

Singular Pronouns in Belief Attributions

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Singular Pronouns in Belief Attributions

Abstract

A pronoun that is used within a belief attribution can either take up the reference of its antecedent or it goes proxy for a description which is recoverable from the antecedent; the former is the *de re* interpretation of the pronoun, the latter the *de dicto* interpretation. Discourse Representation Theory does not provide a mechanism to interpret pronouns *de dicto*. This article proposes a procedure which turns *de re* interpretations of a pronouns that occur in belief attributions into *de dicto* interpretations.

1 Introduction

Throughout the literature we find two kinds of belief, *de re* belief and *de dicto* belief. Belief attributions containing (i) definite descriptions, (ii) indefinite descriptions and (iii) pronouns can be ambiguous about whether they attribute a *de re* belief or a *de dicto* belief. If someone attributes a *de re* belief to an agent he attributes to him a belief about a real object. The way the object is represented in the utterance does not influence the content of the attribution; because the term is used by the speaker to refer to the object and it is not intended to specify the descriptive content of the belief. With a *de dicto* belief attribution one does not attribute a belief about a particular object to an agent; the belief is rather a general proposition. For example, the sentence

- (1) Peter believes that *the German chancellor* has more power than *the prime minister of Bavaria*.

can be understood as attributing the *de re* belief to Peter, namely the belief that the actual chancellor of Germany, i.e. *Gerhard Schröder*, has more power than the actual prime minister of Bavaria, i.e. *Edmund Stoiber*. Another way of interpreting the definite descriptions *the German chancellor* and *the prime minister of Bavaria* is to interpret them *de dicto*. With (1) analysed *de dicto*, one does not attributes a belief to Peter which is about particular people with which he is directly acquainted. That means Peter does not know who is the German chancellor and who is the prime minister of Bavaria. He rather believes that whoever is the German chancellor at the moment holds more power than the person who is prime minister of Bavaria at the moment. This example illustrates the *de re / de dicto* ambiguity that occurs when definite descriptions are used in belief attributions. We also find cases where this ambiguity is triggered

by indefinite descriptions and by pronouns. Indefinite descriptions in belief attributions have two interpretations: they can be used specifically or non-specifically. For example the sentence (which is taken from [KR])

- (2) Mary believes that a famous Swede will attend the conference.

has two readings. The *de re* reading interprets the indefinite description “a famous Swede” as specific: There is some particular famous Swede, with whom Mary is acquainted in some way. As in the case where we have a definite description, the indefinite description in (2) does not contribute its descriptive content to the belief, but it refers to a particular object. In (2), the speaker may not know the person he refers to by saying “a famous Swede”, but he knows that Mary knows the “famous Swede” and that she believes he will attend the conference. The *de dicto* reading of (2) takes the indefinite description to be non-specific: Mary has her reasons to believe that one of the people attending the conference will be from Sweden and famous.

Pronouns trigger the *de re / de dicto* ambiguity of belief attributions as well. This claim might be strange at first sight for pronouns do not have their own descriptive content and therefore we have to answer the question: How can pronouns be interpreted *de dicto*? Geach [Gea67], Evans [Eva80b], originally [Eva77], Neale [Nea90] and van Rooy [vR97a] have shown how pronouns can acquire descriptive content; and they called them “de dicto pronouns” or “pronouns of laziness” (Geach), “E-type pronouns” (Evans), “D-type pronouns” (Neale) and “descriptive pronouns” (van Rooy). I’m going to use the term *descriptive pronouns* or *descriptively used* pronouns as opposed to *referentially used* pronouns, which take up the reference to an object and so trigger the *de re* reading.

For example the sentences

- (3) *Someone* murdered Smith. Stefan believes that *he* has blue eyes.

can have two readings: the *de re* reading takes the pronoun to be referentially used: Stefan believes of a particular person that he has blue eyes. It is not important at all for the *de re* reading whether Stefan has other beliefs about this person; here for example, Stefan might be completely unaware about having beliefs of the person having committed a murder. In the second reading, (3) attributes the *de dicto* belief to Stefan that whoever murdered Smith has blue eyes, or in other words the belief that a person with blue eyes murdered Smith. This reading doesn’t take the pronoun to refer to a particular object - Stefan might have no acquaintance with murderer at all. The pronoun rather goes proxy for a kind of description which can be recovered from the syntactic antecedent.

Syntactical anaphora theories which explain unbound pronouns by means of substituting them by descriptions which can be recovered from their syntactic antecedent. should not run into difficulties explaining the *de re / de dicto* ambiguity in (3). Accounting for this ambiguity in dynamic semantics is not straight forward though. Dynamic semantics as developed by Kamp [Kam81] and Heim [Hei82] resolves pronouns on the ‘semantical level’: the context provides dis-

course referents, one of which serves as the antecedent for a pronoun. Dynamic semantics gets the *de re* reading of (3): the pronoun binds to the discourse referent which refers to the particular person who murdered Smith. Accounts for the *de dicto* reading of (3) in the framework of dynamic semantics have to answer the question how descriptive content can be inserted into the context and how pronouns can bind to it; see for Asher's [Ash93] extension of Discourse Representation Theory and van Rooy's [vR97b] account of descriptive pronouns in Dynamic Predicate Logic.

In this article I give an account for the *de re / de dicto* ambiguity which arises when a singular pronoun that occurs in a belief attribution is anaphorical upon an indefinite description which is in the main context. My approach is formulated in DRT as presented in [KR93] and [KR] and does not follow the "dynamic" accounts from Asher and van Rooy, it rather tries to incorporate ideas of syntactic anaphora theories from Neale and Evans into DRT.

It should be mentioned that the problem of pronouns in belief contexts is of a much wider range than its treatment in this article accounts for. On the one hand, Geach's [Gea67] "Hob Nob sentences" pose the problem of so called *intentional identity*: the pronoun and its antecedent occur in belief attributions to different agents. In contrast to the case exemplified in (3), *intentional identity* covers the cases where both the antecedent and the pronoun can have a *de dicto* interpretation. On the other hand, Quine's Ralph [Qui56] and Kripke's Pierre [Kri79] show that there are even ambiguous *de re* interpretations of belief attributions containing a pronoun.

2 Pronouns in Belief Attributions

Pronouns are either bound by a quantifier or they are unbound. In the latter case we can distinguish between referential and descriptive uses. *Referentially used pronouns* obtain their reference from the reference of the antecedent expression. According to Neale [Nea90], *descriptively used pronouns* obtain their reference via a definite description which is recoverable from the antecedent expression.

It does not make sense to distinguish between the referential use of a singular pronoun and its descriptive use, when both the pronoun and its antecedent occur in the same evaluation context. In such cases referential use and descriptive use would always yield the same reference. Assuming that definite descriptions are treated as anaphorical expressions (see van der Sandt [vdS92]), the following example shows, that there is no difference between the referential use of “she” shown in (4-a) and its descriptive use shown in (4-b).

- (4) A man has a sister. *She* is tall.
 - a. A man has a sister_{*i*}. *She*_{*i*} is tall.
 - b. A man has a sister_{*j*}. *The man’s sister*_{*j*} is tall.

For all cases in (4), the indefinite description “a sister” is the *syntactical antecedent* of the pronoun “she”. Referentially used, the pronoun in (4-a) takes up the reference of its antecedent which is the object referred to by “a sister”. Descriptively used, the pronoun goes proxy for the definite description “the man’s sister” as it is paraphrased in (4-b). Both uses yield references to the same object because the definite description is recovered from the antecedent, and so this definite description can always be bound to this very antecedent.

Much more interesting is the configuration where a pronoun and its antecedent occur in different evaluation contexts. In such cases, we can observe a difference between the referential and the descriptive use of a pronoun. Throughout the paper I will only attend to the case where a pronoun occurs in a belief attribution, whereas the intended antecedent is in the main context.

Imagine the following situation:

- (5) Derrick and Klein are two detectives in Munich. They investigate in a case where Smith was murdered. Derrick does not know that it was his colleague Klein who murdered Smith. Derrick knows that Klein is in Munich, but somehow he draws to the conclusion that Smith’s murderer went to Stuttgart.

First, I give an example with a pronoun in a belief context that is referential used:

- (6) Someone murdered Smith. Derrick believes that *he_{ref}* is in Munich.

The above sentence is true with a referential use of “he”. It expresses the belief of Derrick that ‘Klein is in Munich’. The reference of “he” is determined by the reference of the antecedent. According to the background (5), the antecedent “someone” refers to detective Klein. Consequently, “he” refers to a *belief object*

in Derrick’s belief state, which is a representation of Klein. This analysis is commonly known as *de re* belief attribution.

Now, we turn to the descriptive use of a pronoun in a belief context:

- (7) Someone murdered Smith. Derrick believes that *he_{de re}* is in Stuttgart.

The above sentence is true, too, but here we need the descriptive use of the pronoun “he”. It expresses the belief of Derrick that ‘whoever murdered Smith is in Stuttgart’. The reference of “he” is determined by the definite description which is recoverable from the antecedent. Intuitively, this means that we can paraphrase the belief attribution in (7) as “Derrick believes: the murderer of Smith is in Stuttgart”. According to the background given in (5) this is in fact a belief of Derrick. This analysis is commonly known as *de dicto* belief attribution.

