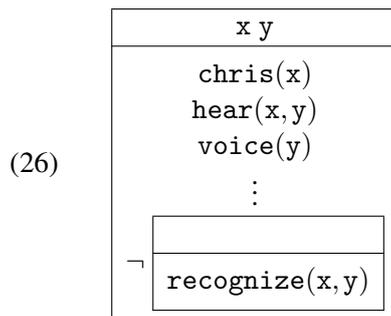
This mechanism applies not just to pronouns but to all presupposition triggers, including for instance proper names, definite descriptions and factive complements.

If binding should fail we fall back on accommodation, i.e. the creation of a suitable antecedent by simply dropping the presupposed referent and content at a suitable position in the DRS. Although some triggers resist accommodation more than others, the possibility of accommodation under contextual pressure is often viewed as one of the defining characteristics of presupposition.

For example, say we add (27) to our conversation:

(27)     His best friend Mark burst out laughing

The pronominal trigger *his*, hidden inside the complex definite *his best friend Mark*, is bound to the previously encountered Chris. But what about the alleged best friend called Mark? Neither the sentence itself, nor the context as a whole provides a plausible antecedent, so binding is out. Presumably, the speaker wants the audience to *accommodate* this new character. We formalize this addition to the common ground by merging the presupposition with the global context.

In principle, when presuppositions generated in embedded DRS positions have to be accommodated there may be a number of non-global subDRS positions eligible for accommodation in the sense that merging there would yield a well-formed, interpretable output DRS. We'll encounter such *local accommodation* in sections 5 and 6. The variety of resolution options presented by local and global binding and accommodation necessitates a preference ranking to avoid explosive overgeneration. For instance, binding is preferred over accommodation, and local binding is better than global. The ranking of accommodation possibilities is a particularly controversial issue, but in the standard DRT+PA approach of van der Sandt (1992) and Geurts (1999), accommodation wants to be as global as possible. These preferences are outranked by global constraints on the well-formedness (avoid free vari-

ables) and coherence (the truth-conditions must comply with the Gricean maxims) of the candidate output DRS.

An effective way to implement all these constraints is to have the resolution algorithm systematically try out all binding possibilities starting from the trigger location and going outward from there. If no viable binding position is found, we turn around and start checking accommodation options in the opposite direction. If no pragmatically plausible solution is found when we return to the trigger location the sentence is judged infelicitous in the given context. For future reference I will spell out the important steps of the algorithm for resolving a single presupposition below.

(28) Say $\varphi$ is a context DRS merged with a PrelDRS. Look for the most deeply embedded presupposition in $\varphi$, call it $\pi$. Because we will be moving this presupposition around when looking for a binding site, we have to mark the place we started in order to backtrack for accommodation, so say $\tau$ is the subDRS in which $\pi$ is triggered.

Binding:

i. Determine the *projection path* of $\pi$ in $\varphi$, i.e. a sequence of immediately subordinating subDRSs, from the context that holds the trigger, $\varphi_1$ up to $\varphi_n$, which is the main DRS, $\varphi$.

ii. Determine whether the presupposition can be bound to a discourse referent in $\varphi_1$, by checking whether the 'content associated with' the possible antecedent 'matches' (two notion that can be defined in many more or less semantic or syntactic ways) the presupposition's content. If so, remove the presupposition and replace all occurrences of the presupposed referent with the antecedent referent and stop. If not, go to (iii).

iii. If we're in the main DRS, $n = 1$, binding has failed and we must try accommodation, i.e. go to (v). Otherwise, go to (iv).

iv. Move $\pi$ from $\varphi_1$ to $\varphi_2$ and go back to (i).

Accommodation:

v. Determine the opposite projection path, from $\varphi_1$, the DRS where $\pi$ is currently stranded, down to $\varphi_n$, the original trigger location $\tau$.

vi. Determine whether the presupposition can be accommodated in $\varphi_1$ by checking whether merging $\varphi_1$ with $\pi$ in $\varphi$ gives a felicitous output DRS.[8] If so, delete the presupposition and give the merged DRS as output. If not, go to (vii).

vii. If we're at the trigger location, $n = 1$, accommodation has failed and the resolution crashes. Otherwise, go to (viii).

---

[8]It is often assumed that global pragmatic preferences outrank the accommodation order generated by our simple back-and-forth algorithm presented here. A more realistic system might generate a number of possible accommodation outputs, preliminarily ranked from global to local, and then compare those to each other to select the most felicitous. As I present it here, the algorithm performs only an absolute felicity check.

viii. Move $\pi$ from $\varphi_1$ to $\varphi_2$ and go back to (v)

To sum up, PA induces a two-stage interpretation architecture: from the syntactic analysis of a sentence a preliminary DRS is constructed fully compositionally, and then a pragmatic/semantic resolution mechanism connects that preliminary structure with the context DRS by resolving its presuppositions. The analysis proposed in this paper will be compositional in the sense that preliminary DRSs are generated compositionally and resolution is algorithmic. The analysis is furthermore unified in the sense that these syntactically generated preliminary representations of belief reports are underspecified for *de dicto*, *de re*, and *de se*. The final output DRSs, by contrast, are determined in part pragmatically, in interaction with the context: they are neither fully compositional (in the strong, Montagovian sense), nor unified, since a *de dicto* output may be truth-conditionally distinct from any *de re* output, which in turn comprises a whole set of specific, mutually distinct beliefs based on different acquaintance relations, one of which the *de se* acquaintance of equality.

## 4.2   Belief in DRT

If we're interested in belief, we have to add an intensional dimension to the DRT semantics. In this section we first simply follow the lead of intensional predicate logic, as laid out in previous sections. Then we evaluate the belief semantics that brings us, and we investigate how we might want to extend it.

The first ingredient we need to add to standard DRT is a logic of belief. To this end, I use the property self-ascription operator, Bel, from 3.1. For simplicity I will assume that DRSs denote sets of contexts, i.e. worlds with a designated first person center, rather than just plain possible worlds.[9] In other words, DRSs denote properties of times and individuals, rather than propositions. This move allows Bel to apply directly to a DRS without tedious property abstractors:

(29)      if $\varphi$ is a DRS and $\xi$ a discourse referent, then $\mathrm{Bel}_\xi\,\varphi$ is a DRS condition.

To give the semantics of Bel in DRT, let's first go over the basics of DRT semantics. The central semantic notion is of an assignment verifying or 'truthfully embedding' a DRS or condition in a world (or rather, in a context), which I denote as $f \models_c \varphi$. The truth definition states that $f$ is a truthful embedding iff there is an extension $g$ of $f$ that subsumes $U(\varphi)$ in its domain (henceforth: $g \supseteq_{U(\varphi)} f :=$ $g \supseteq f$ and $Dom(g) = Dom(f) \cup U(\varphi)$) and that verifies all the conditions of $\varphi$. The verification of atomic conditions is as in predicate logic. As an example of a complex condition, consider the implication: $f \models_c \psi \Rightarrow \chi$ iff every $g \supseteq_{U(\psi)} f$ that verifies the condition of $\psi$, can be further extended to an $h \supseteq_{U(\chi)} g$ verifying the condition of $\chi$. Finally, $[\![\varphi]\!]^f$ denotes the set of contexts for which $f$ is a verifying

---

[9]Adding context-like parameters to intensional indices is also a rather common strategy, cf. e.g. von Stechow and Zimmermann (2005).

embedding. With this terminology the semantics of Bel is as follows:

(30)     $f \models_c \mathrm{Bel}_\xi \varphi$ iff $\mathscr{B}el(f(\xi), c) \subseteq [\![\varphi]\!]^f$

Maier (2006, 2009) further refines this DRT belief semantics in a two-dimensional fragment of Layered DRT to account for the semantic context-dependence and rigidity of indexicals. In that essentially Kaplanian (1989) semantics, interpretation is relativized to both a context and an intensional world parameter: $f \models_w^c \varphi$. The `center` predicate in a belief representation or a main DRS is then tagged as directly referential (with a layer label), meaning that it gets evaluated with respect to $c$ rather than $w$. In this way the meaning of a referential term like *I* can do its contextual reference fixing without ending up in the propositional content. Kaplan assumed that natural language operators see only intensional content (Prohibition of Monsters), but Schlenker (2003) and others have argued that report operators are sensitive to both dimensions of meaning. The standard move at this point would be to collapse the belief embedded LDRS dimensions semantically, through diagonalization. To avoid distracting technicalities here, I will stick with a one-dimensional, unlayered semantics, thus obviating the need for diagonalization.

We will instead ensure the interpretability of predicates like `center` by enriching the single intensional parameter with a unique speaker/thinker parameter, essentially making it into a kind of context. It is important to realize that even with this adjustment we fail to distinguish the reference fixing stage from truth-conditional evaluation (or, character from content, context from index) which, as Kripke (1972) and Kaplan (1989) show, makes it hard to distinguish, for instance *the person called John* and *John*, or *I* and *the current speaker*. As this issue is independent of the unification of *de dicto*, *de re* and *de se* I refer the reader to Maier (2009) for a proper analysis of rigidity in (L)DRT that is compatible with the proposal developed in this paper.

Let's finish with an example evaluation of a belief DRS:

(31)

| x |
|---|
| frank(x) |
| Bel$_x$   <table><tr><td>u</td></tr><tr><td>center(u)</td></tr><tr><td>sound_gay(u)</td></tr></table> |

$[\![(31)]\!]$ = the set of contexts $c$ in which there is an embedding $f : \{x\} \to D$ such that:

(i)   $f(x) \in [\![\mathtt{frank}]\!]^c$, and

(ii)  $\mathscr{B}el(f(x), c) \subseteq \left[\!\!\left[ \begin{array}{|c|} \hline \mathtt{u} \\ \hline \mathtt{center(u)} \\ \mathtt{sound\_gay(u)} \\ \hline \end{array} \right]\!\!\right]^f$

     iff   $\mathscr{B}el(f(x), c) \subseteq \{c' \mid$ there is an embedding $g \supseteq_{\{u\}} f$ such that

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$$g(\mathtt{u}) \in [\![\texttt{center}]\!]^{c'} \text{ and } g(\mathtt{u}) \in [\![\texttt{sound\_gay}]\!]^{c'}\}$$

iff $\quad \mathscr{B}el(f(\mathtt{x}),c) \subseteq \{c' \mid \text{the}[10] \text{ center of } c' \text{ sounds gay in } c'\}$

In other words, (31) means that there is a guy named Frank, and any context $c'$ compatible with Frank's ($\mathtt{x}$) beliefs is one in which the center ($\mathtt{u}$) sounds gay. This correctly captures the (true) *de se* reading of our earlier (18).

## 4.3 Acquaintance as presupposition

With these preliminaries in place we turn to the interpretation of natural language reports. We focus first on the *de re*/*de dicto* distinction. As I showed in section 2, sentences of the form *x believes that y is P* can be used to report x's *de dicto* belief in the proposition expressed by the complement clause, P(y), but also to report her *de re* belief about y that it is P. We have also seen that the traditional account of modalities *de re* and *de dicto* in terms of scope leads to an inadequate semantics of *de re* beliefs. This led to the introduction of a syntactic ambiguity between *de dicto* and *de re*, where the *de re* reading corresponds to an LF where the *res* is moved out of the complement. This *res* moved LF, finally, is interpreted as a relational attitude.

