UNDERSPECIFIED PRESUPPOSITIONS[1]

Frank Keller
Centre for Cognitive Science
University of Edinburgh
keller@cogsci.ed.ac.uk

Abstract

In this paper, van der Sandt's (1992) account of presupposition as anaphora is reconstructed in Underspecified Discourse Representation Theory (UDRT). We show that UDRT readily provides the means for representing presuppositional anaphora, making redundant a special α-structure as employed by van der Sandt. Our account is non-procedural, fully monotonic, and offers an underspecified representation for ambiguities arising from presupposition accommodation.

In this approach, presupposed material is integrated directly into underspecified discourse representation structures. Presupposition binding and accommodation take place by adding subordination restrictions to these underspecified structures. This allows us to capture certain instances of presupposition denial, as well as lexical variation in the behavior of presupposition triggers.

1 Introduction

The need for underspecified representations of semantic ambiguities is widely recognized both in semantic theory and in computational linguistics. An underspecification-based approach to semantics on the one hand should offer the representational devices to effectively express underspecified meanings, and on the other hand should inherit the explanatory power of more traditional semantic theories.

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An instance of such an approach is Underspecified Discourse Representation Theory, initiated by Reyle (1993). It extends the formalism of standard Discourse Representation Theory (DRT, Kamp and Reyle 1993) to include the means for underspecifying the scope relations between Discourse Representation Structures (DRSs). UDRT has been applied to ambiguities arising from scrambling (Frank and Reyle 1992, Reyle 1993) and plural noun phrases (Frank and Reyle 1995a,b, Reyle 1994).

The goal of this paper is to show how an account of presupposition can be integrated into a UDRT setting, the underlying assumption being that presuppositions are best treated as anaphora in the spirit of van der Sandt (1992). Our key idea is that anaphora can be regarded as scope-bearing elements, and that anaphora resolution corresponds to the disambiguation of anaphora scope. Presuppositional anaphora have the special property of remaining scopally underspecified if they cannot be bound to an antecedent. An unresolved presuppositional anaphor then corresponds to an accommodated presupposition in van der Sandt's theory, with accommodation ambiguities remaining underspecified where van der Sandt recurs to disjunctive representations.

In this section, we outline the two frameworks on which our account of presupposition relies: section 1.1 gives a brief overview of UDRT, section 1.2 introduces the analysis of presupposition by van der Sandt and Geurts (1991) and van der Sandt (1992).

1.2 Overview of UDRT

In DRT, the subordination of DRSs is represented graphically with the help of boxes and their nestings relative to each other. UDRT makes this subordination relation explicit by using *labeled DRS-conditions* of the form $l{:}\gamma$ where l is a label (a constant) and γ is a DRS-condition (or a discourse referent). The labels for the conditions in an Underspecified DRS (UDRS) are arranged in a lattice through the relation $\geq$. A *subordination restriction* of the form $l_m > l_n$ states that the condition labeled l_n is strictly subordinate to the one labeled l_m. Weak subordination (including the possibility of equal nesting) is expressed accordingly by $l_m \geq l_n$.

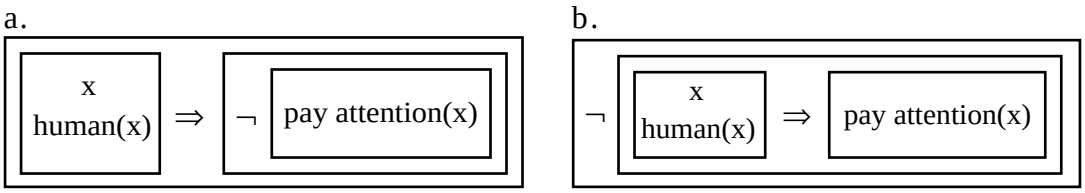
In standard DRT, scope ambiguities are expressed by disjunctive DRSs which differ in the nesting of the sub-DRSs they contain. In UDRT, the aim is to avoid disjunction by leaving the nesting, i.e., the subordination relations

underspecified: an ambiguous discourse is assigned a single underspecified representation, on which inferences can be drawn directly (Reyle 1993, 1995). This can be illustrated using example (1):

(1) Everybody didn't pay attention. (Frank and Reyle 1995b)