2.1 Descriptive Pronouns

Following van Rooy [vR00] I want to use the term *descriptive pronouns* for descriptively used pronouns. The idea of a pronoun recovering descriptive material from its syntactic antecedent goes back to Geach [Gea67].

Sometimes a pronoun may be eliminated from a proposition, without changing the force of the proposition, by simply repeating the antecedent. When such pronouns have no point beyond variety, perhaps elegance, of expression, they might well be called “pronouns of laziness”.

In more general terms, a “pronoun of laziness”, is actually represented as a full NP identical to its antecedent at some level of representation; where “identical” means identical to the semantical representation of the antecedent expression. A specific analysis of *descriptive pronouns* can be found in Neale [Nea90]. Neale explicitly rejects Evans’ account of *E-type pronouns* and argues for the use of *descriptive pronouns* instead. The problem with Evans’ E-type pronouns is that they recover the reference of an expression, but not its descriptive content.

Evans [Eva80a], [Eva80b], and originally [Eva77] claims that pronouns should either be treated as bound variables or as E-type pronouns. E-type pronouns are anaphorical on quantifier phrases but they are not bound by them. Moreover, they are unbound pronouns which refer to the object or to the objects which verify the antecedent clause. Opposed to Geach and Neale, Evans’ E-type pronouns do not go proxy for a description, but they get their denotation “fixed by a description recoverable from the clause containing the quantifier antecedent.” (see [Eva80a] p279). In section D under the heading “Psychological Attitudes”, he even rejects the *de dicto* interpretation of pronouns. I agree with Evans that the *de dicto* reading is unlikely in the sentence

- (8) A man murdered Smith, but John does not believe that *he* murdered Smith.

but I claim that we get it in (7). Evans' view that pronouns are always referring terms causes troubles when we want to explain cross-domain phenomena like the pronoun in (7). If it was an E-type pronoun, its reference is fixed by the description in the domain of the actual world, but this reference may not be available in the domain of a belief world, which would have been the case, if Derrick was not acquainted with Klein at all. Therefore, we can say that E-type pronouns are referentially used pronouns, and as we have seen above, the referential use yields the *de re* analysis in (6), but not the *de dicto* analysis which is needed in (7). Neale [Nea90] improves this shortcoming and revises the definition of E-type pronouns. To distinguish between Evans' E-type pronouns and his, he coins the term *D-type pronouns* which are unbound pronouns that go proxy for definite description recovered via the syntactic antecedent. In contrast to Evans' E-type pronouns, they do not take up the reference to that object which verifies (or all objects which verify) the sentence containing the antecedent, but they rather take up the content of the sentence containing the antecedent. Thus we can say that descriptively used pronouns are *co-descriptive* to the antecedent expression, and Evans' E-type pronouns are *co-referential*. Neale proposes rules that determine the recoverable content for different types of antecedents. Indefinite descriptions, which are the subject of this paper, yield a definite description by application of the following scheme:

- (9) If the antecedent expression is the indefinite description Px occurring in a clause which can be formalized as:
 $(\exists x)[Px \ \& \ Qx]$, then
the recovered content is given by the definite description:
 $(\text{the } x)[Px \ \& \ Qx]$.
where P is the indefinite description and Q the predicate of the clause.(Neale [Nea90])

The next examples (10-a) and (10-b) as well as (10-c) have all the same interpretation which can be formalised as (10-d).

- (10) a. A man hugs Harry.
b. There is a man. *He* hugs Harry.
c. Someone hugs Harry. It is a man.
d. $(\exists x)[\text{man}(x) \ \& \ \text{hug}(x, \text{Harry})]$

Neale's rule in (9) works on natural language sentences. I modify the rule such that it works on semantical representations to capture the equivalence of (11-a), (11-b) and (11-c) on the representational level. Transposing the rule from the domain of natural language to the domain of semantical representations enables us to apply Neale's rule for indefinites to discourse semantics. The effect of the transposition is that the recovered content is not determined by the clause containing the antecedent expression but all the information that is associated with the discourse referent of the antecedent. The rule (9) transposed to discourse semantics is shown below:

- (11) If the discourse referent x is part of the semantical representation of a discourse consisting of conditions $P_1(x), \dots, P_n(x)$ containing x , and of other conditions Q_1, \dots, Q_m which do not contain x :
 $(\exists x)[P_1(x) \ \& \ \dots \ \& \ P_n(x) \ \& \ Q_1 \ \& \ \dots \ \& \ Q_m]$
and x has been determined to be the antecedent of a pronoun, then the recoverable content is given by the following semantical representation:
 $\lambda x.[P_1(x) \ \& \ \dots \ \& \ P_n(x)]$

The recoverable content of (10) is:

- (12) $\lambda x.[\text{man}(x) \ \& \ \text{hug}(x, \text{Harry})]$

When I paraphrase readings which make use of the the recoverable content, I follow Neale and express the recoverable content as a definite description; see (13) for example. The pronoun of the next sentence (13-a) is anaphorical upon “a man” in (10). If we take it to be used descriptively then we replace it by the semantical representation (12) and we can paraphrase (13-a) as (13-b):

- (13) a. Stefan believes that *he* is small.
b. Stefan believes: *the man who hugged Harry* is small.

It has often been remarked that in cases where the pronoun occurs in a belief attribution the “pronouns of laziness” approach makes wrong predictions, see [Gea67], [Ede92], [vR00]. The pronoun cannot always be substituted by the whole descriptive content of the antecedent, but parts of it can. The modified version of Neale’s rule for indefinite descriptions, shown in (11), sometimes recovers too much descriptive content, too. (15) paraphrases (14) where the pronoun has been replaced according to rule (11):

- (14) A blue-eyed man murdered Smith. Derrick believes that *he* is in Stuttgart.
(15) Derrick believes: *the blue-eyed man who murdered Smith* is in Stuttgart.

The original sentence (14) attributes the belief to Derrick that the murderer of Smith is in Stuttgart. But after the substitution of the pronoun the sentence in (15) additionally attributes the belief to Derrick that the murderer has blue eyes. This may be a bit too much. The intended substitution for the pronoun is shown below:

- (16) Derrick believes: *the man who murdered Smith* is in Stuttgart.

This suggests that a descriptive pronoun should not be replaced by all the descriptive material that is found in the context.

Van Rooy [vR97b] explains descriptive pronouns by means of anaphora to properties. Indefinite descriptions introduce objects and properties. Descriptive pronouns take up these properties, and obtain a reference if the property can be

instantiated uniquely. The problem with this account is that it cannot handle the discourse in (10-b) without undergoing modification, because the indefinite in (10-b) introduces the concept (17) to the context.

(17) $\lambda d.\text{man}(d)$

This concept is taken up by the descriptively used pronoun in (10-b) and yields the following result:

- (18) a. Stefan believes that $\lambda d.\text{man}(d)$ is small.
b. Stefan believes that there is only one man and that he is small.

It is certainly not true that Stefan believes that there is only one man. If we drop the uniqueness condition we obtain an analysis paraphrased as follows:

(19) Stefan believes that there is a man and that he is small.

But even this solution is not the intended one, since the belief of Stefan is not about just any man; it is about the man who hugs Harry at a particular time in a particular place.

Van Rooy [vR00] gives an explicit account for descriptive pronouns in belief contexts by employing a counterpart relation between belief objects where all *belief objects* are traced back to the external source they are caused by. Descriptive pronouns do not instantiate a concept as in [vR97b], they can rather denote every belief object which is a counterpart of the object which the antecedent refers to. Since van Rooy generalizes all objects to *belief objects*, the counterpart relation between an actual object and a belief object can be expressed by a relation between two *belief objects*.

The defining condition for van Rooy’s counterpart relation is given below:

Two *belief objects* can be counterparts of each other only if they have the same source, or at least if they have their origin in the same event.

A belief attribution containing a descriptive pronoun is interpreted as follows:

A sentence is true (false), if and only if it is true (false) for all admissible ways of picking out counterparts.
[vR00],section 7.

This account makes the right predictions for (14): The belief object “murderer of Smith” in Derrick’s belief state is traced back to Smith’s murderer via the event of the murder. Derrick knows the existence of the particular event of the murder of Smith, and thus he knows that there is a murderer, although he does not know who it is. So it does not matter that the indefinite description contains information about the eye-colour of the murderer. The important property of the actual murderer of Smith is that he committed the event of the murder. And the same holds for the belief object “murderer of Smith”. Thus

we can say that the actual murderer as well as the belief object “murderer of Smith” have their origin in the same event.

A problem with this account is due to the definition of the truth of belief attributions which requires the same truth value for all ways of picking out counterparts. This requirement is too strong to explain the distinction between (6) and (7). Both examples start as follows:

(20) Someone murdered Smith. Derrick believes that *he* ...