As a first step, let's just translate this account to DRT, keeping the syntactic parses intact. We only need to adjust the translation rules for *thinks*<sub>de dicto</sub> (cf. (16)) and *thinks*<sub>de re</sub> (cf. (17)) to give us the right PrelDRS parts:

(32)   a.   $\text{thinks}_{de\ dicto} \longrightarrow \lambda\mathtt{p}\lambda\mathtt{x}$ $\boxed{\begin{array}{c} \phantom{xx} \\ \hline \mathrm{Bel_x p} \end{array}}$

   b.   $\text{think}_{de\ re} \longrightarrow \lambda\mathtt{y}\lambda\mathtt{P}\lambda\mathtt{x}$ $\left[\begin{array}{ccc} \boxed{\begin{array}{c} \mathrm{R} \\ \hline \mathrm{R(x,y)} \end{array}} & \mathrm{Bel_x} & \boxed{\begin{array}{c} \mathrm{u\ v} \\ \hline \mathrm{center(u)} \\ \mathrm{R(u,v)} \\ \mathrm{P(v)} \end{array}} \end{array}\right]$

Note that instead of quantifying over $\mathrm{R}$, I introduce it here as a presupposition. The main point of using DRT will then lie in the resolution of the higher-order acquaintance presupposition, which is the topic of section 4.4.
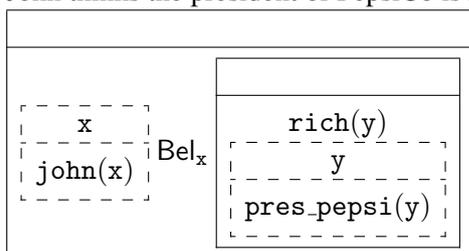
This is basically the route I followed in my earlier (2006) DRT implementation of belief reporting.[11] The obvious downside is the syntactic ambiguity between *de dicto* and *de re* reports. This is quite alien to the DRT way of thinking in which syntactic ambiguities tend to be relegated to semantics/pragmatics. In particular, the DRT+PA architecture seems exceptionally suited for a dynamic reformulation of

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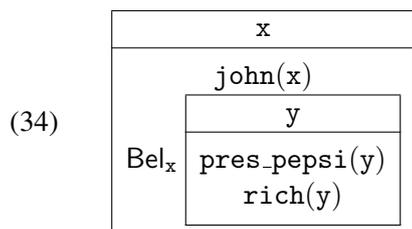[10] Since every context has, per definition, precisely one center, we can safely say "the center" here.

[11] A remark by the anonymous referee about my analysis of Amharic *I*, got me to reconsider not only the Amharic example, but the whole distinction between *de dicto* and *de re*.

the classical scopal analysis, where scope is derived dynamically from the independently motivated and pervasive mechanism of presupposition projection. A much more natural formulation of the *de re*/*de dicto* ambiguity in DRT would thus be to generate an underspecified PrelDRS where embedded definites trigger their usual presuppositions. Restoring the unity of the *think* predicate, we get only the trivial *de dicto* parse, and therefore only one PrelDRS for the *de dicto*/*de re* ambiguous example (6), repeated below, with unified PrelDRS:

(33)     John thinks the president of PepsiCo is rich

```
┌──────────────────────────────────────────────┐
│                    ┌──────────────────────────┐│
│                    │        rich(y)           ││
│  ┌ ─ ─ ─ ─ ┐       │  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ┐    ││
│  │    x    │ Bel_x │  │        y         │    ││
│  ├ ─ ─ ─ ─ ┤       │  ├ ─ ─ ─ ─ ─ ─ ─ ─ ┤    ││
│  │ john(x) │       │  │ pres_pepsi(y)    │    ││
│  └ ─ ─ ─ ─ ┘       │  └ ─ ─ ─ ─ ─ ─ ─ ─ ┘    ││
│                    └──────────────────────────┘│
└──────────────────────────────────────────────┘
```

If a presupposition triggered inside the scope of a Bel operator is bound[12] or accommodated inside the belief DRS, we get an output DRS with *de dicto* truth conditions:

(34)
```
┌────────────────────────┐
│           x            │
├────────────────────────┤
│         john(x)        │
│       ┌──────────────┐ │
│       │      y       │ │
│ Bel_x ├──────────────┤ │
│       │ pres_pepsi(y)│ │
│       │    rich(y)   │ │
│       └──────────────┘ │
└────────────────────────┘
```

If the presupposition projects out of the belief, as they prefer according to our PA algorithm, we should get *de re*. Only if the global, *de re* resolution is pragmatically infelicitous will we even try the local accommodation option represented above. Unfortunately, the *de re* outputs that we generate in this way are simply the wide scope representations refuted in 2.

I propose a solution that combines the unified native DRT+PA approach to *de re*/*de dicto*, with the insights from the relational analysis. The essential ingredient is a more refined mechanism of presupposition projection incorporating the occasional generation of acquaintance relations when projecting definites out of belief boxes.

(35)     [everything as in (28) except replace clauses (iv) and (viii) with the extended versions below]

---

[12]Note that on the standard definition of merging DRSs, there is nothing to bind to inside a belief apart from material introduced by the embedded clause itself. This is arguably inadequate because it often happens that an entity introduced *de dicto* in a belief report is picked up by an anaphoric element in a subsequent *de dicto* report. See Bary and Maier (2009) for examples and a solution involving a modification of the update mechanism compatible with the analysis presented here.
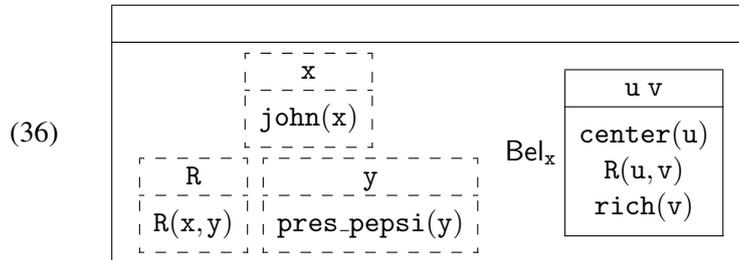
Binding:

iv-a. If the current local context, $\varphi_1$, is not the argument of a belief condition, i.e. if $\mathrm{Bel}_\xi\,\varphi_1 \notin Con(\varphi_2)$, than move $\pi$ from $\varphi_1$ to $\varphi_2$ and go back to (i)

iv-b. If $\varphi_1$ is the argument of a belief condition we must create an acquaintance presupposition while we move $\pi$ up. Say, the belief operator's subject parameter is x (i.e. $\mathrm{Bel}_x\varphi_1 \in Con(\varphi_2)$), and $\pi$'s presupposed referent is y. Choose a fresh relation variable R, and two fresh discourse referents u and v. Add the presupposition that some acquaintance relation holds between x and y, $\partial\langle\{\mathtt{R}\},\{\mathtt{R(x,y)}\}\rangle$, to $\varphi_2$. Move $\pi$ from $\varphi_1$ to $\varphi_2$. Replace all occurrences of y within $\varphi_1$ and its subDRSs with v. Finally, add u and v to the universe of $\varphi_1$, and $\mathtt{center(u)}$ and $\mathtt{R(u,v)}$ to the conditions of $\varphi_1$. Go to (i).

Accommodation:

viii-a.If $\varphi_2$, the next subDRS in the projection path, is not the argument of a belief condition, move $\pi$ from $\varphi_1$ to $\varphi_2$ and go back to (v)

viii-b.If $\varphi_2$ is the argument of a belief condition we must clean up the previously introduced acquaintance presupposition while we move $\pi$ up. Say, the belief operator's subject parameter is x, and $\pi$'s presupposed referent is y. Find and remove any presupposition of the form $\partial\langle\{\mathtt{R}\},\{\mathtt{R(x,y)}\}\rangle$, with some second-order, two-place relation variable R, from $\varphi_1$. Then, with that same R, find the $u,v \in U(\varphi_2)$ with $\mathtt{R(u,v)} \in Con(\varphi_2)$. Remove $\mathtt{R(u,v)}$ and v, then replace all remaining occurrences of v with y. Now move $\pi$ from $\varphi_1$ to $\varphi_2$. Go to (v).

To illustrate the extended resolution algorithm let's return to (33). To resolve the presupposition we first determine the projection path, consisting of the embedded and the global DRS. Local binding fails for lack of antecedents. So according to (iv) we have to move up, to the global DRS. Since this involves crossing a belief box we're directed to (35iv-b). In addition to moving the presupposition up, we have to create R, u, v, and the acquaintance presupposition. The result corresponds to what we would have otherwise got from the syntactically *res*-moved LF translated by (32b), i.e.:

(36)

| | | | | | u v |
|---|---|---|---|---|---|
| | x | | | | center(u) |
| | john(x) | | $\mathrm{Bel}_x$ | | R(u,v) |
| R | y | | | | rich(v) |
| R(x,y) | pres_pepsi(y) | | | | |

Now the context probably contains a suitable antecedent for y somewhere, or else we can try to accommodate it here. Only if the discourse context somehow does

not seem consistent with the introduction of a president of PepsiCo with whom John is acquainted, will we have to retrace our steps. In that case, we follow (viii-b) and clean up the new R presupposition and related materials, and try local accommodation. That gives us the previously represented *de dicto* output, (34). If global binding or accommodation does succeed, however, we are left with a new, second-order presupposition. The next section provides a method for binding those.

## 4.4 Acquaintance resolution

In this section I present my dynamic version of the relational unification of *de re* and *de se* reports. The leading idea is that acquaintance relations should be provided by the context rather than by existential quantification. More specifically, the idea is that this context-dependence can be formalized as a higher-order presupposition, whose resolution involves higher-order unification.

In the unified *de dicto/de re* system presented in 4.3, a global, *de re*, resolution of a belief embedded presupposition introduces a second-order acquaintance presupposition, involving a relation variable R that stands for the contextually supplied acquaintance relation and thus for the description under which the belief is held. In the resolution stage, this R is to be resolved by first trying to bind it to a suitable relation already present in the context DRS. This binding is subject to the usual pragmatic and semantic presupposition binding constraints (salience, accessibility, semantic match) i.e. it follows the resolution path described by our resolution mechanism (35).
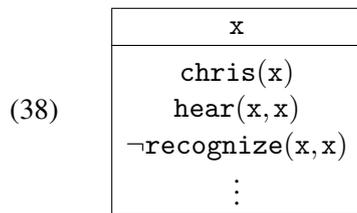
But now note that relations in a context DRS are typically represented by constants in conditions, not by higher-order discourse referents that we can bind to in the traditional DRT sense. So how can we ever find any plausible antecedent relation that matches the presupposed content? The solution is Higher-Order Unification (henceforth HOU, cf. Huet 1975; Dalrymple et al. 1991). This means that we equate the DRS condition that R holds between believer and *res* with a 'suitably parallel' condition from the context, and then find a unifying substitution for R to solve this (higher-order) equation. Resolution consists in applying this substitution to the whole DRS.