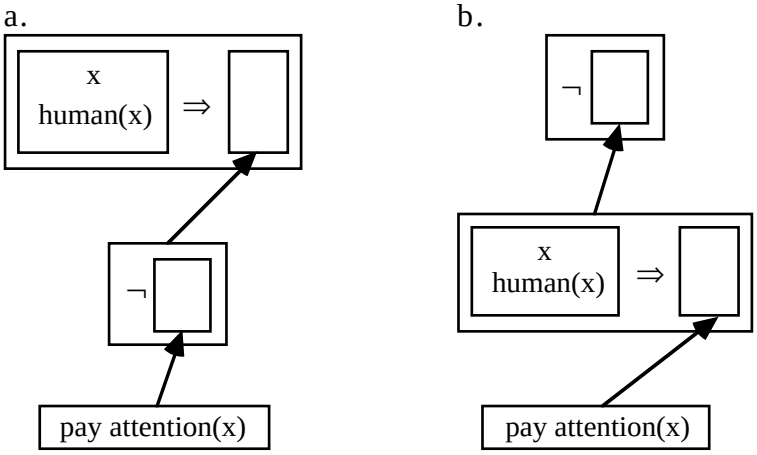
The DRT representation for the two readings of (1) is as follows:

(2)



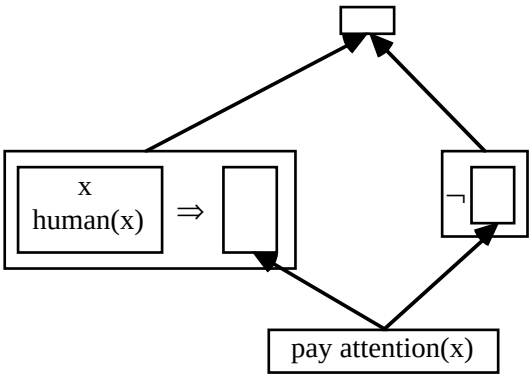
If we reformulate the same representation in UDRT, we get the structures in (3). Here, the subordination relation is represented by upwards arrows meaning ≤:

(3)



These two UDRSs can be represented by a single structure, hence eliminating the need for disjunctive representations:

(4)



We give the formal definition of a UDRS (following Reyle 1993:162):

(5) A UDRS *K* is a pair $\langle L, D\rangle$ consisting of the subordination restrictions $L = \langle L, \geq\rangle$ and the UDRS-conditions D, where *L* forms an upper semi-lattice with 1-element, L is a set of labels, and D a is set of conditions of the following form:

a. $l{:}x$, where $l \in L$ and x is a discourse referent

b. $l{:}x_1 = x_2$, where $l \in L$ and x_1, x_2 are discourse referents

c. $l{:}P(x_1, \ldots, x_n)$, where $l \in L$, $x_1, \ldots, x_n$ are discourse referents, and P is an n-place predicate

d. $l{:}\neg l_1$, where $l, l_1 \in L$

e. $l{:}l_1 \Rightarrow l_2$, where $l, l_1, l_2 \in L$

f. $l{:}l_1 \vee \ldots \vee l_n$, where $l, l_1, \ldots, l_n \in L$

Using this definition, the UDRS depicted in (4) can be restated by giving the subordination restrictions *L* and the UDRS-conditions D:[2]

(6)

$l_1{:}l_{11} \Rightarrow l_{12}$	$l_T \geq l_1$	
$l_{11}{:}x$	$l_1 > l_{11}$	$l_1 > l_{12}$
l_{11}:human(x)	$l_{11} > l_{12}$	
$l_2{:}\neg l_{21}$	$l_T \geq l_2$	$l_2 > l_{21}$
l_3:pay attention(x)	$l_{12} \geq l_3$	$l_{21} \geq l_3$

As UDRT uses a subordination lattice to represent scope ambiguities, disambiguation corresponds to adding more subordination information to the lattice. An unambiguous structure is achieved if the lattice is eventually reduced to a linear order. In example (6), the two readings ensue by adding the constraints $l_{12} > l_2$ and $l_{21} > l_1$, respectively.

1.3 Presuppositions as Anaphora

An example for presupposition triggers are personal pronouns such as *his*. The following sentence presupposes that a rabbit exists which is owned by Theo:

(7) Theo loves his little rabbit.

In this example, the presupposition is *accommodated*, i.e., the existence of a rabbit is asserted and the respective conditions are added to the discourse

[2]Note that we assume that the scope of a quantifier is subordinate to its restrictor, expressed by the constraint $l_{11} > l_{12}$ in this example. This is an extension of the definition of subordination proposed by Reyle (1993) and Frank and Reyle (1995a,b), which is necessary for our definition of accessibility (the referents in the restrictor of a quantifier have to be accessible from its scope, cf. van der Sandt 1992).

representation built so far.