We assume that Derrick has a belief object for the real murderer, i.e. Klein, and another distinct belief object for the concept of being Smith’s murderer. Both belief objects can be traced back to the event of the murder of Smith, and so both belief objects are counterparts of the actual murderer of Smith, i.e. they are counterparts of Klein. According to the above requirement a belief attribution of the form (20) has to be true for all admissible counterparts. But neither the belief attribution in (6) is simultaneously true for the belief object representing Klein and for the belief objects representing the murderer of Smith, nor the belief attribution in (7). Our assumptions about Derrick’s belief state clearly state that he knows that Klein is in Munich and that he believes that Smith’s murderer is in Stuttgart. This shortcoming relative to this particular phenomenon will be amended by spelling out a part of the causal chain on which the counterpart relation is based. All in all, my approach to *descriptive pronouns* is inspired very much by ideas from Neale [Nea90], van Rooy [vR97b] and [vR00] and van Rooy and Zimmermann [vRZ96] who all cover more general phenomena than I do. In contrast to van Rooy’s solution which uses intensional discourse referents taking up descriptive content implicitly, I will stick to extensional discourse referents at the expense of a higher complexity of the construction algorithm: ¹ the proposal will employ operations that work on the level of semantic representation to copy the descriptive content to the intended position.

To sum up, the situation sketched in (5) together with the examples (6) and (7) suggest that there are cases where a pronoun in fact is a kind of “pronoun of laziness”, i.e. the pronoun has to be replaced by some semantic material which has been recovered from the antecedent. We will have to answer the question of which semantic material of the antecedent actually replaces such a “pronoun of laziness”.

¹van Rooy uses DPL [GS91], Asher [Ash93] provides DRT with intensional discourse referents

3 Dynamic Semantics

The problem of “descriptive pronouns in belief attributions” is related to the process of anaphora resolution, the semantics of presuppositions and the semantics of belief attributions. I turn to dynamic semantics in which we can find detailed accounts for each of those problems.

Dynamic Semantics as developed by Kamp and Heim and others (DRT [Kam81], FCS [Hei82], DPL [GS91]) was designed to deal with referential connectedness in discourse. Sentences are not interpreted independently on their own; the basic unit of interpretation is rather a sequence of sentences, a discourse. A sentence is always interpreted relative to a context which binds the sentence’s anaphorical elements (e.g. tense, pronouns, presuppositions). In contrast to dynamic semantics, syntactic approaches to anaphora like E-type theory assign semantical representations to sentences in order to make them interpretable on their own. They determine the antecedent of a pronoun on syntactic grounds and use this *syntactic antecedent* to establish the semantic representation of the pronoun.

I will use the framework of *Discourse Representation Theory* by Kamp and Reyle [KR93] and [KR], for short DRT. Sentences, contexts, beliefs and presuppositions are all represented by means of *Discourse Representation Structures*, DRS’s.

3.1 Interpretation

In dynamic semantics sentences are interpreted as functions from contexts to contexts, such that the new context only contains worlds which make the sentence true. The interpretation process splits up into two stages: first, a *construction stage*, and second, an *update stage*, see [Kama]. At the *construction stage*, a sentence is processed and transformed into a preliminary semantical representation, which contains semantical and presuppositional information. The semantical information is the content of the DRS, the presuppositional information holds the requirements on the context. A pronoun for example is an anaphoric element which requires the context to provide a suitable antecedent. At the *update stage*, the update process tries to satisfy all the requirements and then merges the DRS of the sentence with the DRS of the context. For example, if all anaphoric elements of the preliminary representation can be resolved in the context, then the DRS of the sentence is merged with the context. The overall result is an update of the context with the new information given by the sentence. The two stage mechanism can be found in [Ash93], [vEK96] and [Kama].

3.2 Anaphora Resolution

In dynamic semantics anaphora resolution proceeds in two steps: First, search for all accessible discourse referents that have certain properties, which are compatible with the requirements spelled out by of the anaphoric element. Second,

identify the anaphoric discourse referent with one of the suitable discourse referents. Setting up referential connections, anaphora resolution yields a tight connection between the updating DRS and the context.

4 Belief

This section is a short introduction of the semantical representation of belief attributions in DRT, according to Kamp and Reyle [KR].

An agent bears an attitudinal state which comprises such propositional attitudes as beliefs, wishes, hopes and others. According to [KR] each attitude is represented by a pair consisting of (i) a mode indicator specifying the type of the attitude and (ii) a DRS which specifies its content.

For instance, the belief that someone has the name John is represented by the following pair DRS:

$$(21) \quad \langle BEL, \boxed{\begin{array}{c} a \\ \text{named}(a, \text{"John"}) \end{array}} \rangle$$

A representation of an attitudinal state will be a set of such pairs, which Kamp and Reyle call an *articulated DRS*. Attitudinal states which consist exclusively of beliefs are called *belief states*. Let p_0 be an attitudinal state; to express that (21) is a part of p_0 we use the following condition:

$$(22) \quad p_0: \left\{ \langle BEL, \boxed{\begin{array}{c} a \\ \text{named}(a, \text{"John"}) \end{array}} \rangle \right\}$$

Attributing a belief to an agent is to describe a part of the entire attitudinal state of that agent. For instance, to attribute the belief shown in (21) to Peter we attribute the attitudinal state specified in (22) to him; we use the predicate ‘ATT’ to report the attitudinal state of an agent.

$$(23) \quad \boxed{\begin{array}{c} P \quad p_0 \\ \text{Peter}(P) \\ \text{ATT}(P, p_0) \\ p_0: \left\{ \langle BEL, \boxed{\begin{array}{c} a \\ \text{named}(a, \text{"John"}) \end{array}} \rangle \right\} \end{array}}$$

The belief attribution is true, if the belief state p_0 can be matched by the actual belief state of Peter. For a detailed explanation of the evaluation of attitude attributions I refer to Kamp and Reyle [KR] and Kamp [Kamb].

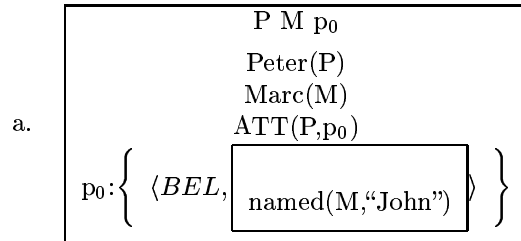
4.1 The Domain of Belief

The basic entities of the domain of belief are *belief objects*. They play the same rôle in the belief state as real objects do in the real world: they have properties and they stand in relations to each other. In terms of intensional models, the domain of belief consists of all objects of the model which belong to a world that is compatible with the agent’s beliefs. Kaplan [Kap69] calls belief objects *Intermediate Entities*: they mediate between a person and the real objects the

attitude is about. Taking this consideration into account we can conclude that every discourse referent which occurs in an articulated DRS specifying a belief plays the rôle of a *belief object*. On the one hand, these discourse referents can be bound from outside the belief and thus they refer - strictly speaking - to objects, but they refer in an indirect way: such a discourse referent which refers to an actual object expresses the existence of a counterpart relation between its reference and the belief object which it stands for. Explicit representations of this counterpart relation in the DRT framework are given by means of so called *external* and *internal anchors*; for example in [Kam88], [Kamb] and [Ash86].

(24) is an example of using referring discourse referents in belief attributions. It represents a belief which Peter has about Marc. The discourse referent M which refers to Marc is bound by the universe of the main DRS, but in the context of the attitudinal state, it denotes a belief object which is the counterpart of Marc. The counterpart relation is due to some sort of causal relation, that connects Peter's beliefs with the individual Marc, (e.g. Peter may have seen Marc once and Marc was introduced to him under the name John.)

(24) Peter believes that Marc is named John.



On the other hand there are discourse referents that are bound by the universe of the DRS they occur in, or at least by some other DRS which expresses a belief and is part of the same articulated DRS. These discourse referents denote belief objects which do not necessarily have counterparts in the real world. An example is given in (23) which represents the belief attribution 'Peter believes that someone is named John.'

4.2 Specifying Belief Objects

In natural language we use the same expressions to refer to objects of the real world and to denote belief objects of a particular cognitive agent. In order to specify a belief object by natural language one can use two different methods. We can specify a belief object:

by counterpart : the existence of a belief object can be asserted by referring to a real world object. The so determined belief object is a counterpart of the object.

by description : the existence of a belief object can be asserted by specifying properties and by specifying relations to other belief objects.

A specification of a belief object by counterpart yields a *de re* belief. The expression refers to an object outside the scope of the belief context, but the object is used to specify a counterpart within the belief context and to assert its existence. For example:

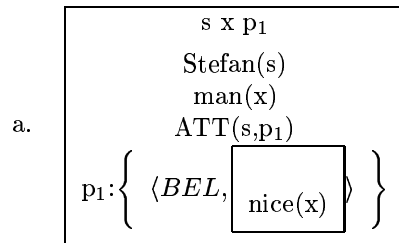
(25) Stefan believes that the man drove well.

In (25), the belief is, strictly speaking, about two actual entities: it is about the particular man referred to by the definite description “the man” and about the particular event of someone driving well.

In the following we will have a closer look at belief attributions that involve one belief object which is specified by counterpart or specified by property. After that, we will analyse belief attributions involving two belief objects which are related to each other. The next sentence shows a belief attribution involving one belief object which is specified by counterpart.