Before adding some additional restrictions, let's illustrate the story so far with an example resolution of (19). First, we construct the PrelDRS for the ambiguous (19), repeated below. Remember that, as far as syntax is concerned, we have only the straightforward '*de dicto*' parse. Hence the only PrelDRS we derive is (37):
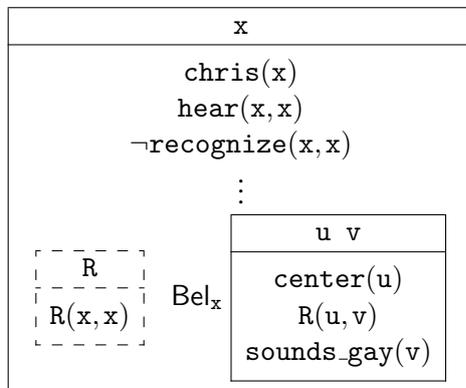
(37)     Chris thinks he sounds gay

$$\boxed{\begin{array}{|c|}
\hline
\phantom{xxxxx} \\
\hline
\left[\begin{array}{|c|} \hline \text{z} \\ \hline \texttt{chris(z)} \\ \hline \end{array}\right] \; \text{Bel}_z \; \begin{array}{|c|} \hline \phantom{x} \\ \hline \texttt{sounds\_gay(w)} \\ \left[\begin{array}{|c|} \hline \text{w} \\ \hline \texttt{he(w)} \\ \hline \end{array}\right] \\ \hline \end{array} \\
\hline
\end{array}}$$
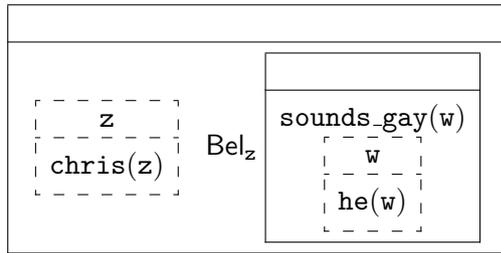
Next, we add this PrelDRS to a context, in this case a DRS where, among other things, it is salient (to the reporter and her audience) that Chris is hearing his own voice, though he doesn't realize it.

(38)
$$\begin{array}{|c|}
\hline
\text{x} \\
\hline
\texttt{chris(x)} \\
\texttt{hear(x,x)} \\
\lnot\texttt{recognize(x,x)} \\
\vdots \\
\hline
\end{array}$$

After the merge we start resolving, following the extended algorithm outlined in (35). The proper name presupposition is bound in its triggering domain. Then we turn to the embedded presupposition. This lacks a local antecedent, so it moves up to the main DRS. Since it thereby crosses a belief box it introduces an acquaintance presupposition. The original anaphor itself is then bound by Chris:

$$\begin{array}{|c|}
\hline
\text{x} \\
\hline
\texttt{chris(x)} \\
\texttt{hear(x,x)} \\
\lnot\texttt{recognize(x,x)} \\
\vdots \\
\left[\begin{array}{|c|} \hline \text{R} \\ \hline \texttt{R(x,x)} \\ \hline \end{array}\right] \; \text{Bel}_x \; \begin{array}{|c|} \hline \text{u v} \\ \hline \texttt{center(u)} \\ \texttt{R(u,v)} \\ \texttt{sounds\_gay(v)} \\ \hline \end{array} \\
\hline
\end{array}$$

We have bound the presuppositions triggered by *Chris* and *he* to the Chris from the context, but we have introduced a new second-order presupposition, which we must now try to bind to something in the context.

According to (38) all we know about $\texttt{R}$ is that $\texttt{R(x,x)}$ must hold. Actually, because $\texttt{R}$ is supposed to represent an acquaintance relation for a *de re* belief, we also know from the discussion in 2.3 that $\texttt{R}$ must be a vivid relation of acquaintance, preferably a direct perceptual link between its arguments, though I will continue to suppress this general information in example representations. Since $\texttt{x} = \texttt{x}$ always holds, and equality is a highly vivid relation of acquaintance (cf. 3.2) we can try

binding R to $=$, the relation of identity. Higher-order binding consists in replacing all occurrences of R by $=$. This gives the output in (39), reporting that Chris thought "I sound gay", as shown in the example semantic computation of a structurally identical DRS in (31):

(39)

$$\text{Bel}_x \begin{array}{|c|} \hline \vdots \\ \hline \begin{array}{|c|} \hline \text{u v} \\ \hline \begin{array}{c} \texttt{center(u)} \\ \texttt{u} = \texttt{v} \\ \texttt{sounds\_gay(v)} \end{array} \\ \hline \end{array} \\ \hline \end{array} \quad = \quad \text{Bel}_x \begin{array}{|c|} \hline \vdots \\ \hline \begin{array}{|c|} \hline \text{u} \\ \hline \begin{array}{c} \texttt{center(u)} \\ \texttt{sounds\_gay(u)} \end{array} \\ \hline \end{array} \\ \hline \end{array}$$

If the subject had been Frank instead of Chris, this *de se* reading would have been just right, but for Chris it happens to be false in the current scenario. We'll have to dig deeper to get the true *de re* reading that we expect for Chris. We'll use HOU for that purpose below.

First we will pause to formulate an essential constraint on acquaintance resolution, inspired by the remarks about *de se* above: When resolving an acquaintance presupposition that is presupposed to hold between a subject and himself we must try to bind to the (universally available) relation of equality first. This restriction ensures a preference for *de se* readings in co-referential reports, thus answering the first objection against the relational framework, briefly mentioned at the end of 3.2, viz. that the relational analysis fails to account for any differences in acceptability between the two 'readings' of a *de re/de se* report. The proposed 'equality first' principle explains why people hesitate to accept (19) as a true report of our mistaken identity scenario. When interpreting such a report, we first resolve to equality, which leads to an incoherent output DRS, and then we have to recompute and search the context for a suitable acquaintance relation.

Now to continue the derivation of the marked, non-*de se* reading of (19). We saw that the default failed, so we try other resolution options in the order specified by the algorithm in (35). In this case, that means we search the global context for a salient and parallel condition to match $\texttt{R(x,x)}$. We find that $\texttt{hear(x,x)}$ is the only suitable (vivid, perceptual, salient) statement of a relation between x (Chris) and himself. So we equate these statements:[13]

(40)     $\texttt{R(x,x)} \doteq \texttt{hear(x,x)}$

We proceed by using HOU to determine a non-trivial[14] substitution that unifies this

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[13]I use $\doteq$ to denote 'formal equality' of lambda terms, rather than mere semantic co-reference.

[14]In fact, there are infinitely many solutions, which may be grouped into four different equivalence classes (under $\alpha\beta\eta$-interconvertability of $\lambda$-terms):

(i)     $\texttt{R(x,x)} \doteq \texttt{hear(x,x)}$

    a.  $\big[\texttt{R} \mapsto \lambda\texttt{s}\lambda\texttt{t}[\texttt{hear(x,x)}]\big]$
    b.  $\big[\texttt{R} \mapsto \lambda\texttt{s}\lambda\texttt{t}[\texttt{hear(x,t)}]\big]$

higher-order equation:

(41)     $\big[\texttt{R}{\mapsto}\lambda\texttt{s}\lambda\texttt{t}[\texttt{hear(s,t)}]\big]$

Applying this substitution to our DRS gives:

(42)

$$
\text{Bel}_\texttt{x}\left[\;\vdots\quad \boxed{\begin{array}{c} \texttt{u v} \\ \hline \texttt{center(u)} \\ \texttt{hear(u,v)} \\ \texttt{sounds\_gay(v)} \end{array}}\;\right]
$$

In this final output DRS, Chris ($\texttt{x}$) thinks he ($\texttt{u}$) is hearing someone ($\texttt{v}$) who sounds gay.

The example above demonstrates how treating acquaintance as a presupposition derives both *de se* and *de re* readings from a unified, compositional PrelDRS and a slightly modified DRT+PA resolution algorithm. What sets the account apart from its rivals is that it falls squarely within semantics/pragmatics. I do not rely on any syntactic ambiguities, movements, or morpho-phonological subtleties (like feature deletion under agreement à la von Stechow (2002)). Instead I use only the independently motivated mechanisms of DRT+PA and HOU, in combination with the general relational analysis of *de re*. This account is the first to cash out the vague idea of context-dependent acquaintance formally, by switching to a dynamic framework. Another advantage of treating acquaintance as a presupposition is the built-in explanation of the observed difficulty of interpreting co-referential pronoun reports non-*de se*, viz. by deriving a non-*de se* derivation only when equality fails and an alternative is contextually salient, as in our mistaken identity case.

## 5   Beliefs about beliefs

An interesting testbed for our semantics is the case of iterated belief reports, i.e. reports of beliefs about beliefs. For instance:

(43)     John believes that Mary thinks I'm cool

This sentence reports a *de re* belief (John's belief about Mary) about another *de re* belief (Mary's belief about me). In 5.1 I show that the doubly embedded *I* in (43) is problematic for the classical relational account, in a context where John *thinks* there is a *de re* belief between Mary and me, while *in fact* Mary's belief was

---

c.     $\big[\texttt{R}{\mapsto}\lambda\texttt{s}\lambda\texttt{t}[\texttt{hear(s,x)}]\big]$
d.     $\big[\texttt{R}{\mapsto}\lambda\texttt{s}\lambda\texttt{t}[\texttt{hear(s,t)}]\big]$

The first three lead to nonsensical output DRSs, so we could discard them for that reason. Alternatively, we could formulate a constraint that states that each parallel variable (here, both $\texttt{x}$'s) should be non-vacuously abstracted over.

about someone else. In 5.2 I show the extra, syntactic stipulation needed to account for this problem in the classic relational account. Finally, in 5.3 I show how my presuppositional account deals with the example automatically and compare that with the syntactic account.

## 5.1 The puzzle of the doubly embedded indexical

Consider the following, new scenario:

(44) John and Mary are friends. Mary says: "That guy is cool". John thought she was pointing to me. In fact, she's pointing to Peter.

From Mary's utterance it follows that she has a *de re* belief, not about me, but about Peter. I would be entitled to report her belief as (45a), but not (45b):

(45) a. Mary thinks Peter is cool
     b. #Mary thinks I'm cool

John also has a *de re* belief, about Mary. Since he is confused about the object of her belief he would disagree with our judgments in (45). Because he thinks Mary's belief is about me, we intuitively judge (46) true:

(46) John believes that Mary thinks I'm cool

The puzzling observation is that we use a first person pronoun in (46) even though neither John's nor Mary's belief appears to be *de re* about me. More precisely, the straightforward relational parse paraphrasable as *John believes of Mary that she believes of me that I am cool* of (46) fails to capture the correct truth conditions.