However, if such an animal has already been mentioned in the discourse, the presupposition gets canceled (or neutralized), i.e., *his little rabbit* is interpreted as referring to the pre-established rabbit, and does not introduce a new one. This is the case for the examples in (8), where a rabbit is mentioned in the first conjunct and in the antecedent of the implication, respectively:

(8) a. Theo has a little rabbit and his rabbit is grey.
b. If Theo has a little rabbit, his rabbit is grey. (Van der Sandt and Geurts 1991:259)

With reference to such examples, van der Sandt and Geurts (1991) and van der Sandt (1992) argue that presuppositions behave in the same way as anaphora. They consider the following cases of pronominal anaphora, which are closely analogous to the examples of presupposition canceling in (8):

(9) a. Theo has a little rabbit and it is grey.
b. If Theo has a little rabbit, it is grey. (Van der Sandt and Geurts 1991:259)

Here, the pronoun *it* is bound to the antecedent *a little rabbit*. In much the same way, the presupposition trigger *his rabbit* in (8) can be regarded as an anaphor which is bound to the antecedent *a little rabbit*, and therefore gets neutralized. Hence, van der Sandt and Geurts conclude, presuppositions are not really canceled (i.e., retracted from the DRS), but rather bound to existing referring material in much the same way as pronouns.

The crucial difference to pronouns is that a presuppositional anaphor can be accommodated if it fails to find a suitable antecedent: in this case, its content is added to the DRS built so far. Presuppositions possess this possibility of being accommodated because they bear descriptive content of their own and hence can introduce a new discourse referent. This is not the case for pronouns, since these are semantically void (apart from agreement information).

To formalize the intuition that presuppositions behave like anaphora, van der Sandt and Geurts (1991) modify standard DRT as follows:

- Conventional DRSs are pairs of a set of referents and a set of conditions $K = \langle U(K), Con(K) \rangle$. Van der Sandt and Geurts use α-DRSs $K = \langle U(K), Con(K), A(K) \rangle$ instead, where A(K) is the anaphora structure (α-structure) of the DRS, which is again an α-DRS.
- Instead of the top-down construction algorithm with integrated anaphora

resolution of Kamp and Reyle (1993), van der Sandt and Geurts (1991) employ a bottom-up construction mechanism using a categorial grammar. An α-DRS is built for one sentence at a time, its anaphora are collected in the α-structure, but not resolved. Then the α-DRS is merged with the DRS of the preceding discourse, and its α-structure is resolved bottom-up.

The treatment of presuppositions takes place in the resolution of the α-structure. It is subdivided into two parts:

- The resolution starts with the most deeply embedded anaphor and tries to bind it in the usual way, i.e., by looking for an antecedent which is suitable and accessible (in the sense of Kamp and Reyle 1993:154). The algorithm tries to bind as low as possible: it links the anaphor to the antecedent which is closest on its projection line.
- If no binding is possible, the anaphor has to be accommodated. Accommodation proceeds top-down: the information contained in the respective α-DRS is added to the highest DRS possible. The accommodation site is constrained by conditions on possible and admissible DRSs (cf. van der Sandt 1992:365ff for definitions of these notions).

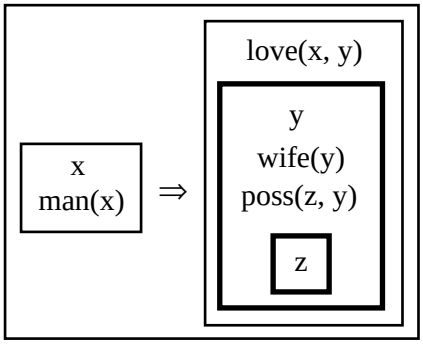
In addition to van der Sandt and Geurts's (1991) rather procedural view of resolution and accommodation, a more declarative formulation is suggested by van der Sandt (1992). We will draw on this version when we present our proposal for anaphora binding in section 2.

We demonstrate how van der Sandt and Geurts's account works using the following example:

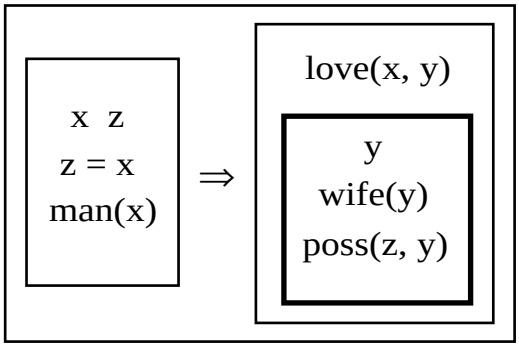
(10) Every man loves his wife. (Van der Sandt 1992:366)

The unresolved α-DRS for (10) is given in (11a): (Thick lines mark α-structures.)

(11) a.

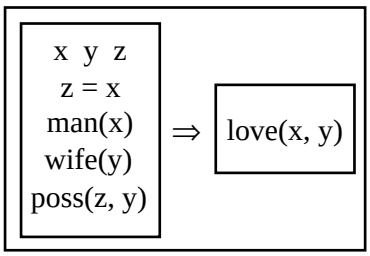


b.