(26) shows a *de re* belief about one object, i.e. about an individual:

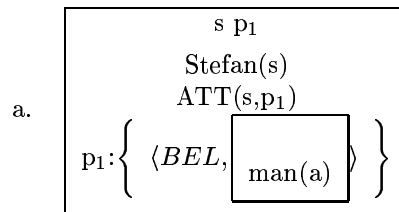
(26) Stefan believes that the man is nice.



(26) is a classical example of *de re* belief; Stefan attributes a property to a particular man.

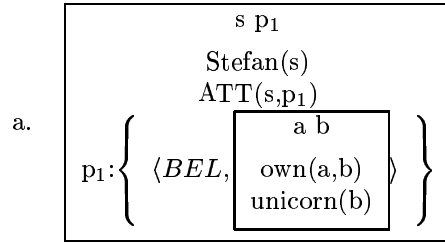
If we specify a belief object by a property, we specify it by description. Since we do not refer to any actual object, the belief object has no real world counterpart. Thus, we can say the specification is *de dicto* and the belief attribution (27) is *de dicto*, too.

(27) Stefan believes that there is a man.



Another way of specifying belief objects *de dicto* is to determine them by relations to other belief objects which are also specified *de dicto*.

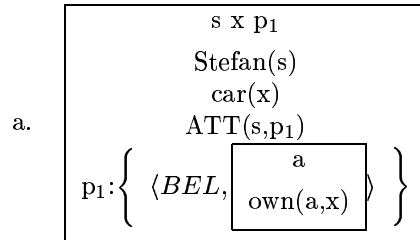
(28) Stefan believes that someone has a unicorn.



The belief object denoted by “a unicorn” is specified by a property, the belief object “someone” is then specified by a relation to “a unicorn”. All in all, we obtain a *de dicto* analysis. It should be noted that the relation of owning relates objects in quite a unique way; very often objects have a well specified owner. Throughout the paper I will make use of such uniquely relating relations without mentioning that they are special in this way.

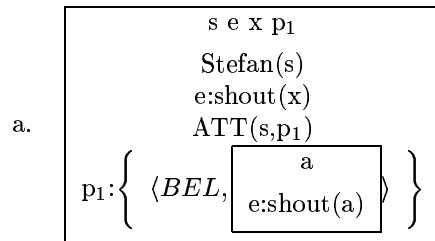
The next two examples combine specification by counterpart and by description. One belief object is given by counterpart the other by relation to the first. I call this kind of specification *specification by relation to a counterpart*.

(29) Stefan believes that someone owns the car.



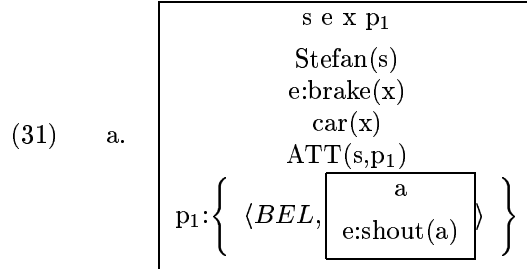
Above, the expression “the car” specifies a belief object by counterpart. The belief object denoted by “someone” is then specified by the relation “own” to the belief object which is specified by counterpart. Thus we obtain a *specification by relation to an object*. A similar analysis is given in (30), but here the counterpart is not an individual but an event.

(30) Stefan believes that someone shouted.



Stefan attributes the property of being a shouting-event to an event with which he has been in direct contact - this makes the belief attribution *de re* relative to that event. Furthermore, Stefan’s belief about the event involves another belief object which is not specified *de re*, but rather *de dicto*, or following the

terminology I have just introduced, this belief object is specified *by relation to an event*. This belief object has the property of having performed the event of the shout. The belief expressed in (30) cannot be *de re* relative to the individual that performed the shout, because in case the event was not a shout, but rather the sound of car brakes, we run into troubles if we want to identify the agent that performed the shout. The next DRS represents this situation.



Stefan wrongly believes that the event *e* was a shout. Thus the discourse referent *a* can only be *specified by relation to an event* but not *by counterpart*.

4.3 Counterparts

What makes a belief object and a real world object counterparts of each other? If there is a kind of acquaintance relation between the agent of a belief and the object the belief is about, then we can say that there is a counterpart relation between the object and the belief object that ‘represents’ the real world object in the belief. I assume for the rest of the article that the acquaintance relation we employ here requires some sort of causal relation which goes back to some sort of evidence which is caused, for instance, by direct cognitive contact. An interesting point about one link in the causal chain which leads to an acquaintance relation and thus to a counterpart relation has been made by Zimmermann [Zim99]. He proposes a *de origine* analysis of *de re* beliefs: According to Zimmermann, these ‘*de re* beliefs’ are not about the *res* (*viz* the actual objects) but they are rather about their source. The source is the event which caused the object to be represented in the belief state. The relevant discourse referent has to be related to the external, informative event, that caused its entering the information state in which it occurs. Such an *informative event* is the anchor for a causal chain that ties objects of belief to real objects. The relation between the informational source and the belief state is thus one of *de re* belief.

In the following we apply Zimmermann’s *de origine* approach to the specification of belief objects. If a belief object is specified by a description containing the informative event which caused it entering the belief state, then we have a *de origine* specification of a belief object. The *de origine* specification is very close to the specification *by relation to an event*: The belief about the event is *de re*, but the same belief is *de dicto* relative to the specified belief object, because it does not (necessarily) have a counterpart.

I do not follow Zimmermann’s proposal and explain away *de re* beliefs by

de origine beliefs. But with Zimmermann's account we are able to distinguish between *de re* beliefs where we just assume the existence of the counterpart relation and '*de re* beliefs' where we know the information which caused the belief object entering the belief state; (these '*de re* beliefs' are *de origine* beliefs). The important point about this distinction is that we have two categories for beliefs where others just have the category *de re* belief. For instance van Rooy [vR00] uses a counterpart relation which is defined by the source of belief objects. This definition treats belief objects exactly in the same way as Zimmermann's *de origine* account of discourse referents. In our terms this means, that *de re* beliefs and *de origine* beliefs are not treated distinctly [vR00].

To sum up, we can specify a belief object *de re* (*viz* by counterpart of an object) which determines the real object the belief is about. A second possibility of specifying a belief object is to specify it *de origine* (*viz* by relation to an event). It determines the rôle which the believer thinks the belief object plays in a real event. A third way is to specify belief objects *de dicto* (*viz* by description) which determines beliefs that are not about particular objects or events at all.

5 Definite Descriptions

Definite descriptions fall under the phenomenon of presuppositions. I will mainly stick to the accounts of van der Sandt [vdS92] and Kamp [Kama] which treat presuppositions as a kind of anaphora.

Presuppositions are processed in two stages: At the *computation stage* a preliminary representation is constructed of the current sentence, in which all the presuppositions it generates are explicitly represented. At the *justification stage* the presuppositions of the preliminary representation are justified relative to the context representation, after which the sentence representation is merged with the context representation. *Justification* is a term for the mix of verification (binding/satisfaction) and accommodation: some parts of the anaphoric material may be bound and some parts may be accommodated. Very often there is a variety of possible justifications. Each resolution of the presupposition can set up different referential connections between the sentence and the context; and thus, the discourse can be structured in multiple ways depending on the resolution.

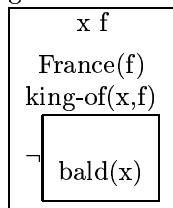
The justification stage as described in van der Sandt [vdS92] splits up into binding and accommodation. First, the binding procedure tries to find conditions which match the descriptive content of the presupposition in the local DRS. If matching succeeds, the discourse referents of the presupposition are identified with those of the matching conditions. Otherwise, this step is repeated for all DRS's that are accessible from the original position of the presupposition, until the match succeeds. Second, if no match can be found, the presupposition is accommodated in an accessible DRS, complying with some constraints of informativity and redundancy. The preferred accommodation site is at top level, the least preferred site is the local DRS.

Only global and local resolution of presuppositions are of interest for this article, therefore I don't discuss intermediate cases, where binding or accommodation takes place in a DRS that is distinct both from the main DRS and from the local one. The definite description "the king of France" in the sentence

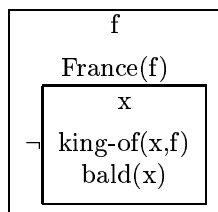
(32) The king of France is not bald.

is resolved globally or locally as shown in (33) and (34), respectively.

(33) global resolution



(34) local resolution



(33) asserts that there is a king of France, but that he is not bald. (34) denies that there is a bald king of France.

5.1 Definite Descriptions in Belief Attributions

In this section I show two possible ways of resolving a definite description that occurs in a belief attribution. It can be resolved globally and it can be resolved locally within the attribution. Another possibility which is not treated here is the resolution within the belief state of a second agent which occurs in nested belief attributions and in cases of *intentional identity*.

Definite descriptions in belief contexts are often ambiguous as regards whether they should be accommodated locally within the belief context or globally within the main context. The description of the following sentences is an example:

(35) Derrick believes that the murderer of Smith is bald.

Van der Sandt's constraints about preferred solutions only yield the global analysis for (35). The local analysis has to be postulated by an additional constraint, which determines the domain:

Definition 5.1 Domain Constraint

Before the resolution process starts, the admissible solutions can be restricted to one single domain which is either (i) the universe of the model or (ii) the belief objects of one particular agent.