To see why, let's apply the classic relational account of section 2–3. The most straightforward parse moves both *Mary* and *I* to the *res* positions of their attitude verb:

(47)
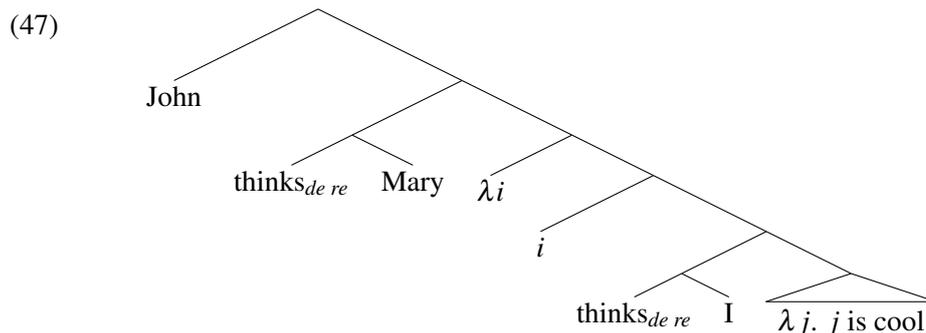


Applying our translation rules we can see why this tree does not represent a sensible reading. For readability I'll use $\alpha_u^R$ as an abbreviation of $\mathtt{the}(\lambda v(R(u,v)))$, 'the unique individual that $u$ is R-acquainted with':

(48) $\exists R[R(j,m) \wedge \mathsf{Bel}_j \lambda u \exists R'[R'(\alpha_u^R, i) \wedge \mathsf{Bel}_{\alpha_u^R} \lambda u'[\mathtt{cool}(\alpha_{u'}^{R'})]]]$

26

The problem with (48) is that there is an indexical, i, occurring inside a semantic belief operator ($Bel_j$). Now, indexicals are rigid designators (Kaplan 1989), which means that they behave semantically like variables bound from outside the intensional operator. Hence, like the wide scope descriptions rejected in 2.3, they create singular propositions. In other words, we should be able to create a double vision scenario to disqualify this logical form. We achieve this by adding to our scenario (44) a second encounter between John, Mary and me:

(49)  John and Mary meet me again. John doesn't recognize me from the first encounter. Mary to me: "You're a dork"

John might report this to me as (50a), which I in turn could report with (50b):

(50)  a.  John to me: "Mary thinks you're not cool"
      b.  John believes that Mary thinks I'm not cool

We find that in the extended scenario, (44)+(49), both (43) and (50b) are true, the latter analyzed on a par with the former as *John believes* de re *of Mary that she believes* de re *of me that I am not cool.*

The next step in the argumentation against the syntactic analysis in (47) would be to derive an Ortcutt-like contradiction from the occurrence of a single rigid designator, i, in the two contradictory belief contents ascribed to John. The fact that these belief contents are themselves beliefs, containing existential quantification over acquaintance relations, complicates matters somewhat. It is after all quite possible that Mary knows me under two distinct guises and thus has two distinct beliefs that John knows are *de re* about me. To rule out this possibility we simply add to our story that John thinks Mary met me only once. Because John doesn't recognize me on the second encounter, the unique acquaintance he believes to exist between me and Mary is the one underlying the first scene (which, moreover, is *in fact* an acquaintance relation between Mary and Peter). With this addition we can indeed derive that John believes that Mary believes a contradiction, viz. that a certain individual, me, known under only one guise, is both cool and not cool.
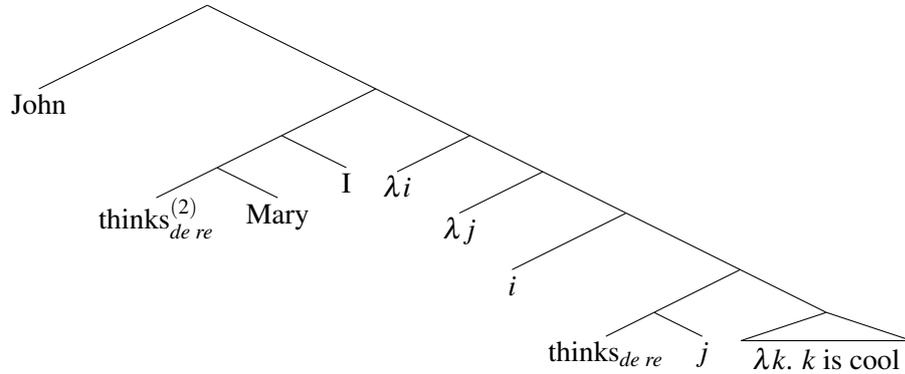
## 5.2  Fixing the relational account: longer *res* movement

Having pinpointed the problem thus, a solution within the relational framework presents itself. What we must do is move the doubly embedded *res* one step further, leaving behind a descriptive guise in the logical representation of John's belief as well as in Mary's. This means that John's belief is *de re* about two individuals, Mary and me. To represent this syntactically we need to generalize the *thinks*<sub>de re</sub> predicate to take multiple *res*. Here's the version with two *res*:

(51)  $thinks^{(2)}_{de\ re} \longrightarrow \lambda y_1 \lambda y_2 \lambda P \lambda x \exists R_1 \exists R_2 [R_1(x, y_1) \wedge R_2(x, y_2) \wedge Bel_x \lambda u [P(\alpha_u^{R_1}, \alpha_u^{R_2})]]$

With this generalized *de re* attitude operator we can represent a proper LF:

(52)

$$\text{John} \quad \text{thinks}^{(2)}_{de\ re} \quad \text{Mary} \quad \text{I} \quad \lambda i \quad \lambda j \quad i \quad \text{thinks}_{de\ re} \quad j \quad \lambda k.\ k \text{ is cool}$$

An attempt at an explicit semi-natural language paraphrase: John believes of Mary and of me that the former believes of the latter that he is cool. The indexical first person pronoun is moved outside both belief embeddings, so this relational interpretation should be immune to the double vision problem.

To see that (52) indeed does not suffer from double vision, note that in (52) John no longer has to believe his representation of Mary ($\alpha_u^{R_1}$) to be acquainted with the *actual me* (i), as was the case with (47), but rather with *his representation of* the actual me under $R_2$ ($\alpha_u^{R_2}$). John's mistaking me and Peter in the first scene, (44), exploits precisely this distinction between whom one is acquainted with and whom one believes to be acquainted with.

To verify that (52) really does represent a plausible, contradiction-free reading of (43), I will describe the acquaintance relations that play a role in the *de re* beliefs involved. For ease of reference then let's first write out the logical translation of (52), which shows the three existentially quantified acquaintance relations.

(53)   $\exists R_1 \exists R_2 [R_1(j,m) \wedge R_2(j,i) \wedge Bel_j \lambda u \exists R_3 [R_3(\alpha_u^{R_1}, \alpha_u^{R_2}) \wedge Bel_{\alpha_u^{R_1}} \lambda u'[cool(\alpha_{u'}^{R_3})]]]$

For $R_1$ we can take John's actual relation to Mary in the first scene, i.e. their being friends. For $R_2$ we must take John's acquaintance with me, but the scenario doesn't explicitly specify any such acquaintance. It does say that John "thinks Mary is pointing to me", which presupposes that John does in fact know me. This implicit way by which John is acquainted with me is our $R_2$. Now, $R_3$ is supposed to hold in John's beliefs between his representation of Mary under $R_1$ (*my friend*) and his representation of me under $R_2$ (*that guy Emar*, say). We can take $R_3$ to be the salient seeing and pointing relation as witnessed by John in the first scene. The content of the belief he ascribes to Mary is then that she believes the person she's pointing to is cool, which is in line with the story.

As for the negative counterpart report, (50b), note that we can take the same representation of Mary, $R_1$, but the acquaintance between me and John is different. The relevant relation here is the perceptual one that goes with the new pointing on the second encounter, (49). John is acquainted with me as *that guy over there that Mary is pointing at*. The third acquaintance relation, between "my friend Mary" and "the person I see Mary pointing at", is, again, that very pointing/seeing

relation. The content of the belief John ascribed to Mary is then that the person she is pointing at is not cool. This, too, fits the story precisely. And since the two beliefs John ascribes to Mary on the basis of our two encounters are really about different representations (of a single me) there is no contradiction.

I conclude from this and the previous section that the interpretation of iterated *de re* belief ascriptions of depth *n*, strictly require chains of *n res* movements, as demonstrated above for $n = 2$. At the end of this section I briefly discuss the consequences of this discovery.

## 5.3 Resolving embedded acquaintance presuppositions

In this section I show that my presuppositional account automatically derives a representation equivalent to the stipulative long *res* movement LF required by the classic relational account.

Applying the PrelDRS construction algorithm to our iterated report leaves everything *in situ*:
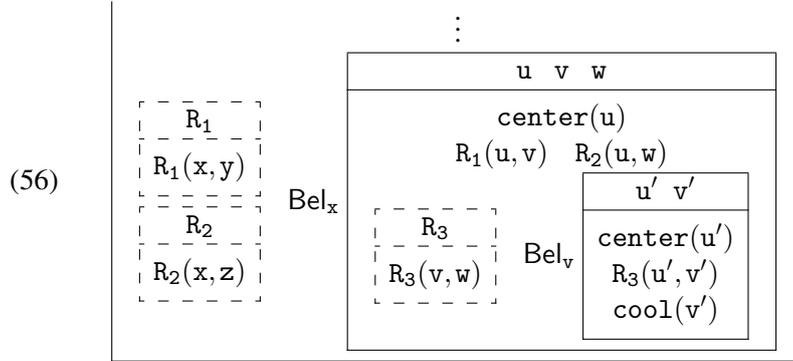
(54)  John believes that Mary thinks I'm cool
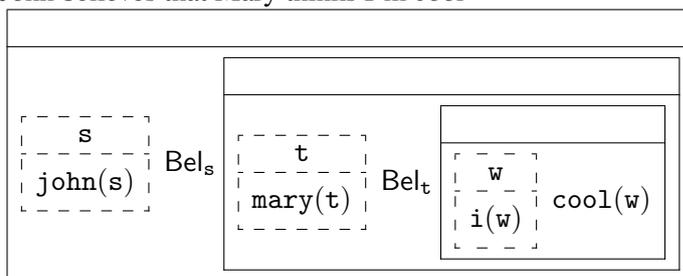


The relevant input context is extracted from the scenario in (44). On the basis of the discussion in 5.2 above I already add the information (implicitly conveyed by (44)) that John knows me:[15]

(55)

| x | y | z | s |
|---|---|---|---|
| john(x) | mary(y) | speaker(z) | peter(s) |
| friends(x,y) | | emar(z) | point(y,s) |
| | | know(x,z) | |
| | | ⋮ | |

We merge (55) and (54) and start the resolution process. The outermost NP (*John*) and the two embedded ones (*Mary* and *I*) have each triggered a presupposition. Each of them will find an antecedent in the main DRS. For the latter two however that means crossing one, or even two belief boxes. Following our resolution algorithm each crossing introduces an acquaintance presupposition, rep-
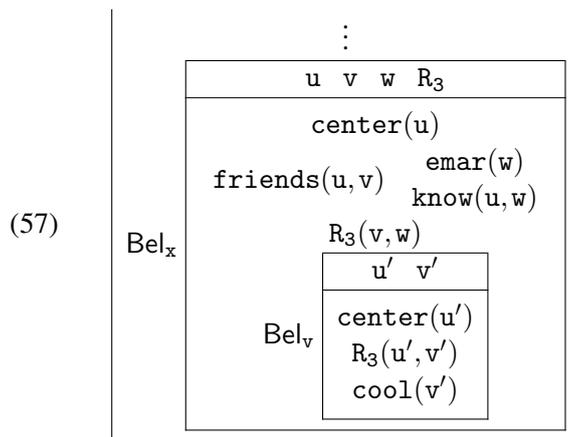
---

[15]It is not absolutely necessary to assume this information to be present at the context at this point. It may well be accommodated at a later stage.

resenting the *de re* character of those 'wide scope' resolutions. Binding the *res* to their obvious antecedents in the context thus leaves us with three acquaintance presuppositions:

(56)

```
                            ⋮
                    ┌─────────────────────────────────────┐
                    │           u   v   w                  │
                    ├─────────────────────────────────────┤
      ┌ ─ ─ ─ ─ ┐   │            center(u)                 │
      ┆   R₁    ┆   │      R₁(u,v)   R₂(u,w)               │
      ┆ R₁(x,y) ┆   │                    ┌──────────────┐  │
      ┆─ ─ ─ ─ ─┆Belₓ  ┌ ─ ─ ─ ─ ┐      │    u′  v′     │  │
      ┆   R₂    ┆   │   ┆   R₃    ┆      ├──────────────┤  │
      ┆ R₂(x,z) ┆   │   ┆ R₃(v,w) ┆ Belᵥ │  center(u′)  │  │
      └ ─ ─ ─ ─ ┘   │   └ ─ ─ ─ ─ ┘      │  R₃(u′,v′)   │  │
                    │                    │   cool(v′)    │  │
                    │                    └──────────────┘  │
                    └─────────────────────────────────────┘
```

The outermost acquaintance presuppositions should be bound, by HOU, in the global context. $R_1$ is easily bound to the two being friends, as stated explicitly in the scenario and consequently represented in the context DRS. $R_2$ is supposed to be a relation between John and me. It can be bound too because we've assumed a context where John already knows me, as someone named Emar (simplistically represented as the conjunction of the two relevant conditions from the context: $emar(z)$ and $know(x,z)$).