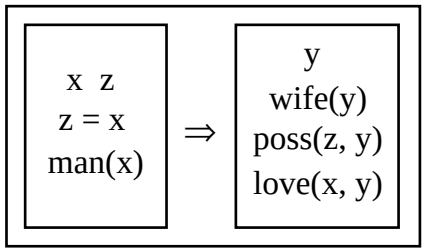


Now the α-structure of (11a) is processed. The most deeply embedded referent is z which arises from the pronoun *his*. It can be bound to x and is removed from the α-structure. This yields (11b). Then, we try to bind the remaining α-DRS for *wife*. No suitable antecedent can be found, thus accommodation has to take place. We start top-down and try to accommodate in the top DRS, which is impossible since z would be a free variable. Hence the accommodation has to take place in the restrictor DRS (intermediate accommodation), yielding (12a):

(12) a.



b.



According to van der Sandt (1992), there is also the possibility of local accommodation: the α-DRS for *wife* can also stay further down the projection line and be accommodated in the scope of the quantifier, which yields (12b).[3]

2 Underspecified Presuppositions

In this section, we propose a reconstruction of the account of presupposition as anaphora put forward by van der Sandt and Geurts (1991) and van der Sandt (1992). We show that UDRT readily provides the means for representing presuppositional anaphora, making redundant a special α-structure as employed by van der Sandt and Geurts. Our account is non-procedural, fully monotonic, and offers an underspecified representation for ambiguities arising from presupposition accommodation. It can be used to capture certain instances of presupposition denial, as well as lexical variation in the behavior of presupposition triggers.

[3]It has to be pointed out that the existence of these two readings is not uncontroversial, Beaver (1994a,b, 1995) gives examples where the intermediate reading is not available and argues that this reading is not triggered by presupposition but rather related to the information structure of the discourse. He shows that discourse topic and focus affect the accommodation of presuppositions.

2.1 Against α-Structure

The use of a separate α-structure to ‘‘store’’ anaphora until they are resolved can be criticized for several reasons:

- The theoretical status of the unresolved anaphora in the α-structure is unclear. In particular, van der Sandt and Geurts (1991) and van der Sandt (1992) give no semantic interpretation for α-DRSs, they assume that only fully resolved DRSs (where A(K) is empty) have truth values.[4] In contrast to that, our underspecified account of presupposition requires no storage mechanism comparable to the α-structure. UDRSs have a truth-conditional semantics and are equipped with a proof theory (Reyle 1993, 1995).
- In van der Sandt and Geurts 1991, a very procedural view of anaphora resolution is put forward: the proposed algorithm searches a DRS first bottom-up and then top down, the order is crucial.[5] This is remedied to a certain extend in van der Sandt 1992, where a set of restrictions is provided to replace the algorithm. We try to improve on this, as our analysis attempts to factor out as much declarative constraints as possible, so as to keep the account independent of a certain processing strategy. Order-dependence should be postulated only where absolutely necessary.[6]
- Van der Sandt’s resolution mechanism is non-monotonic: the content of the α-structure is deleted and relocated to another part of the DRS (‘‘semantic move-α’’, Beaver 1995:125).[7] We will show that an account using UDRSs

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[4]But cf. Bos 1994, where van der Sandt’s (1992) notion of α-DRS is explicated and semantically interpreted, allowing α-DRSs to act as underspecified representations for anaphoric material. But Bos (1994) still assumes a separate (procedural) accommodation component and accommodation ambiguities have to be represented disjunctively.

[5]The same is true for the extensions of the van der Sandtian account in Bos 1994.

[6]Cf. Krause 1995 for an elaboration of this criticism and an alternative proposal which integrates van der Sandt’s approach into a type-theoretical framework, where presupposition resolution is treated as abductive inference.

[7]Bos (1994) proposes a copying mechanism as an alternative: presuppositional information is accommodated or resolved by copying the content of the α-DRS to the relevant accommodation site (while leaving the original intact). This leads to a monotonic account but duplicates the

can preserve monotonicity: binding and accommodation take place by adding subordination restrictions to the structure built so far, no information has to be deleted or copied.

2.2 UDRSs instead of α-DRSs

To improve on the representational framework of van der Sandt, we reconstruct the theory of presupposition as anaphora in UDRT. Our account differs in the following respects from van der Sandt's (1992) original proposal:

- We assume that anaphora resolution operates on underspecified structures. Anaphora are integrated into the UDRS right from the start, with their scope left underspecified. This obviates the need for a separate α-structure. The presuppositional UDRSs we assume can be constructed straightforwardly by a modified HPSG grammar (Pollard and Sag 1994), as detailed in Keller 1995.
- We specify a resolution function which attempts to determine a suitable antecedent for an anaphor. If it succeeds, UDRS-conditions and subordination constraints are added to the UDRS built so far, thereby fixing the reference of the anaphor (while preserving monotonicity).
- Anaphoric material which cannot be resolved is accommodated. In this case, the resolution function adds no further information, the scope of the anaphor is left underspecified. This is desirable in the light of the data we present in section 2.3: further subordination constraints (to disambiguate the accommodation site) should be added only if this is necessary to create an antecedent or to maintain the consistency and informativeness of the discourse.