This *ad hoc* constraint reflects the intuition that one can deliberately switch between *de re* and *de dicto* analyses.

If the domain is set to the belief state the definite description occurs in, then the domain constraint forces local resolution; we obtain a *de dicto* analysis. The definite description specifies the belief object by description. The local resolution of (35) is paraphrased in (36).

(36) Derrick believes that there is someone who murdered Smith and that this person is bald.

If the domain is set to the main context, the definite description must be resolved globally, we obtain a *de re* analysis. The definite description specifies the belief object by reference. A paraphrase of the global resolution of (35) is shown in (37).

(37) There is a murderer of Smith. Of *him* Derrick believes that *he* is bald.

6 Pronouns

As mentioned earlier, pronouns are either bound by a quantifier or they are unbound. The dynamic view on unbound pronouns is the following: unbound pronouns are free variables which have to be bound by the context. The context provides a set of discourse referents among which there has to be identified a suitable antecedent.

We can distinguish two types of antecedents: (i) extensional discourse referents which refer to extensions, *viz* objects and collections of objects, and (ii) intensional discourse referents which refer to intensions, *viz* concepts.

DRT as presented in Kamp and Reyle [KR93] solely uses extensional discourse referents. They are introduced by indefinite expressions and quantifier constructions, for example. The first sentence in (38) directly introduces two extensional discourse referents:

(38) A man walked. He was singing.

One discourse referent, let's say e , refers to the event of a man walking and the other to this particular man, let's say m . The pronoun "he" takes the discourse referent m as its antecedent, and so it refers to whatever m refers to.

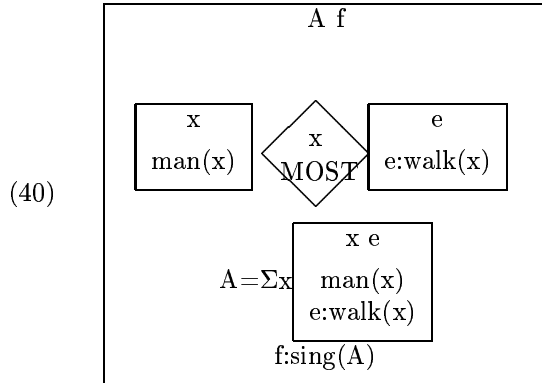
Quantifier constructions also introduce extensional discourse referents. These discourse referents usually refer to sums of objects. For example, the first sentence in (39) indirectly introduces two discourse referents:

(39) Most men walked. They were singing.

One discourse referent, E , refers to the event comprising all single events where one of the men walked (see Asher 1993 [Ash93]). The other discourse referent, let's say M , which is introduced by the first sentence in (39) refers to the collection of all the men who actually walked.

I call the introduction of E and M "indirect", because they are not the discourse referents which are directly introduced by "men" and "walked". These discourse referents occur within the quantified expression and they are not accessible to pronouns which occur in the main context. The discourse referents E and M are introduced into the context by a mechanism called *E-type abstraction*.

E-type abstraction constructs the reference to a collection of objects by abstracting over a discourse referent which occurs within the duplex condition representing the quantified expression. This is DRT's way of enabling pronouns to be anaphorical to nominals which stand in logically inaccessible positions. The reference provided by E-type abstraction comprises all objects which verify the quantified expression with respect to a particular discourse referent. Technically, the *scope* and the *restriction* of the duplex condition are merged; one of the discourse referents is made the *distinguished discourse referent*. The distinguished discourse referent together with the set of conditions form a property. The property's extension is a collection of objects which is assigned to a fresh discourse referent. An analysis of (39) shows how E-type abstraction is done in DRT:



The pronoun “they” from (39) takes the discourse referent A as its antecedent where A is the result of E-type abstraction over the duplex condition. The discourse referent A refers to all the men who walked.

In Asher’s DRT [Ash93] and van Rooy’s DPL ([vR97b]) some constructions introduce *intensional discourse referents*. Intensional discourse referents refer to properties; subsequently, they either can be applied to *extensional discourse referents* or they can be interpreted as *extensional discourse referents* after they have been evaluated in a particular world. In van Rooy [vR97b] for example, indefinite descriptions introduce properties into the global context, containing the descriptive content of the indefinite description. For example, the first sentence of (41) introduces the concept $\lambda x.\text{bride}(x)$ to the context:

(41) It is not true that there is no bride at the wedding. She hides behind the pillar.

The pronoun “she” then takes this concept as its antecedent. According to van Rooy, it is necessary for a felicitous uptake of concepts that they have a unique instantiation. This uniqueness condition is met in (41), for it is fairly natural that there is only one bride at a wedding. The following example is correctly predicted to be odd:

(42) ?It is not true that there is no guest at the wedding. He hides behind the pillar.

In contrast to (41) the above example is bad, because the pronoun takes up the concept $\lambda x.\text{guest}(x)$, which violates the uniqueness condition under normal circumstances - usually there are more than one guest at a wedding. For a detailed discussion I refer to [vR97b].

6.1 Interpreting Pronouns *de dicto*

So far, we have seen that we can use definite descriptions to specify belief objects either *de re* (i.e. by counterpart) or *de dicto* (i.e. by relation to other belief objects).

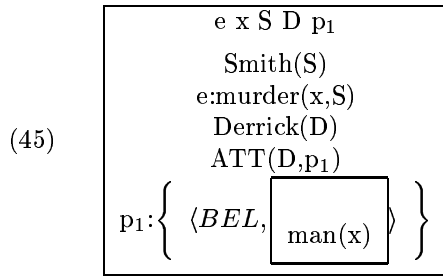
As the following example shows, pronouns can also specify belief objects *de re* and *de dicto*.

(43) *Someone* murdered Smith. Derrick believes that *he* is a man.

We obtain the *de re* reading when we analyse the pronoun as taking up the reference of its *syntactic antecedent*; in this case the belief object Derrick has a belief about is *specified by counterpart*. (43) may be informally paraphrased by

(44) x murdered Smith. Derrick believes that x is a man.

The *de re* reading of (43) and the informal paraphrase (44) is explained by DRT's anaphora resolution mechanism. First, the NP "someone" will introduce a discourse referent x into the context which is suitable to be the antecedent of a singular, male pronoun. Next, the pronoun "he" binds to the discourse referent x .



Recalling the situation given in (5) the *de re* reading of the belief attribution of (43) can also be paraphrased by the sentence

(46) Derrick believes that Klein is a man.

which is certainly a possible reading. Nevertheless, according to my intuitions about the sentence (43) the preferred reading is not the *de re* reading, but the *de dicto* reading which can be paraphrased as follows:

(47) Derrick believes: *the murderer of Smith* is a man.

The above sentence should be read in a way such that the predicate "believe" takes scope over the definite description. To avoid such scope ambiguities I paraphrase the *de dicto* reading of (43) by the following sentence which is intended to be equivalent to (47):

(48) Derrick believes that a man murdered Smith.

The corresponding DRS, (49), which represents the *de dicto* analysis of (43) cannot be the result of the standard construction procedure applied to (43).

$$(49) \quad \left\{ \begin{array}{l} \text{e x S D} \\ \text{Smith(S)} \\ \text{Derrick(D)} \\ \text{e:murder(x,S)} \\ \text{ATT(D,p}_1\text{)} \\ \text{p}_1: \left\{ \begin{array}{l} \langle \text{BEL}, \text{f:murder(a,S)} \rangle \\ \text{man(a)} \end{array} \right\} \end{array} \right\}$$

The problem is that at the first stage, *viz* the *construction stage*, the sentences are processed independently from the context. This means that the second sentence of (43) is transformed into a preliminary representation which only contains information that is contained in the sentence itself; “Derrick believes that he is a man” does not yield a preliminary representation containing descriptive information about a murderer of Smith, although it does have the requirement that the context has to provide a suitable antecedent for the pronoun “he”. which is resolved in the *update stage*.

In order to solve the the problem of how we get the *de dicto* analysis in (49) of the sentences (43) we can pursue two different strategies: As one possibility, we can modify the process at the *construction stage* to make it context dependent, such that it can use descriptive material from the context DRS to build the preliminary representation. The second possibility is to ensure that the context contains discourse referents which refer to entities which can be interpreted *de dicto* in the *update stage*. That means, if a pronoun occurs in a belief attribution and is anaphorical on such a discourse referent, then the pronoun takes up the reference of this discourse referent and it has to yield some sort of descriptive content to make the belief attribution *de dicto* .

An approach which solves the phenomenon of descriptive pronouns by modifying the *update stage* is given by van Rooy’s accounts of descriptive pronouns in [vR97b] and [vR00]. These accounts are formulated in Dynamic Predicate Logic with intensional discourse referents, a reformulation in DRT would benefit from Asher’s DRT asher93:reference. Asher presents a treatment of intensional discourse referents in DRT. He shows how concepts can be introduced into the discourse during the *construction stage*, how pronouns can be anaphorical to them and how these pronouns have to be interpreted in the *update stage*.