Finally, we turn to the embedded acquaintance presupposition $R_3$, which relates John's $R_1$ representation of Mary with his $R_2$ representation of me. There is nothing to bind to locally, and the presupposition cannot be moved outside the belief box without creating unbound variables ($v$ and $w$).[16] So, according to our resolution algorithm, we must accommodate it locally. Modeling acquaintance accommodation just like first order presupposition accommodation, we end up with the following output DRS:

(57)

```
                    ⋮
          ┌───────────────────────────────┐
          │        u   v   w   R₃          │
          ├───────────────────────────────┤
          │           center(u)           │
          │                     emar(w)    │
          │      friends(u,v)             │
          │                    know(u,w)   │
      Belₓ │          R₃(v,w)              │
          │          ┌──────────────┐     │
          │          │    u′  v′     │     │
          │          ├──────────────┤     │
          │     Belᵥ │  center(u′)  │     │
          │          │  R₃(u′,v′)   │     │
          │          │   cool(v′)    │     │
          │          └──────────────┘     │
          └───────────────────────────────┘
```

---

[16] In PA terminology, the presupposition is 'trapped'. I'll assume that this purely syntactic check for unbinding variables is part of the computation of the accessibility path in (28).

This DRS correctly captures the semantics of the iterated report, as it ascribes the following thought to John: "There is an acquaintance between my best friend and that guy I know called Emar, and the former believes the person she is so acquainted with is cool".

To conclude this section, let's compare the two solutions to 'puzzle of the doubly embedded indexical'.

The first adds to the classic relational account a stipulation enforcing maximal *res* movement in the syntax. *Res* movement is at the heart of the classic account as presented in sections 2–3. It is needed because the relational semantics requires the complement to be split into a separate *res* and ascribed predicate.[17] On the other hand, *res* movement is also the account's most heavily criticized feature:

> Linguists could object that '*res* movement', i.e., the movement of [the *res*] from the specifier position to the left boundary of the sentence violates well-established locality restrictions and is not attested elsewhere in syntax. [von Stechow and Zimmermann 2005:3]

It is this same mechanism that Schlenker (2004) calls "magic" (p.21). Von Stechow and Zimmermann add that it makes the relational account "much more complicated [than Kaplan's]" (p.3), as does Anand (2006:26), who deems it "salutary to remove the complex machinery of *res* movement from the grammar". Von Stechow and Zimmermann, finally, even blame *res* movement for making the account "non-compositional" (p.15), on the understanding that a strictly surface compositional semantics would have to interpret the *res in situ*, as fully integrated in the embedded clause.[18] In light of this discussion the result arrived at in section 5.2, that iterated belief requires even longer *res* movements, may be construed as extra evidence against the classic relational account.

On the presuppositional acquaintance framework, the iterated belief with embedded indexical does not cause any problems. The definite NPs (*John*, *Mary*, *I*) each trigger their presuppositions in situ. These presuppositions are naturally bound in the actual context, introducing the relevant acquaintance presuppositions in the process. Resolving these presuppositions then gets us the desired reading. It is thus the independently motivated, standard presupposition resolution algorithm which ensures that the indexical is interpreted *de re* in the main context, so the problem signalled in 5.1 never arises arise.

---

[17]This separation by syntactic *res* movement is precisely what sets apart the classic relational analysis from the rival analysis based on Kaplan's 'Adding "Says"' (1989, ch.XX). In a sense, the belief semantics based on Kaplan's analysis of indirect speech is truly compositional, without requiring movements, and covers *de dicto*, *de re* and *de se* uniformly. However, as von Stechow and Zimmermann show, this approach fails to predict adequate truth conditions for almost every belief ascription. For detailed proof of the inadequacy of a Kaplanian belief semantics, I refer to the proofs in their paper.

[18]In a different sense, resorting to syntactic movement is done precisely to allow a strictly compositional formulation of the semantics proper. The problem however then rears its head in the syntax: how to motivate the movement syntactically?

Note further that the presuppositional derivation shows that the full power of PA resolution is needed for an acquaintance-based *de re* semantics. Thus the predicate *presupposition* as something that can be bound or accommodated in the global context or in some non-global sentence internal position, seems warranted. I discuss a further case of acquaintance accommodation in section 6 below.

# 6  Quantified belief reports

In this section I show how our system deals with quantified belief reports such as (58).

(58)     Each guy thinks he sounds gay

After reviewing the data (6.1), I show that the classic accounts of sections 2–3 fail with respect to these data (6.2), and then show that we really need the flexibility provided by treating acquaintance as a presupposition in DRT+PA (6.3).

## 6.1  Judging quantified reports in a mixed context

Consider again the experiment in which Frank and Chris hear recorded voice samples and judge them gay. Unlike Frank, Chris does not realize he has just judged his own voice. Our first reaction may be to say that (58) is false as Chris would never wittingly describe his own voice as gay; only Frank thinks he sounds gay.

Indeed we find this intuition in the literature. Consider Chierchia's discussion of a universally quantified report parallel to our (58):

> (59)     Everyone in that room thinks that he is Hume
>
> The most plausible interpretation of (59) claims that each person in the relevant room has a certain de se attitude (perhaps due to schizophrenia[ia]).                    [Chierchia 1989:10]

On the basis of that general judgment, (58) must be false because only Frank has the relevant *de se* attitude. Note that this evidence is somewhat circumstantial, in the sense that Chierchia does not explicitly consider what would happen in a 'mixed' *de re/de se* context like ours.[19]

But we could also argue as follows. Since we have judged both (18) (about Frank) and (19) (about Chris) true individually, in our mixed scenario, we are bound to judge their conjunction true, and from there we proceed immediately to judging (58) true as well. Zimmermann (p.c.), explicitly considering a universally quantified report like (58) in a mixed scenario, reports the same judgment:

---

[19]Other, even more circumstantial evidence for the falsity judgment comes from Percus and Sauerland (2003a). They claim that native speakers judge the *only* converse of a universal report (*only Frank thinks he sounds gay*) true in a mixed scenario. From that judgment it seems plausible to conclude that (58) must be false.

universally quantified reports do not require everybody in the domain to have the same *de se* attitude.

The picture that emerges from the scarce data discussed above is the following: whenever a quantified subject binds a belief report's *res*, there is a preference for 'universal *de se*' readings, but under contextual pressure, such as with (58) in a mixed context where the universal *de se* reading would be false, we can allow different *de re* and *de se* acquaintance relations. This reconciles Chierchia's remark with Zimmermann's. Moreover, this default preference for universal *de se* is entirely parallel to the observed preference for *de se* in simple reports, and should come out as a derivative thereof in the final semantic analysis.

## 6.2 Previous attempts: *de re/de se* unification vs. separation

First, let's apply the standard relational *de re/de se* semantics of section 3.1–3.2. Assume a *de re* parse with *res*-moved *he*, bound by a quantifier-raised *each guy*:

LF:
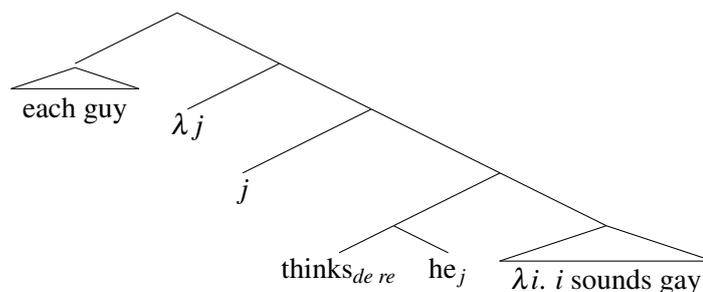


Translating *each guy* as a generalized quantifier, as in (60), we'd get the truth conditions in (61):

(60)    each guy $\longrightarrow \lambda X \forall x[\mathtt{guy(x)} \to X(x)]$

(61)    (58) $\longrightarrow \forall x[\mathtt{guy(x)} \to \exists R[R(x,x) \land \mathrm{Bel}_x \lambda u[\mathtt{sounds\_gay(the(\lambda v(R(u,v))))}]]]$

In this representation, each of the guys has a *de re* belief about himself, i.e. each is *in some way* acquainted with himself and believes under that acquaintance relation that he sounds gay. In this weak reading it is not required that they both have the same acquaintance relation, just that for each individual we can find a suitable one. In the mixed scenario we can: equality for Frank, 'the person whose voice I'm hearing' for Chris. Thus, the sentence is predicted to be true. Conclusion: the plain relation semantics derives Zimmermann's judgment, but not the default all-*de se* behavior predicted by Chierchia/Percus & Sauerland.

Then consider Chierchia's *de se* separatist account, discussed in 3.3. Chierchia introduces a syntactic ambiguity between *de re* and *de se* LFs. On a *de se* parsing we get universal *de se* truth-conditions:

(62)    Each guy thinks he sounds gay

LF:

each guy   $\lambda j$
                $j$
                    thinks$_{de\ se}$
                              $\lambda i.\ i$ sounds gay
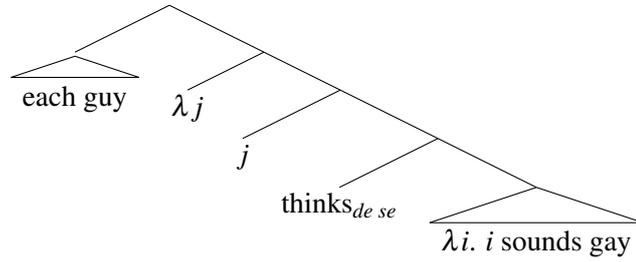
$\forall x[\mathrm{guy}(x) \rightarrow \mathrm{Bel}_x \lambda u[\mathrm{sound\_gay}(u)]]$

In the mixed scenario the strong reading represented by this LF is false, because Chris doesn't have the required *de se* belief. This prediction corresponds to the judgments suggested by the data from Chierchia and Percus & Sauerland. The question is whether the other reading somehow captures the Zimmermann judgment. This, it turns out, depends on how the separatist understands '*de re*'. If it means mere *de re*, excluding *de se*, then the '*de re* LF' is also false, because only Chris holds such a strictly *de re* belief. If, however, the *de re* reading would include *de se* as a special case, as when we take the LF and semantics of the plain relational account for the second reading, we'd get a true reading.