2.1.1 Representation

We assume that presuppositions have a particular scope potential in much the same way as other scope-bearing elements, e.g., indefinites and quantifiers. Lexical and syntactic constraints restrict the scope of these elements by setting the minimal label l_{min} and the maximal label l_{max} as lower and upper scope boundaries (cf. Reyle 1993, 1994 for details).

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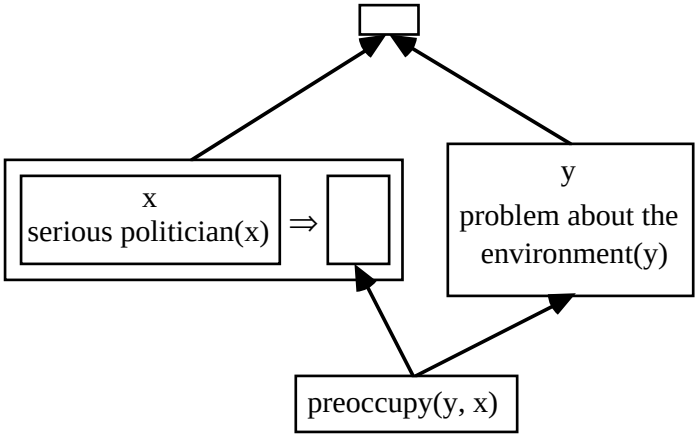
anaphoric information, hence introducing undesirable redundancy.

As an example consider (13), where the indefinite can take arbitrarily wide scope, hence its l_{min} is the bottom element of the lattice, and l_{max} is its top element. This can be rendered in UDRT as shown in (14).

(13) A problem about the environment preoccupies every serious politician. (Reyle 1993:132)

(14)

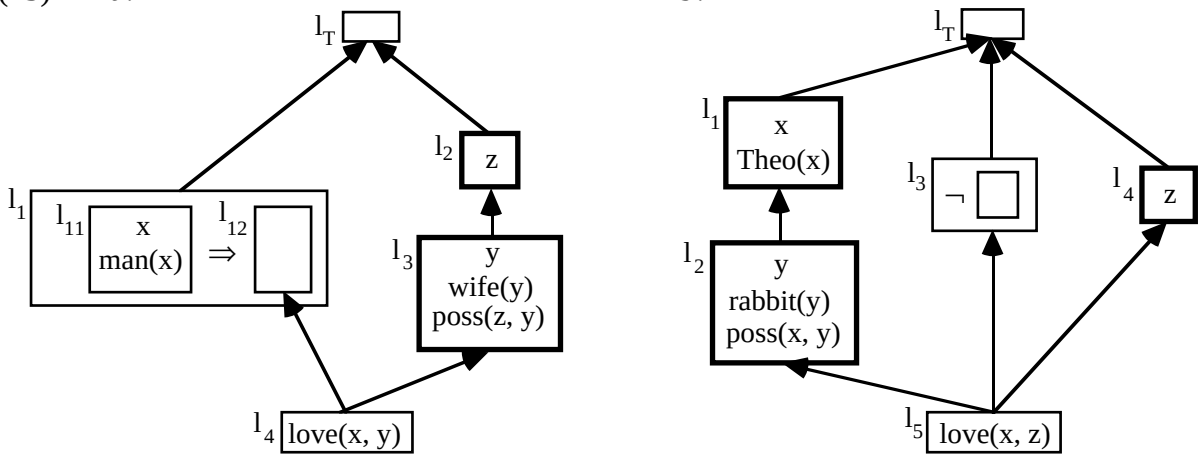


The scope of an indefinite can be more restricted than in (14), e.g., if the indefinite is part of a negated clause.

We assume that the scope of presuppositional anaphora is essentially unrestricted: the upper limit to its scope is the top box, i.e., $l_{max} = l_T$ holds. Its lower limit corresponds to the position of the presupposition trigger.

(15a) illustrates this by giving the UDRS for van der Sandt's example in (10) (again, thick lines indicate anaphoric material which has to be resolved by a separate resolution component):

(15) a. b.



In this example *his* introduces the pronominal referent z and triggers an anaphoric UDRS in which the NP argument of *his* is established as presupposed. In (15a), the relevant UDRS is {y, wife(y), poss(z, y)}. Consider

another example, which has anaphoric material both in the subject and in the object NP:

(16) Theo's rabbit doesn't love him.

The UDRS for this example is depicted in (15b). Here, the pronoun *him* introduces an anaphoric element, and both the proper noun *Theo* and the genitive morphology trigger presuppositions.

In Keller 1995, we propose an HPSG grammar which constructs the UDRSs given in this section. This is achieved by a set of syntactic and lexical constraints introducing the appropriate subordination restrictions and UDRS-conditions. The lexical entries for presuppositional elements mark the labels of the relevant UDRS as anaphoric, which then triggers the anaphora resolution component.