None the less, I think it is tempting to do without intensional discourse referents, and therefore I pursue an approach to descriptive pronouns which makes changes affecting only the *construction stage*. Descriptive pronouns have to be handled by a construction mechanism which is sensitive to the already established context. If we decide to go this way, and if we want to analyse (43) *de dicto* (see (49)), then the condition

$$(50) \quad \text{f:murderer(a,S)}$$

has to be represented already as a part of the belief attribution in the *construc-*

tion stage with the pronoun “he” triggering the addition of descriptive material to the belief attribution.

To sum up, in order to get the intended *de dicto* reading of (43) we do not analyse the pronoun “he” as co-referential with its antecedent; this would yield the *de re* analysis shown in (45). Furthermore, we do not make use of intensional discourse referents; so we do not analyse pronouns as being anaphorical upon concepts. We have decided to pursue an approach which explains the *de dicto* reading (49) of the sentence (43) by inserting descriptive material into the belief attribution. This new material should then allow us to interpret the belief *de dicto*, although the belief is about something denoted by the pronoun “he” the antecedent of which refers to a real object.

6.2 The Recoverable Content

Following Neale [Nea90] a descriptive pronoun recovers the information from the clause which contains the antecedent; and the recoverable information is interpreted as a definite description. Below I give some more examples where I discuss some factors which influence the ability of the antecedent to replace the pronoun by a definite description. I always give a *de re* reading and a *de dicto* reading which is obtained by replacing the pronoun by the definite description which I intuitively think is the intended one. In particular I will look at definite descriptions which specify belief objects in three different ways: the intended definite descriptions specify belief objects by property, by relation to an object and by relation to an event.

It should be noted that I use a notion of *de re* belief which is not truly *de re*. The notion I use is rather sloppy, because it assumes some sort of direct cognitive contact between the agent and the object or some sort of assent from the agent to the way the speaker refers to the object. This means, that if I talk about the beliefs which Dennis has about Anne, then I mean those beliefs which Dennis in fact has about Anne and of which Dennis simultaneously thinks that they are about the person he knows as ‘Anne’.

The following sentences in (51) sketch a situation according to which we want to discuss some examples.

- (51) Anne lives in Tübingen; she has blue eyes, but she always wears brown contact lenses. She lives with her brother, John. Anne went out to the cinema with Dennis, who is her boyfriend.
Dennis has some wrong beliefs about Anne:
He thinks that she lives in Stuttgart. He thinks that she has brown eyes. He does not know that she is John’s sister. But Dennis knows that John has a sister and that he shares his flat with her in Tübingen. Recently, John told Dennis, that her sister broke his TV. But of course Dennis does not draw the conclusion that Anne broke John’s TV.

The following five examples are discussed relative to background which is provided by the situation given in (51). The first line always is the example that is going to be discussed; the “a.” sentence shows a paraphrase of the *de re* reading of the example’s belief attribution; and the “b.” sentence shows a paraphrase of its *de dicto* reading.

In the following two examples, (52) and (53), each antecedent provides a description which specifies belief objects by property.

- (52) There is a girl with blue eyes. Dennis believes that *she* is his girl-friend.
 a. Dennis believes that Anne is his girl friend
 b. ?Dennis believes that *the blue-eyed girl* is his girl-friend.
- (53) There is a girl with brown eyes. Dennis believes that *she* is his girl-friend.
 a. Dennis believes that *XY* is his girl-friend
 b. ?Dennis believes that *the brown-eyed girl* is his girl-friend.

The *de re* analysis (52-a) is true, because Anne is a possible referent for the indefinite description “a girl with blue eyes” in the first sentence and because Dennis believes of her that she is his girl-friend. The *de dicto* reading (52-b) is not a possible analysis of (52) according to my intuitions, therefore it is marked with a question mark.

The sentence (53) is similar to (52) apart from the specification of the eye colour: (53)’s *de re* reading paraphrased in (53-a) is false, because the indefinite description “a girl with brown eyes” cannot refer to Anne and because Dennis has no beliefs about someone else (here “XY”) being his girl-friend. The *de dicto* reading (53-b) is again not a possible analysis of (53).

The following example, (54), shows an antecedent which provides a description that specifies a belief object by relation to an object.

- (54) John has a sister. Dennis believes that *she* lives in Tübingen.
 a. Dennis believes that Anne lives in Tübingen.
 b. Dennis believes that *the sister of John* lives in Tübingen.

The *de re* reading of (54) shown in (54-a) is false, because Dennis thinks that Anne lives in Stuttgart but not in Tübingen. The *de dicto* reading (54-b) is true, because Dennis has beliefs that John has a sister and that she lives with him in the same town. The intended description which replaces the pronoun “she” is **sister of John**.

(55) shows a similar set up. The belief object provided by the recoverable description is specified by relation to an event.

- (55) A girl broke John’s TV. Dennis believes that she is John’s sister.
 a. Dennis believes that Anne is John’s sister.
 b. Dennis believes that *the one who broke John’s TV* is John’s sister.

According to (51) Dennis has the belief that John’s sister broke the TV, but not

that Anne broke the TV. Thus again, the *de re* reading (55-a) is false; and the *de dicto* reading (55-b) is true. The intended description which replaces the pronoun is **someone who broke John's TV**.

The following example shows an antecedent which is contradictory to Dennis beliefs:

- (56) A girl broke John's TV and she went to the cinema with Dennis. Dennis believes that she is John's sister.
- a. Dennis believes that Anne is John's sister.
 - b. Dennis believes that *the girl who broke John's TV and who went to the cinema with him* is John's sister.

The intended recoverable description is **girl who broke John's TV and who went to the cinema with Dennis**. It refers to both the event of breaking the TV and the event of going to the cinema with Dennis. The *de re* reading (56-a) is false anyway, and this time the *de dicto* reading (56-b) false, too, because the description cannot be applied properly to Dennis' belief state. In Dennis beliefs there is not a single belief object with which he associates both events: the event of someone going to the cinema with him and the event of breaking John's TV.

To sum up, substituting a pronoun by a definite description is not simply taking the content of the antecedent. As suggested by (52-b) and (53-b), simple properties have not enough force to substitute a pronoun. If the description makes use of at least one actual object, the content is qualified to substitute the pronoun by means of a definite description, see (54) and (55). But as (56-b) shows, the description cannot replace the pronoun without checking it against the entire belief state of the agent to which the belief is attributed. If the description identifies two belief objects which are distinct, then it fails.

This means, that we have two levels of context dependence: the content of the definite description that replaces the pronoun is dependent on the content of the antecedent and on the belief state the description is applied to.

7 Substitution of a Pronoun by a Description in DRT

In the previous sections I have presented cases which suggest that pronouns should sometimes be analysed as a kind of “pronouns of laziness”. This observation is due the ambiguity we find with belief attributions containing a pronoun which can be interpreted *de re*, but also *de dicto*. The *de re* readings of such belief attributions take the pronoun to be coreferential with the antecedent whereas the *de dicto* readings take the pronoun to go proxy for a description recoverable from the context.

Before we see how a description can be recovered from the context and how exactly it can replace the pronoun I want to stress that I propose to substitute a pronoun by a description only as alternative solution to the *de re* solution - the construction algorithm will be such that it takes the *de re* analysis and overwrites it with the *de dicto* analysis. In cases where a pronoun is inside a belief attribution and its antecedent is taken from the (main) context we first analyse the attribution *de re*. If we want to proceed to get the *de dicto* analysis we keep the antecedent discourse referent that is available from the *de re* analysis; then we delete the *de re* analysis and repeat the construction procedure for the corresponding sentence with a modified construction mechanism for the pronoun. The discourse referent which has been linked to the antecedent is used to recover the descriptive content from the context. This content is checked for its suitability to replace the pronoun and modified if necessary. After that, the pronoun is replaced by the modified descriptive content in a particular way. The rest of the sentence is processed without any modification. I am completely aware that this is only a temporary solution which does not smoothly integrate into the construction procedure of DRT.

7.1 Descriptions

This subsection contains some notes on descriptions. Descriptions are commonly used as definite descriptions and indefinite descriptions. In natural language both types of descriptions have a nominal part which determines their content. I call this part the *descriptive part* of a description. The descriptive part can be complex; relative clauses and adjectives can modify the head of the nominal part and so they augment the descriptive part with information. Additionally to the definite use and the indefinite use of a description I want to propose an *identifying use* of a description. In this article all descriptions which replace a descriptive pronoun are taken from the domain of the actual world, because the antecedent occurs in the main context, and they will be used in the domain of belief, because the pronoun which is going to be substituted, occurs in a belief attribution. The problem is at hand: the descriptive part of a description which is taken from the actual world can be instantiated by an actual object, but there is no guarantee that there is an instantiating object in a different domain. Nevertheless, although there might be no match, we might be able

to *identify* an object which fits the description well enough. The *identifying use* of a description does not bind to a salient object as definite descriptions do, nor does it assert the existence of an object with certain properties as indefinite descriptions do. This particular use will get its own representation in the preliminary representation. I will refer to this representation as *identifying description*. The identifying description will then be transformed to proper DRS conditions which pick out an object of the domain without attributing properties to it.