Chierchia's own account is unclear about the semantics of the *de re* LF but Percus & Sauerland seem to hold this 'overlapping meanings' view of the ambiguity. The prediction is that (58) has both a true and a false reading in our mixed scenario, allowing us to make some sense of the conflicting intuitions of Chierchia and Zimmermann. Moreover, if they would stipulate a general preference for *de se* LFs they would even get the observed default behavior right (for both embedded and simple reports).

My objections against this kind of approach are not so much empirical as methodological. Very generally, one should avoid resorting to syntactic ambiguity. We'll see below how the evidence in favor of the ambiguity can be accounted for in a non-ambiguous way by using dynamic acquaintance resolution. For now, let me point out another theoretical desideratum. We would like to derive the preference for *de se* from something more basic. Also, postulating a preference for a certain LF in a static framework cannot quite capture the idea of *contextual pressure* overriding a given default. It is in its analysis of this context-dependence that the dynamicity of my presuppositional account paid off in the case of unembedded reports, so let's see how that extends to the quantified version.

## 6.3   Presupposing acquaintance

Recall that a major advantage of the presuppositional framework over its relational inspiration was the built-in preference ranking of unifying acquaintance relations, leading to the desired context-driven asymmetry between *de se* resolution and contextually supplied mere *de re* ones. It may be hoped that this will give us precisely what's needed in the quantified case, a preference for universal *de se* that may give under contextual pressure.

Let's see what happens when we interpret the quantified report (58) against the background of a DRS representing the mixed scenario. The PrelDRS is generated straightforwardly: *he* triggers a presupposition, the belief report is parsed compositionally, and *each guy* is a generalized quantifier, built with DRT's dynamic universal quantifier $\Rightarrow$:

(63)   each guy $\longrightarrow \lambda X$ 

$$\boxed{\;\boxed{\begin{array}{c} \text{z} \\ \hline \text{guy(z)} \end{array}}\;\Rightarrow\;\boxed{\begin{array}{c}\;\\ \hline \text{X(z)} \end{array}}\;}$$

When we add the PrelDRS to the context we get:

(64)

$$\boxed{\begin{array}{c} \text{x} \qquad\qquad \text{y} \\ \hline \text{chris(x)} \qquad \text{frank(y)} \\ \text{hear(x,x)} \\ \neg\text{recognize(x,x)} \\ \vdots \\ \boxed{\begin{array}{c}\text{z}\\ \hline \text{guy(z)}\end{array}} \Rightarrow \text{Bel}_z \boxed{\boxed{\begin{array}{c}\text{sounds\_gay(w)}\\ \dashV \text{w} \\ \dashV \text{he(w)}\end{array}}} \end{array}}$$

The pronoun will have to cross a belief box to find a suitable antecedent, thus introducing a second-order acquaintance presupposition before binding in the restrictor of the quantifier, to the quantified variable z:

(65)

$$\boxed{\begin{array}{c} \vdots \\ \boxed{\begin{array}{c}\text{z}\\ \hline \text{guy(z)}\end{array}} \Rightarrow \boxed{\begin{array}{c}\text{R}\\ \hline \text{R(z,z)}\end{array}} \text{Bel}_z \boxed{\begin{array}{c}\text{u v}\\ \hline \text{center(u)}\\ \text{R(u,v)}\\ \text{sounds\_gay(v)}\end{array}} \end{array}}$$
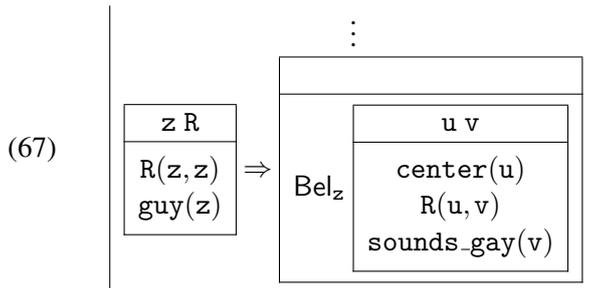
The result so far reads: each guy has a *de re* belief about himself that he sounds gay, under an unspecified acquaintance relation.

Now we must resolve the acquaintance relation R. According to the built-in preference for *de se* we should always try equality first. Substituting equality for R and simplifying the representation a little gives (66), Chierchia's universal *de se* reading:

(66)

$$\left[\;\begin{array}{|c|}\hline z\\\hline \texttt{guy(z)}\\\hline\end{array}\;\Rightarrow\;\texttt{Bel}_z\;\begin{array}{|c|}\hline u\\\hline \texttt{center(u)}\\ \texttt{sounds\_gay(u)}\\\hline\end{array}\;\right]$$
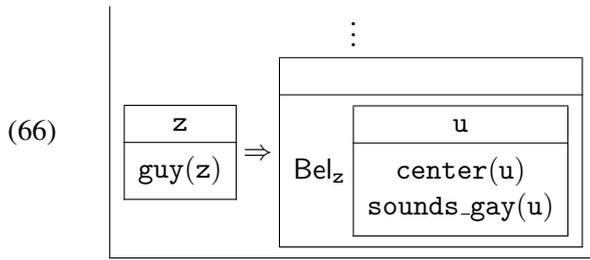
However, as noted above, this universal *de se* reading may be preferred in general, but it is false in our mixed scenario. So, in this particular case we go back and try to find a different relation for R to bind to. Binding R means finding a suitable condition relating z to z to equate the presupposed content $R(z,z)$ to. But because z is introduced locally, by the quantifier, there is no such condition to be found anywhere in the DRS. As with the embedding in 5.3, the presupposition is trapped inside the quantifier, where it cannot find a proper antecedent. So, again as in the derivation in 5.3, when binding fails we turn to accommodation.

Following the algorithm specified in (35) we first try accommodation in the highest accessible DRS, where binding failed, i.e. the restrictor. Accommodation at subDRS $\varphi$ means merging the presupposition with $\varphi$. Restrictor accommodation gives (67):

(67)

$$\left[\;\begin{array}{|c|}\hline z\ R\\\hline \texttt{R(z,z)}\\ \texttt{guy(z)}\\\hline\end{array}\;\Rightarrow\;\texttt{Bel}_z\;\begin{array}{|c|}\hline u\ v\\\hline \texttt{center(u)}\\ \texttt{R(u,v)}\\ \texttt{sounds\_gay(v)}\\\hline\end{array}\;\right]$$

On our current analysis of universal quantification, a condition of the form $\varphi \Rightarrow \psi$ means that *all* discourse referents in the restrictor $\varphi$ are universally quantified over. With such a semantics, (67) would mean that for all guys $z$ and all their self-acquaintance relations $R$, $z$ would believe the person he's $R$-acquainted with to sound gay. Since everybody is at least acquainted with himself under equality, (67) would be even stronger than the universal *de se* reading (66), which was already false in our scenario.

We could simply accept this and, following the resolution algorithm, move on to try the next accommodation site, which amounts to local accommodation (see (69) below). But we can do even better, by adopting a selective binding mechanism. This means that we replace $\Rightarrow$ with a so-called duplex condition that specifies which variables are quantified over. The unquantified discourse referents in a quantifier domain are then simply existentially quantified over, as usual in DRT. To deal with the odd case where a scope DRS contains an unquantified variable introduced existentially in the restrictor (which is precisely what happens with R in

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(67)), we copy the restrictor into the scope, semantically:

(68) $f \models \varphi \left\langle \begin{smallmatrix} \forall \\ \Xi \end{smallmatrix} \right\rangle \psi$ iff for all extensions $g \supseteq_\Xi f$ verifying $\varphi$ there is a further extension $h \supseteq_{U(\varphi)\backslash\Xi} g$ that verifies $\varphi \oplus \psi$

Under this refined DRT view of quantification, the restrictor accommodation DRS (67) means that all guys that have some acquaintance to themselves, are guys that have an acquaintance to themselves under which they believe they sound gay. And since everybody always bears some acquaintance to himself, this information is semantically redundant in the restrictor, and (67) turns out to be equivalent to the DRS we'd get from local accommodation:

(69)
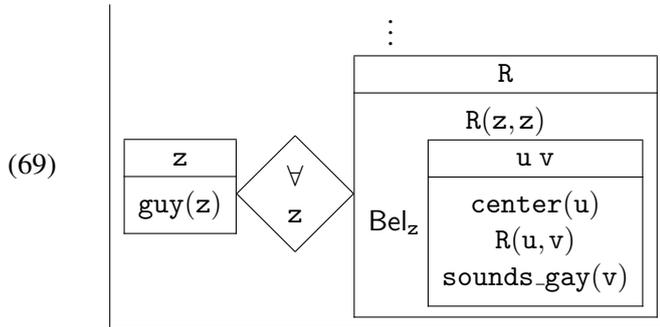


This represents the desired reading, truth-conditionally equivalent to the one generated by the relational account (61): for each of the guys we can find some acquaintance relation under which they think they sound gay.

To sum up, the static relational account derives only Zimmermann's true reading, while (an amended version of) the separatist account derives both Chierchia's and Zimmermann's a matter of syntactic ambiguity. With acquaintance presuppositions we also get both Chierchia's reading, by binding to equality, and Zimmermann's, by local accommodation, but now without the need for a syntactic ambiguity. What's more, relying solely on the independently motivated mechanisms of PA, the former comes out as the preferred, default option while the latter only surfaces in exceptional contexts like our mixed scenario because that default fails to give a consistent output there. As in the test case discussed in section 5, we've used both binding and accommodation in the resolution of the acquaintance variable. I take this a sufficient justification for the strong claim that acquaintance is not simply context-dependent, but really is best thought of as a presupposition, as modeled within a representational dynamic theory like DRT+PA.

# 7 Shifted indexicals and *de se* pronouns

In sections 3, 4 and 6 we have discussed sentences of the form *x believes that he is P* that report beliefs about oneself. The reason such co-referential reports are interesting is that they have both *de se* and *de re* interpretations, even when

embedded under quantifiers. We have noted that the former is the default, with the latter surfacing only in mistaken identity scenarios. We have been comparing two types of analyses. The one postulates a syntactic ambiguity between *de re* and *de se* LFs, the other, my own, provides a uniform, underspecified representation, pushing the *de re/de se* distinction from syntax down to pragmatics. I successfully countered one of the arguments from the separatists, based on Chierchia's universal *de se* reading of quantified reports in section 6. In the current section we answer another, more serious challenge for unified relational approaches.

This challenge involves reports that have only *de se* readings. The central observation, which has attracted some attention in the recent semantics literature, is that natural languages provide different ways of constructing such '*de se* reports'. Because the relational analysis of *de re* treats *de re* and *de se* as special cases of a general relational LF, or in our cases as particular contextual resolutions of a single PrelDRS, it naturally has trouble accounting for constructions that are purely *de se*. In a sense this is precisely the downside of the *de re/de se* unification motivating the relational analysis. Therefore, all unificational *de re/de se* analyses, including Kaplan's quantified characters and my acquaintance presuppositions, are expected to inherit this difficulty.