2.1.2 Binding

After the underspecified representation for a sentence has been constructed, the anaphora it contains have to be resolved relative to the discourse processed so far. We assume that this is done by a separate anaphora resolution function, which is subject to the following constraints:[8]

(17) Let $K = \langle L, \mathrm{D}\rangle$ be the UDRS for the discourse built so far and $K_s = \langle L_s, \mathrm{D}_s\rangle$ the UDRS of a newly added sentence. Let $\mathrm{A}_s \subseteq \mathrm{L}_s$ be the set containing the labels of the anaphoric expressions of K_s.[9] Then K is updated to K' as follows:
$K' = K \cup K_s \cup \mathit{res}(K \cup K_s, \mathrm{A}_s)$

(18) $\mathit{res}(\langle L, \mathrm{D}\rangle, \mathrm{A}) = \bigcup_{l \in A} \langle L' \cup \{l = l'\}, \{l{:}x = y\}\rangle$
where the following conditions have to hold:

(19) a. $\{l{:}x, l'{:}y\} \subseteq \mathrm{D}$
b. $y \in \mathit{suit}(\mathrm{D}, x)$
c. $l' \in \mathit{acc}(L, l)$ and $L' = \emptyset$ or
$l' \in \mathit{acc}(L, l)$ and $l' \in \mathit{acc}(L \cup L', l)$ with $L' = \{l' = l''\}$ for some $l'' \in \mathrm{L}$

(20) $\mathit{suit}(\mathrm{D}, x) = \{y \mid \{\gamma \mid \{l{:}x, l{:}\gamma(x)\} \subseteq \mathrm{D}\} \subseteq \{\gamma \mid \{l{:}y, l{:}\gamma(y)\} \subseteq \mathrm{D}\}\}$

(21) $\mathit{acc}(L, l) = \{l' \mid \{l \geq l'', l' \geq l''\} \subseteq L\}$

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[8] We use a generalized union operator which applies not only to sets but also to tuples of sets: $\langle \mathrm{A}_1, \ldots, \mathrm{A}_n\rangle \cup \langle \mathrm{B}_1, \ldots, \mathrm{B}_n\rangle = \langle \mathrm{A}_1 \cup \mathrm{B}_1, \ldots, \mathrm{A}_n \cup \mathrm{B}_n\rangle$

[9] In Keller 1995, we explicate how the set A_s is constructed by the syntactic component.

As stated in (17), the UDRS for the discourse built so far is updated by merging it with the UDRS of the newly incoming sentence and possibly adding conditions to resolve the anaphora contained in the new UDRS.[10]

The conditions to be added are computed by the function *res* defined in (18): to bind the anaphoric referent x to the referent y, the condition l:x = y and the subordination constraint l = l' are added, which has the effect hat the two discourse referents are identified, and their respective UDRSs merged. Further subordination constraints may be added via *L'*. To ensure proper anaphora binding, *res* is subject to a number of constraints:

(19a) selects a pair of referents in the set of UDRS-conditions D.

(19b) ensures that the antecedent y is suitable for x. In clause (20) we define *suit*(D, x), the set of suitable antecedents for an anaphor x under the conditions D, as follows: a referent y is suitable for x if the conditions attached to x are a subset of the ones attached to y.[11]

(19c) requires either that l', the label of the antecedent, is accessible from l, the label of the anaphor, or that l' can be made accessible by adding a further subordination constraint.[12] The first possibility is the standard case: no additional subordination constraints are added, *L'* is empty. The second possibility arises since an anaphor can fix the (underspecified) scope of its antecedent (cf. the examples in section 2.3.1). This is the case if there is a label l'' such that adding *L'* = {l' = l''} to *L* makes l' accessible from l.[13]

Our definition of accessibility given in (21) is different from the one employed

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[10]The case of ambiguities arising from multiple binding sites for the same anaphor is not covered by this definition. We leave this issue aside.

[11]This is of course only a rough approximation. We will not elaborate on the conditions for suitability any further here.

[12]Note that this condition does not allow to add arbitrary equations to make l' accessible: of course only such additions are possible which result in a well-formed subordination lattice, for instance by collapsing ≥ to =. Hence this condition is not as permissive as it seems at first glance.