The descriptive part of a description is a possibly complex property, it has one argument and conditions specifying constraints over the argument. Technically, a description can be represented by a DRS with a distinguished discourse referent. The extension of the description is the set of all objects that yield a true interpretation for the DRS when it is substituted for the distinguished discourse referent.

$$(57) \quad \lambda d.D$$

The descriptive part D can be seen as a conjunction of conditions, $P_1(d) \& \dots \& P_n(d)$. (57) is equivalent to the following condition:

$$(58) \quad \lambda d.(P_1(d) \& \dots \& P_n(d))$$

Any object that has the complex property (57) does also have the property (58) and thus it has all the simple properties $P_1 \dots P_n$.

7.2 The Identifying Use of Descriptions

As said above there is a problem if we want to use a description within more than one domain: a description which has an extension in the actual world, may have no extension in the belief world. Therefore, I propose to use descriptions which have been recovered from the context, such that they identify objects.

If we want to identify an object of a particular domain by means of a description, we only want to pick it out, but we do not want to attribute any properties to it. Thus I propose a notion of identification by description such that an object is identified by a description if it is preferred over the other objects of the domain for the reason that it matches the description best. The identifying use of the descriptive part D is represented by the term shown in (59).

$$(59) \quad \Delta dD$$

But as we will see, the term (59) is only a preliminary representation which will be substituted in the course of the construction of the DRS. Since the descriptive part consists of simple properties, (59) is equivalent to (60):

$$(60) \quad \Delta d(P_1(d) \dots P_n(d))$$

In contrast to properties which have been described in the previous paragraph, the identifying use of a description does not ensure that an object which is

identified by the description D does also have all simple properties $P_1 \dots P_n$ of D . The notion of identification presented here does not imply uniqueness of a matching object; it rather ensures that the identified object is one of the *best matches* - all other objects of the domain match the description equally well or less. The identifying use of a description is therefore a relative constraint on the selection of objects, not an absolute one. An object is not picked out because of its absolute nature, but because of its nature compared to all other objects of the domain.

In the following three sections I will briefly show (i) how a description can identify an object without attributing its descriptive content to the object; (ii) what I understand under the *best match* of a description; and (iii) conditions that make a property suitable to be used in an identifying description.

7.3 Relevant Properties

If we want to replace a pronoun in a belief attribution by some sort of description, we do not simply accommodate the descriptive content associated with the antecedent into the belief attribution, we rather use it to *identify* a suitable belief object as denotation of the pronoun.

Since we take the material for the description from a main context and apply the description in another domain, i.e. the domain of the attitudinal state of a particular agent, we have to deal with conditions that are true in the main context, but that are possibly not true within the domain the description is applied to. These conditions are not used by the identification process, because they represent *irrelevant* properties within the domain of that particular cognitive state. All other properties which have a matching object within that domain are called *relevant properties*. Instead of taking a description which has an instantiation in the actual world and transposing it to a belief world, I give an example which takes a description which has an instantiation in a possible world, but not in the actual world, and transpose it to the actual world. The definite description

(61) “the city that was the capital of the FRG in 1980 and that was the biggest German city in 2000”

evaluated in our actual world, picks out the city *Bonn* with the first clause and the city *Berlin* with its second clause. But *Berlin* doesn't match the first part, and *Bonn* doesn't match the second part. So the whole description does not identify any actual object.

7.4 Best Match

I want to define the *best match* of a description as any object that satisfies all relevant properties. If there is no such “best matching object”, then this can have two reasons: Either there is no relevant property or there is no object that matches *all* relevant properties. If we define the process of identification in terms of a best match, then we do not obtain a process that determines a

unique object; but the process guarantees for every object which is a *best match*, that there is no other object satisfying a property of the description, which is not satisfied by the *best matching* object itself.

Coming back to the example (61), the whole description evaluated in the actual world has no best match; thus it does not determine a reference. Every condition of the form “ $a = (61)$ ” is false. A possible repair strategy would be to admit any *partial match* as identified object, but I won’t elaborate this possibility any further.

To clarify the term *relevance of a condition* let me give another example.

- (62) “the city that was the capital of the FRG in 1980 and had more than 10 billion inhabitants in 2000”

The above description, (62), has a best match in the actual world, namely the city Bonn. Since the second part of the description is not satisfied by any object at all, it is not relevant, and so it does not contribute any of its content to the whole description.

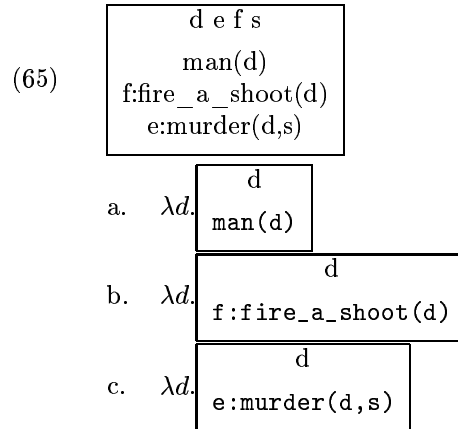
7.5 Recovering a Description from the Main Context

Later on the semantical representation of descriptive pronouns will be built from information which has been taken from the main context relating to the actual world. Recovering the descriptive part of a description from the syntactic antecedent is the task of picking up those properties from the context that are associated with the antecedent. I call the properties that have been picked up *possible conditions*, and a description consisting of all possible conditions a *possible description*.

Neale [Nea90] and van Rooy [vR00] present different ways of finding possible conditions which are suitable for building an *identifying description*. Neale proposes to take all the descriptive material of the whole quantified expression for quantifiers like *every* and *most*; for indefinite descriptions he proposes just to take the descriptive content of the restriction. In the DRT framework, indefinites are not treated as quantifiers, so we do not have a restriction. I follow van Rooy [vR00] in taking all the information that is associated with a particular discourse referent in a particular information state. In DRT this means, that we recover the syntactic antecedent by taking the information associated with a discourse referent d in a DRS K . This information associated with d is defined as all DRS-conditions of K which contain a discourse referent which is coreferential with d . Using reference-classes instead of particular discourse referents allows us to capture information that is introduced into the discourse by referentially used pronouns. For example, both discourses (63) and (64) provide the same properties for the recovery process, in case “a man” is the antecedent of a descriptively used pronoun:

- (63) A man fired a shot. He murdered Smith.
(64) A man murdered Smith. He fired a shot.

We can extract the following three properties: i) being a man, ii) being the agent of the particular event of shooting and iii) having murdered Smith. The first property is expressed by the *possible condition* $\lambda d.\text{man}(d)$. The second property and the third property have references to the time and the place when the events of shooting and murdering took place. The according three properties are listed below:



The discourse referents within the property which are not bound by the universe of the DRS are free. To avoid that, the properties should only be used within the DRS from which they are extracted. This makes sure that these discourse referents are bound.

7.6 Qualified Properties

As we have seen in the examples (14), (52-b) and (53-b), not all possible conditions contribute to the description which replaces the descriptive pronoun. Those conditions which are actually used in the description are called *qualified conditions*. and the properties attributed in these conditions are called *qualified properties*.

I want to propose that there are qualitative differences between properties: Those properties which contain references to an object (see (65-c)) or to an event (see (65-b) and (65-c)) seem to be suitable to be used to identify objects within belief contexts, whereas properties which do not make use of references to external objects (see (65-a)) don't seem to be suitable. I draw my conclusions from the observations I have made at the end of section 6 and on grounds of the observation of Zimmermann [Zim99], see section 4.3. A possible condition taken from the main context is a qualified condition, only if it specifies a belief object *by relation to an event* or *by relation to an object*, when it is used in belief contexts.

7.7 Recovering a Description from the Context

If we want to recover descriptive material from the main context in order to substitute the descriptive pronoun, we first take the discourse referent δ that we have found for the *de re* analysis. Second, we collect all conditions from the context which contain discourse referents equivalent to δ . Next we replace every discourse referent that is equivalent to δ by δ . This set of new conditions containing δ which results from this substitution forms the set of *possible conditions*. Third, we obtain the set of *qualified properties* by removing all simple properties, i.e. those conditions which do not have a discourse referent distinct from δ ; simple properties do not obey the condition for qualified properties. Fourth, the identifying description is the DRS built from the universe U and the qualified properties. U consists of all discourse referents occurring in the set of the qualified conditions.

8 Implementation

The *best-match* constraint can be implemented in two ways: The *static strategy* introduces conditions which guarantee that the *best match* constraint is met relative to the entire domain of the particular belief state. In the following section I will shortly show how this can be done. Another way is the *dynamic strategy* which implements the *best-match* constraint only relative to the part of the belief state which is known from the context. Thus an object may be identified as the best matching object although there might be better matching objects in the domain. Anyone who is interested in this approach I want to refer to van Rooy and Zimmermann's joint paper [vRZ96].