So what are the data? *De se* reports come in three varieties: (i) reports with shifted first person subjects; (ii) infinitival and gerundial reports with silent PRO subjects, as discussed in 3.3; and (iii) reports with logophoric subjects. In 7.1 I show that my unification of not only *de re* and *de se* but also *de dicto* makes for a very attractive analysis of *de se* reports of the shifted first person variety. The idea is that rather than assigning them a dedicated *de se* LF (cf. e.g. Schlenker 2003), or treating them as *de re* reports (cf. Maier 2006, 2009), shifted reports come out as *de dicto* reports, if we just follow our previously established unified representations and resolution algorithm. In 7.3 I show why this analysis does not extend to (ii) and (iii), and then follow Anand (2006) in positing a distinct class of syntactic *de se* constructions for them.

## 7.1 Shifted indexicality

In many languages (including Amharic, Ancient Greek and Zazaki), an unmistakably indexical first person form embedded in a belief or speech report may refer not to the actual speaker of the report, but to the subject of the attitude:[20]

(70)  ǰon ǰəgna nə -ññ yɨl -all     [Amharic]
      *john hero be -***1.sg** *say.3.sg -aux.3.sg*
      'John$_i$ says that he$_i$ is a hero'     [Schlenker 2003:68]

---

[20]To argue that we are not just dealing with a kind of generic, non-indexical pronoun, Schlenker shows that the Amharic first person behaves exactly like English *I* in non-reportative contexts (including other subordinate clauses and quantifiers). To argue that we are not dealing simply with direct quotation Schlenker and others point out mixed reports containing shifted and non-shifted expressions, and Anand (2006) notes some uses of shifted indexicals that do not precisely echo the reported speaker's words verbatim.
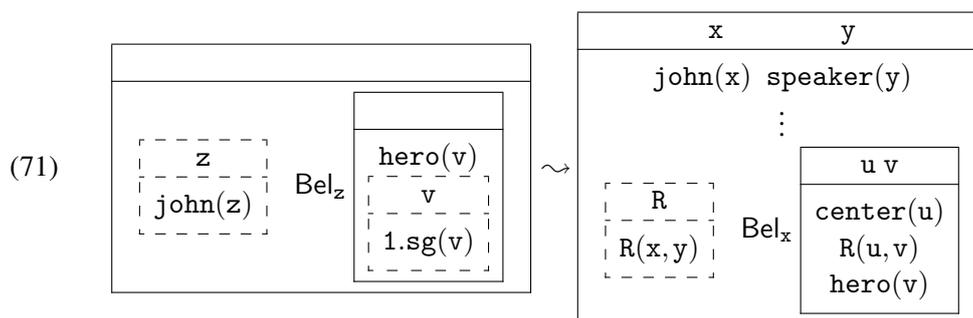
For convenience I will henceforth rely on a free gloss of this well-tested example to illustrate the phenomenon of shifted indexicality. I refer to Anand and Nevins (2004) and Anand (2006) for a thorough linguistic investigation that takes into account some of the cross-linguistic variety with respect to which verbs can or must shift which indexicals.

In 3.3 we've seen Chierchia's analysis of PRO as bound by an operator in a dedicated *de se* LF. Building on this idea, von Stechow (2002) analyzes shifted indexicals as variables bound by the attitude verb. As a result, Amharic *I* is not interpreted as an indexical, but rather as a bound variable.

Schlenker builds a framework in which the Amharic construction is, semantically speaking, the default way of reporting a *de se* attitude. The English way of reporting becomes the challenge: he has to posit a morpho-syntactic feature deletion rule to get the same *de se* reading for English co-referential *de re/de se* reports like (18) (*Frank thinks he sounds gay*). Schlenker's account thus also follows Chierchia's in introducing two distinct logical forms, one for *de re* and one for *de se*. The price for getting Amharic right, is the assumption, contra Kaplan and relational analyses, of a syntactic ambiguity and uninterpreted third person features in *Frank thinks he sounds gay*.

On the other hand, on a unificational account the shifted first person is highly problematic. In a sense, the reason such analyses have trouble with shifted *I* is precisely that they treat *de se* as a subspecies of *de re*. The *res* is logically represented outside the belief context, so a first person pronoun syntactically embedded as *res* will always refer to the actual speaker. This corresponds to Kaplan's (1989) well-known 'prohibition of monsters', which works fine for English *he* and *I*, but fails for Amharic and other languages that allow shifted indexicals.

In particular, the relational account incorrectly predicts that (70) means the same as its literal English counterpart: John says that I am a hero. The presuppositional version inherits this faulty prediction, as shown in the derivation below: the embedded *I* is bound to the actual speaker, creating a *de re* representation with an acquaintance presupposition between the belief subject and me:



(71) — Left: [ [z; john(z)] $\mathrm{Bel}_z$ [ hero(v); v; 1.sg(v) ] ]  $\leadsto$  Right: [ x, y : john(x) speaker(y); ⋮ ; [R; R(x,y)] $\mathrm{Bel}_x$ [ u, v : center(u); R(u,v); hero(v) ] ]
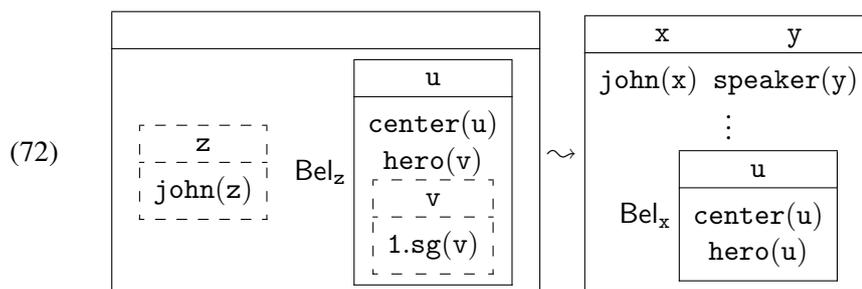
## 7.2 *De se* as *de dicto*

As soon as we resolve the Amharic *I* globally, to the actual speaker, as in (71), we get the English-type *de re* reading. Based on this diagnosis, Maier (2006, 2009)

proposes that the Amharic *I* here is bound locally, to John's belief center, i.e. himself. However, this previous analysis still regards (70), syntactically, as a *de re* report, causing a tension that requires some rather complicated additional machinery to repair.

In the current framework the distinction between *de re* and *de dicto* is moved from the syntax to the resolution stage: each report gets the same unified Prel-DRS that can resolve to either a *de dicto*, *de re* or *de se* output, depending on the context. If we now follow previous presuppositional analyses of Amharic shifting (Maier 2006, 2009; Hunter and Asher 2005) as local resolution of the embedded *I* to the (implicit) first person attitude center, we completely bypass the introduction of acquaintance presuppositions. We should get *de se* without *de re* for Amharic constructions. To flesh out this proposal technically, I extend the idea of building an explicit center representation into belief DRSs from *de re* resolutions to all Prel-DRS representations of beliefs.[21] The Amharic first person pronoun then binds to this, semantically first person, local center, which immediately gives the right, *de se* reading: In all of John's belief alternatives, the center, he himself, is a hero (cf. (31), p.18).

(72)

```
┌──────────────────────────────────┐        ┌────────────────────────┐
│                                   │        │    x         y         │
│                    ┌────────────┐ │        ├────────────────────────┤
│                    │     u      │ │        │ john(x)  speaker(y)     │
│  ┌ ─ ─ ─ ─ ─┐      ├────────────┤ │        │                        │
│  ╎     z    ╎      │ center(u)  │ │   ↝    │           ⋮            │
│  ╎ ─ ─ ─ ─ ─╎ Belz │ hero(v)    │ │        │       ┌──────────┐     │
│  ╎ john(z)  ╎      ├ ─ ─ ─ ─ ─ ┐│ │        │       │    u     │     │
│  └ ─ ─ ─ ─ ─┘      ╎     v      ╎│ │        │  Belx ├──────────┤     │
│                    ╎ ─ ─ ─ ─ ─ ╎│ │        │       │ center(u)│     │
│                    ╎ 1.sg(v)   ╎│ │        │       │ hero(u)  │     │
│                    └ ─ ─ ─ ─ ─ ┘│ │        │       └──────────┘     │
│                    └────────────┘ │        └────────────────────────┘
└──────────────────────────────────┘
```

It looks like we can derive the proper *de se* output by a simple *de dicto* resolution. This, then, is the real payoff of unifying the construction stages for *de dicto*, *de re* and *de se* and moving the introduction of acquaintance relations from the syntax to the pragmatic resolution stage.

Let me point out already some predictions of this proposal before filling in the remaining gaps. First, if the context is set up so that John believes something about me rather than about himself, the current proposal will generate the alternative, *de re* resolution of *I* shown in (71). In other words, we predict that Amharic allows both shifted and unshifted interpretations. According to Schlenker and others, this prediction is borne out. Second, since the `center` predicate is restricted to beliefs (in a fuller proposal, this would be extended to all attitudes and reported discourse representations), the extra binding possibilities introduced for Amharic-type first person pronouns are properly restricted. In particular, we do not generate unwanted shifty interpretations in other embeddings that have been discussed as

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[21]Because we model belief sets as sets of centered worlds, every belief has a center, a first person 'experiencer', and it is safe to assume that the construction algorithm furnishes every belief DRS with a representation of its center, as we are already doing for all *de re* resolutions. Alternatively, we could model the local resolution of Amharic *I* through accommodation of a belief center.

potentially troublesome in the literature (cf. Schlenker's (2003:69) relative clause embedding in Amharic: *[My$_j$ brother]$_i$ found a girl that I$_{*i}$ like*; or Partee's (1989) quantification over (third person) speakers: *Every speaker$_i$ has difficulty stopping when I$_{*i}$ should*).

As it stands, however, the proposal is still missing a crucial ingredient: how to explain the difference between English and Amharic *I*? In our presuppositional framework, the simplest solution is to stipulate a difference in resolution preference between English and Amharic *I*. I follow Hunter and Asher (2005) who adorn the presupposition triggered by English, but not Amharic, *I* with an operator (⇑) enforcing global resolution.[22]

Note that some stipulation like this is unavoidable in the sense that there simply *is* a typological, lexical difference between English and Amharic with respect to the first person. The question is only how best to capture it. In this light, Kaplan's (1989) Prohibition of Monsters in English, Schlenker's (2003) filtering mechanism, von Stechow's (2002) 'Amharic parameter', and Hunter and Asher's (2005) ⇑-presuppositions are all different answers to this question. The last of these answers just happens to be most compatible with the current DRT framework.[23]

The important selling point of my account is that it does not rely on feature deletion or 'de-rigidification' of the indexical in syntax/morphology. Everything is taken care of by our pragmasemantic resolution module, which treats Amharic *I* as a real, semantically first person pronoun. The difference between the Amharic shifted *I* and the English (or Amharic) rigid *I* is merely a matter of preferred resolution sites of the same presupposition: English *I* must be bound globally, while Amharic *I* can also be bound by a local first person, i.e. an attitude center.

The local resolution option of Amharic *I* is what we previously would have called a *de dicto* output. Interestingly, the Amharic shifty *I* route to *de se* is quite different from the English *de se* resolution of *John thinks he's a hero*, which goes from an underspecified PrelDRS to an intermediate *de re* representation followed by a default acquaintance resolution to equality. This crucial deviance from my earlier (2006; 2009) *de re* analysis of Amharic *I* is reminiscent of Anand's (2006) argumentation against a unitary treatment of *de se* ascriptions in which he too distinguishes the *de se* of shifted indexicality from that of English co-referential *he*. In the next section we briefly turn to what Anand considers a third, distinct variety of *de se* reporting.