[13]A similar proposal is put forward by Kamp et al. (1995), who suggest that the need to bind a pronoun to a certain antecedent might promote this antecedent to top position.

by van der Sandt (1992): we cannot define accessibility in terms of subordination, since the representations we construct leave the scope for anaphora underspecified, i.e., an unresolved anaphor is subordinate only to the top label l_T. We therefore draw on the fact that an anaphor is ‘‘anchored’’ to a subordinate UDRS-condition (the verb in the case of examples (15a)), which is also subordinate to the material which has to be accessible for the anaphor. Hence (21) states that *acc*(*L*, l), the set of labels accessible from l in a lattice *L*, contains the labels for which a label l'' exists that is subordinate both to l and to the accessible label l'.[14]

Note that (in contrast to van der Sandt 1992) our anaphora resolution component contains no conditions to prevent the unbinding of variables: this is unnecessary as we construct UDRSs in a way which ensures that all variables remain bound. An example for this is (15b): here the referent x in the condition l_2:poss(x, y) is bound correctly since l_2 is subordinate to l_1, where x is introduced. The relevant subordination constraint is added lexically. The same holds for the condition l_3:love(y, z). Here a syntactic condition, the Closed Formula Principle, ensures that the correct subordination constraints are introduced and y and z are bound (cf. Keller 1995 for details).

Furthermore, we do not need van der Sandt’s (1992:365) additional conditions to ensure that anaphora are processed bottom-up and left-to-right: these conditions are remnants of the procedural formulation of his theory which carry over to his declarative reformulation. They disappear if we dispense with the α-structure.

We use the example (10) to illustrate how anaphora resolution works according to our proposal. First consider the subordination constraints and conditions $\langle L, D\rangle$ of (15a):

[14]For this definition to work, the UDRSs we construct have to contain the mentioned ‘‘anchoring’’ relations for anaphora. This has to be taken care of in the syntactic component.

(22)

l_1:$l_{11} \Rightarrow l_{12}$	$l_T \geq l_1$	
l_{11}:x	$l_1 > l_{11}$	$l_1 > l_{12}$
l_{11}:man(x)	$l_{11} > l_{12}$	
l_2:z	$l_T \geq l_2$	
l_3:y	$l_2 \geq l_3$	
l_3:wife(y)		
l_3:poss(z, y)		
l_3:love(x, y)	$l_{12} \geq l_4$	$l_3 \geq l_4$

The set of the labels of the anaphoric expressions for this example is A = {l_2, l_3}. The application of the resolution function *res* (cf. (18)—(21)) yields the following result:

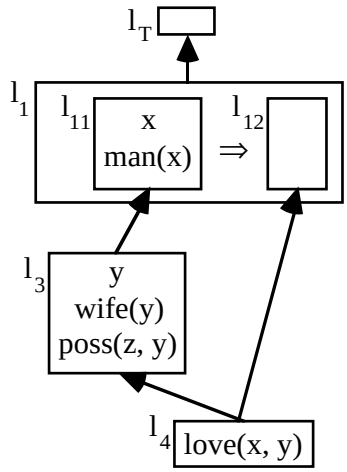
(23) $res(\langle L, D\rangle, A) = \langle\{l_2{:}z = x\}, \{l_2 = l_{11}\}\rangle \cup \langle\varnothing, \varnothing\rangle$

In this example, z can be resolved to x as x is suitable for z according to definition (20), and l_{11} is accessible from l_2 according to definition (21), since there is the label l_4 which is subordinate to both l_2 and l_{11}. In contrast to this, y cannot be resolved, as no suitable antecedent can be found, and therefore no condition for y is added. The updating of the constraints in (22) leads to the constraints in (24), depicted in (25).

(24)

l_1:$l_{11} \Rightarrow l_{12}$	$l_T \geq l_1$	
l_{11}:x	$l_1 > l_{11}$	$l_1 > l_{12}$
l_{11}:man(x)	$l_{11} > l_{12}$	
l_2:z	$l_T \geq l_2$	
l_2:z = x	$l_2 = l_{11}$	
l_3:y	$l_2 \geq l_3$	
l_3:wife(y)		
l_3:poss(z, y)		
l_3:love(x, y)	$l_{12} \geq l_4$	$l_3 \geq l_4$

(25)

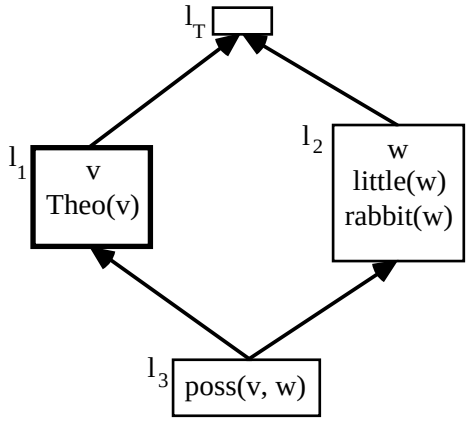


We give another example, where the presupposing material triggered by *his rabbit* can actually be bound:

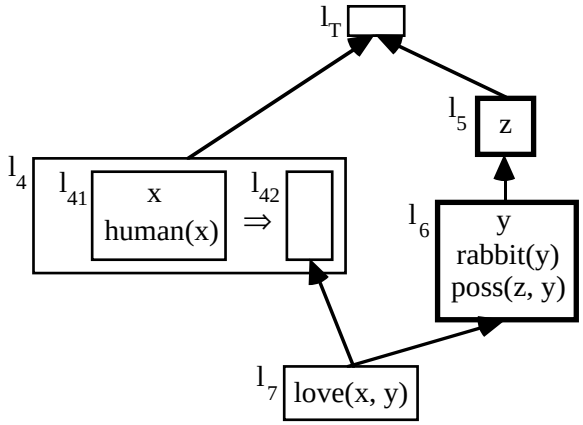
(26) Theo has a little rabbit. Everybody loves his rabbit.