8.1 Static Strategy

The static account of implementing an *identifying description* provides a discourse referent referring to an object that is a *best match* of the identifying description relative to the whole domain the description is applied to. If no *best match* can be found, the discourse referent does not refer to any object of the domain. In order to check the relevance of a property we have to introduce a precondition explicitly before we assert the property. As said earlier, the condition for a property to be relevant is that its extension is not empty, i.e. there is an object satisfying the property. The following condition shows an attribution of the property P_i to the variable x only in case P_i is relevant

$$(66) \quad \exists a[P_i(a)] \Rightarrow P_i(x)$$

The implication in (66) asserts nothing in case that $\exists a : P_i(a)$ is false, but it attributes $P_i(x)$ in case that $\exists a : P_i(a)$ is true.

A description can consist of more than one property, and so we have to check the relevance for each property to obtain the identifying use of a description. Each property has to be asserted in the above manner.

(67) shows how a description consisting of n conditions, $P_1 \dots P_n$, identifies an object referred to by x . Either the whole formula is false, or otherwise x holds the property of being a *best match* within the domain.

$$(67) \quad \begin{aligned} &(\exists a[P_1(a)] \Rightarrow P_1(x)) \ \& \\ &(\exists a[P_2(a)] \Rightarrow P_2(x)) \ \& \\ &\dots \ \& \\ &(\exists a[P_n(a)] \Rightarrow P_n(x)) \end{aligned}$$

Applying the static strategy to the *identifying description* in (68-a) is defined by replacing it by the representation shown in (68-b). (68-b) contains conditions that ensure that the fresh discourse referent d_{new} has the *best match* property. Of course, the new discourse referent d_{new} has to be inserted into the universe of the local DRS.

$$\begin{array}{l}
(68) \quad \text{a. } y = \Delta d \quad \begin{array}{|c|} \hline d \\ \hline P_1(d) \\ \dots \\ P_n(d) \\ \hline \end{array} \\
\text{b. } y = d_{new} \quad \begin{array}{|c|} \hline a \\ \hline P_1(a) \\ \hline \end{array} \Rightarrow \begin{array}{|c|} \hline P_1(d_{new}) \\ \hline \end{array} \\
\quad \dots \\
\quad \begin{array}{|c|} \hline a \\ \hline P_n(a) \\ \hline \end{array} \Rightarrow \begin{array}{|c|} \hline P_n(d_{new}) \\ \hline \end{array}
\end{array}$$

I want to repeat the view on *identifying descriptions*. Identifying descriptions do not attribute their properties to the described objects. For example in the above case (68), there is no condition P_i , such that the condition $P_i(x)$ is necessarily true. Identifying descriptions attribute the property of being a *best match* to an object, which is not a property that the object has by virtue of its own nature. Being a *best match* is a property relative to all other objects of the domain.

8.2 Comment on the Dynamic Strategy

The dynamic account of implementing an *identifying description* identifies a suitable discourse referent from the context as the *best match* relative to the context. Basically, such a strategy would insert a presupposition into the preliminary representation presupposing a belief object which would have all relevant properties. The implementation of the dynamic strategy would go beyond the scope of this article.

9 Resolving Descriptive Pronouns in Belief Contexts

Applying the identification mechanism in belief contexts is straightforward for the static strategy.

The difference between the referential use and the descriptive use is not one of ambiguity of antecedents. I therefore simply propose to keep the standard anaphora resolution along the accessibility path in order to find the discourse referent that is linked to the antecedent. This discourse referent is taken for retrieving an identifying description which recovers the descriptive content of the syntactic antecedent and replaces the descriptive pronoun by an *identifying use* of a description. Resolution of the identifying description proceeds as presented above; in the rest of the section I want to exemplify the process by an example:

(69) A man murdered Smith. He fired a gun. Derrick believes that *he_{desc}* is in Stuttgart.

The next DRS (70) is a representation of first two sentences of (69):

(70)

a	b	S	e ₁	e ₂
man(a)				
Smith(S)				
e ₁ :murder(a,S)				
gun(b)				
e ₂ :fire(a,b)				

In the first step, the anaphora resolution mechanism resolves the pronoun to bind to the discourse referent *a*. The first step yields the *de re* reading. In order to obtain the *de dicto* reading we have to memorise the discourse referent *a* and repeat the the analysis of the belief attribution with a modified construction procedure. The discourse referent *a* serves as the antecedent for the descriptive pronoun.

Now, we can recover the descriptive part of the syntactic antecedent. (71) shows the descriptive part with the *possible conditions*; i.e. the conditions which contain *a*:

(71) Δa

a				
man(a)				
e ₁ :murder(a,S)				
e ₂ :fire(a,b)				

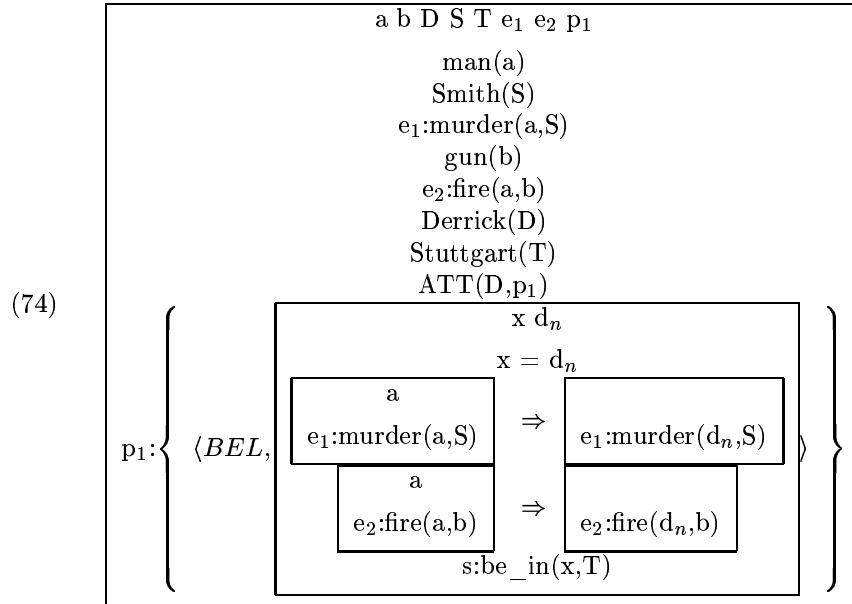
The next step reduces the *possible description* to a *qualified description* by “throwing away” those conditions which do not use at least one discourse referent referring to an actual object; here we delete the condition *man(a)* and obtain:

$$(72) \quad \Delta a \begin{array}{c} a \\ e_1:\text{murder}(a,S) \\ e_2:\text{fire}(a,b) \end{array}$$

The description (72) is used to replace the descriptive pronoun. We therefore obtain the following preliminary representation (73) for the whole discourse in (69):

$$(73) \quad \begin{array}{c} a \ b \ D \ S \ T \ e_1 \ e_2 \ p_1 \\ \text{man}(a) \\ \text{Smith}(S) \\ e_1:\text{murder}(a,S) \\ \text{gun}(b) \\ e_2:\text{fire}(a,b) \\ \text{Derrick}(D) \\ \text{Stuttgart}(T) \\ \text{ATT}(D,p_1) \\ \left. \begin{array}{c} p_1: \left\langle \text{BEL}, \begin{array}{c} x \\ \left. \begin{array}{c} a \\ e_1:\text{murder}(a,S) \\ e_2:\text{fire}(a,b) \end{array} \right\} \right\rangle \\ s:\text{be_in}(x,T) \end{array} \right\} \end{array}$$

Applying the static strategy for resolving the identifying description yields the final representation:



This DRS attributes a belief to Derrick which can be informally paraphrased as follows: “If someone murdered Smith then it was d_n ; if someone fired a gun, then it was d_n ; d_n is in Stuttgart.” It should be remarked that none of the implications in the belief attribution of (74) have to be part of Derrick’s belief state in that very form, they rather characterize the entire belief state. The corresponding paraphrase of (74) should be the following: “if Derrick believes that someone murdered Smith then he believes that it was d_n ; if he believes that someone fired a gun, then he believes that it was d_n ; furthermore, Derrick believes that d_n is in Stuttgart.”

10 Summary

The present article shows that a singular pronoun which occurs in a belief attribution can have two different interpretations one of which is triggered by the referential use of the pronoun and the other by its descriptive use. The referential use yields readings of the belief attribution which are *de re* relative to the reference of the syntactic antecedent; contrarily, the descriptive use of the pronoun cause *de dicto* readings of the belief attribution. Since these *de dicto* readings cannot be explained by the framework of DRT, an account is developed which incorporates elements of syntactic anaphora theories into DRT: The pronoun is substituted by a suitable description which is recoverable from the context. It is a finding of this article that the suitability of a description is dependent on two kinds of contextual factors: (i) the information which is associated with the syntactical antecedent, and (ii) the information concerning the belief state of the according agent. To restrict the investigation the article focusses on cases where the syntactic antecedent is an indefinite description which occurs in a main clause, and the pronoun is a singular pronoun and part of the complement sentence of a belief attribution. The construction procedure for *de dicto* readings of pronouns builds up onto the according *de re* reading where the pronoun has been taken to be referentially used. The discourse referent which holds the reference of the pronoun in the *de re* reading, serves as starting point. All information of the context that is associated with the reference of that discourse referent is checked whether it is suitable for substituting the pronoun. The article contains a brief proposal of performing the final substitution of the pronoun by the suitable information. It finishes with an example showing the semantical representation.

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