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[22]In our system an implementation would require adding a clause to the resolution mechanism that checks for the presence of ⇑ in a presupposition. If an ⇑ is detected the recursive checking of binding/eccommodation possibilities is bypassed and only global binding is tried.

[23]This is not to say that I endorse Hunter and Asher's (2005) analysis of indexical shifting. I merely borrow their operator for marking that a presupposition has to be bound globally and attach it, lexically, as do they, to English *I*. Cf. Maier (2009) for similar adaptation of Hunter and Asher's ⇑-operator, and for a critical evaluation of the rest of their account of indexicality.

### 7.3 *De se* pronouns: PRO and LOG

Now we turn to the remaining cases of unambiguous *de se* reporting constructions. First, infinitival complement reports with silent PRO subjects in English, and then logophorically marked reports as found in many West-African languages.

Let's recap our discussion of Chierchia's (1989) arguments for *de se* LFs from section 3.3. In our mistaken self-identity scenario Frank recognizes he's judging his own voice, but Chris does not. Co-referential *he* reports are compatible with both kind of situation, *de se* and *de re*, but infinitival reports with silent PRO subjects can only be read *de se*:

(73)   a.   Chris believes that he sounds gay, though he doesn't realize it.
       b.   #Chris believes to have a gay voice [*though he doesn't realize it]

According to Chierchia the overt pronoun construction is ambiguous between a *de re* and a *de se* LF, while the infinitival construction has only the *de se* LF. Crucially, in the *de se* LF, the embedded subject, PRO or *he*, is bound syntactically.

I have countered some arguments for this syntactic *de re*/*de se* ambiguity in 4.4, 6.2–6.3, and 7.1–7.2, but the original motivation, the unambiguously *de se* truth-conditions of (73b), remains. Below I will first show why we can't simply extend our *de se* as *de dicto* analysis of Amharic *I* to PRO (and its cousin, the logophor), before conceding that, in the case of PRO, we are dealing with a purely syntactic variety of *de se* after all.

So let's extend our local binding analysis of Amharic shifted *I*. As in 7.2 above, we will derive a *de se* output by binding the embedded subject, PRO, to the local belief center. The only thing we have to add is that where Amharic *I* can be bound by a local or global first person, PRO *must* be bound locally. Assuming the content of the presupposition lexically triggered by PRO to be `center` will ensure the availability of local belief center resolution.[24]

Note that we are analyzing PRO semantically as a first person pronoun. Although this gives the right truth conditions, it can't be the whole story, because there is independent evidence that PRO bears third person features. We can bring out these seemingly invisible features by making it bind a reflexive (Schlenker 2003):

(74)      John hopes PRO to buy {*myself / himself} a car

Reflexives must be bound in their local domain, so it is really PRO rather than *John* that binds *himself*. And because reflexives agree with their binders, it follows that PRO is not first but third person. Before attempting a solution to this 'feature mismatch problem', we turn to the phenomenon of logophoricity, where the same problem shows up in a slightly different guise.

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[24] To be sure that pragmatic pressure does not overrule the closest binding match, we could further stipulate a ⇓-operator, the mirror image of Hunter and Asher's ⇑ on English *I*, meant to enforce local binding.

Schlenker (2003) and Anand (2006) argue that the so-called logophoric pronouns found in West-African languages behave just like PRO, that is, as *de se* pronouns. A logophor here is a kind of overt pronoun that occurs only in report contexts and designates the reported speaker from her own, first person perspective, i.e. *de se*. The crucial data involve mistaken identity, which do not allow reporting with logophoric pronouns (Kusumoto 1998; Anand 2006):

(75)  ó so pé oun r'i John   [Yoruba]
      *he say that LOG see John*
      he said he saw John [only felicitous if he said, "I saw John"] [Anand 2006:56]

As far as we're concerned in this paper, the logophoric pronoun, henceforth LOG, is just a visible realization of our English PRO.

Interestingly, then, in some of these West-African languages with logophors, including Yoruba, Abe and Ewe, the logophor is commonly taken to be an actual *third person* pronoun. Therefore, an analysis of LOG as sketched for PRO above, i.e. as essentially a first person bound locally by the belief center, runs into the same feature mismatch problem.

At this point I will follow Anand (2006) in admitting a third, entirely syntactic route to *de se*.[25] In addition to the pragmasemantic *de se* as *de re* (English *he*) and *de se* as *de dicto* (Amharic *I*) derivations, this third variety covers the unambiguously *de se* PRO and LOG reports. The defining characteristic of this class is that they are *de se* syntactically. In the current framework that means they are *de se* at the level of the PrelDRS already, rather than only after resolution of an underspecified representation. Strong evidence in favor of a syntactic treatment of logophors in particular comes from Anand's (2006:§1.4.4) fieldwork on Yoruba, which shows syntactic blocking effects with LOG.

On the current view, PRO and LOG are no longer pronouns that trigger presuppositions. In fact, they are more like reflexives, whose binding is almost universally assumed to take place somewhere in the syntax, during the PrelDRS construction stage, before the pragmatic resolution stage. Concretely, the PrelDRS of (75) would look something like this:

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[25]Maier (2006) sketches a more pragmasemantic solution: PRO and LOG contribute two distinct elements to the representation, (i) a standard third person pronoun *he*, and (ii) a restriction on the resolution of the corresponding acquaintance presupposition to the effect that it *must* be resolved to equality. I'm not sure how to elegantly implement this restriction part in the current framework, if only, because the acquaintance presupposition is not part of the PrelDRS.

(76)

$$\left[\;\; \boxed{\begin{array}{c} z \\ \hline he(z) \end{array}}\;\; \mathsf{Say}_z\;\; \boxed{\begin{array}{c} u \\ \hline center(u) \\ see(u,v) \\ \boxed{\begin{array}{c} v \\ \hline john(v) \end{array}} \end{array}}\;\; \right]$$
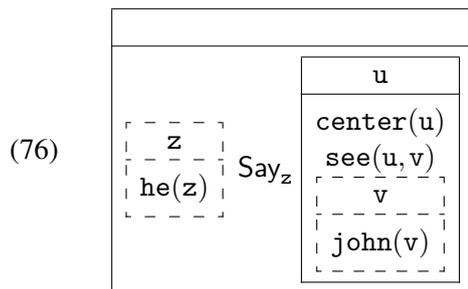
There are many ways to set up the syntax to derive such *de se* PrelDRSs, one would be to import a version of Chierchia's mechanism of binding PRO at LF. Since I have nothing to add to existing syntactic accounts, I refer to Anand (2006:§1.4.3) for a precise implementation of Chierchia's syntactic binding mechanism designed to take care of LOG binding as well.

I conclude that Chierchia was partly right. *De se* LFs ($\approx$ *de se* PrelDRSs) exist. However, these LFs are reserved for PRO and LOG exclusively. English co-referential *he*, embedded or not, and Amharic or English *I* reports are all given the same compositional but underspecified PrelDRS, which, in a context, is resolved pragmatically to a *de dicto*, *de re* or *de se* output.

# 8   Conclusion

This paper provides a pragmatic, unified analysis of *de dicto*, *de re* and *de se* reports. The analysis is unified in the sense that it generates uniform, but highly underspecified, preliminary representations for (almost) all belief reports. It is pragmatic in the sense that it's the pragmatic DRT presupposition resolution mechanism that does all the work. This allows us to keep the syntax and semantics entirely straightforward: no syntactic ambiguity, no feature deletion, minimal movements and invisible items, and a simple possible worlds semantics.

My core proposal has two main ingredients. The first is a resurrection of a traditional analysis of the *de re*/*de dicto* ambiguity as a scope ambiguity. In a DRT setting this means that a presupposition triggered inside a report complement can resolve locally to derive *de dicto*, or globally to derive *de re*. I adapt the presupposition resolution algorithm to incorporate the idea that a *de re* representation always involves a context-dependent acquaintance relation/mode of presentation. The context-dependence of acquaintance is modeled as presuppositional as well. The adapted resolution algorithm specifies that whenever a presupposition moves out of a belief, it triggers the introduction of such an acquaintance presupposition.

The second ingredient of my proposal is the method of resolving this presupposed acquaintance relation. By default, we always first try to bind it to the relation of equality, which will yield a *de se* output. If the context does not allow this, we search for a suitable and salient other relation that holds between subject and *res*. Technically, this involves binding a second-order presupposed discourse referent, modeled in terms of a process known as higher-order unification. The default reso-

lution to equality captures the privileged status of *de se* interpretations with respect to mere *de re* ones that we see already in simple ambiguous reports of the form $x_i$ *believes that he$_i$ is P*.

After presenting this presuppositional proposal as well as the syntactically oriented classical approach, I applied them both to a number of interesting test cases. The first involves reports of beliefs about *de re* beliefs. The classical syntactic account of *de re* runs into problems, which can only be fixed by stipulating a longer *res*-movement, which was already considered the weak point of this type of approach. My presuppositional account derives the right readings immediately. The only interesting thing to note is that the derivations involve not only higher-order binding, but also accommodation of acquaintance presuppositions.

The next test involved quantified *de re/de se* belief reports like *everyone believes that he is P*. In the classical framework, a syntactic *de re/de se* ambiguity is required to generate all available readings. The presuppositional approach, however, derives these readings from a single, syntactic structure (or rather, from a single preliminary DRS). Moreover, it correctly predicts that we always get a universal *de se* interpretation, unless speaker and hearer know that the domain of quantification contains some normal *de se* believers and some mistaken identity *de re* believers. Only in that particular case can we accommodate the acquaintance presupposition and arrive at a true, mixed *de re/de se* reading.

Finally, I considered unambiguously *de se* reports. The first example is the shifted interpretation of the first person in Amharic, where *John thinks I'm a hero* means that John believes *de se* that he's a hero. In our DRT framework we can transparently represent Amharic *I* as triggering a first person presupposition. This presupposition can be bound by the actual speaker, yielding the English-style *de re* interpretation; or by the local, first person experiencer or 'center' of the belief, yielding the 'shifted' *de se* reading. I then turned to infinitival report constructions (*x believes to have been P*) and West-African logophors, known to allow only *de se* interpretations. Here, I was forced to make some concessions. Following Anand (2006) I proposed that these constructions are *de se* syntactically. We thus end up with three types of *de se*, exemplified by (i) English *he*, which resolves *de re* and creates an acquaintance presupposition that prefers to be bound to equality; (ii) Amharic *I* which resolves *de dicto*, by binding locally to the belief center; and (iii) infinitival and logophoric reports, which have a different syntactic structure from which a *de se* PrelDRS gets formed in the DRS construction stage. Note however, that the first two of these *de se* types are just instances of the general belief representation and resolution that covers all other *de dicto* and *de re* reports, including embedded, iterated or quantified ones.

Thus, I hope to have convinced the reader that *de dicto/de re* and *de re/de se* ambiguities are pragmatic rather than syntactic ambiguities. Furthermore, I have tried to show how the presupposition-as-anaphora theory in DRT can be used to properly formalize the pragmatic resolution of underspecified belief representations to *de dicto*, *de re* or *de se* outputs, according to contextual demands.

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