The processing of the first sentence give rise to the UDRS in (27a). No anaphora resolution is possible at this stage. Then the second sentence of (26) gets processed and is assigned the UDRS in (27b).

(27) a.



b.



The UDRSs in (27a) and (27b) are merged and anaphora resolution is performed, the labels of the anaphoric expressions being A = $\{l_5, l_6\}$. The application of the function *res* produces the result in (28):[15]

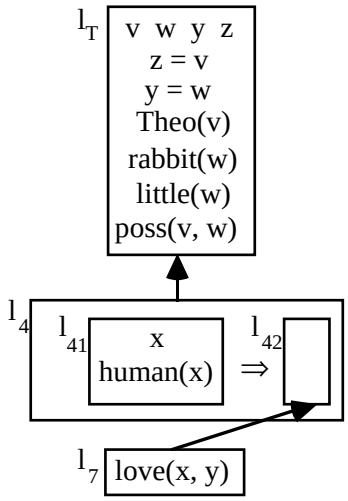
(28) $res(\langle L, D\rangle, A) = \langle\{l_1 = l_T, l_5 = l_1\}, \{l_5{:}z = v\}\rangle \cup \langle\{l_2 = l_T, l_6 = l_2\}, \{l_6{:}y = w\}\rangle$

Here, both z and x are bound to antecedents pre-established in the discourse. Note that in both cases the antecedents are not directly accessible, but first have to be raised to the top level by adding the constraints $l_1 = l_T$ and $l_2 = l_T$,

[15] In addition to that, we get the reading where z is bound to x, as in (15a).

respectively. This is a (trivial) example for how the resolution of an anaphor can disambiguate the scope of its antecedent. The second disjunct of condition (19c) takes care of this, as described above. The resulting UDRS is:[16]

(29)



No anaphor is left unresolved in (29), hence we get a linear subordination order corresponding to an unambiguous UDRS.

2.1.3 Accommodation

We propose no additional mechanism for presupposition accommodation. The assumption is that the result of the anaphora resolution provides a suitable (underspecified) representation of accommodated presuppositions.

As an example consider the constraints in (24), graphically represented in (25). Here, the resolution component failed to bind the referent y, no conditions were added for y. The representation in (25) corresponds exactly to the DRSs (12a) and (12b) proposed by van der Sandt for this sentence: the accommodation site of the presupposition triggered by *his wife* is left underspecified, just like quantifier scope can be left underspecified in UDRT.

The disambiguation of (24) is achieved by adding the restriction $l_3 = l_{11}$, which yields intermediate accommodation, or by adding $l_3 = l_{12}$, which leads to local accommodation. The first possibility strengthens the lexically determined constraint $l_2 \geq l_3$ to $l_2 = l_3$, the second one entails $l_2 > l_3$. Note that accommodation higher in the lattice (i.e., global accommodation) is blocked due to the constraint $l_2 \geq l_3$: this is correct, as it avoids the unbinding of the

[16]We ignore the condition labeled l_3, which is redundant in this representation.

variable z.

In addition to admitting the same accommodation sites as van der Sandt's account, our proposal has the following advantages:

- No separate accommodation mechanism is proposed, no fixed accommodation sites are predicted. This provides not only an underspecified representation for accommodation ambiguities, but also allows for the scope of accommodated material to be disambiguated by information that is added later in the discourse. Such disambiguation can occur if an antecedent for an anaphor is needed or if discourse consistency and informativeness has to be maintained (cf. section 2.3.1 for examples). The account of van der Sandt and Geurts (1991) and van der Sandt (1992), in contrast, computes a fixed accommodation site (viz., as far up the projection line of the anaphor as possible) and uses disjunctions to represent accommodation ambiguities. Their prediction is that once the site has been determined, it cannot be changed by the subsequent discourse.[17] In section 2.3.2, we give counterexamples involving presupposition denial.
- Furthermore, our proposal can be extended to deal with presupposition triggers which are more restricted in the possible accommodation sites they allow: as the subordination constraints for presuppositions are introduced lexically, additional constraints can be stipulated for specific lexical entries, thus lexically restricting accommodation behavior. Relevant examples include verbs which take a sentential complement, discussed briefly in section 2.3.3. Note that van der Sandt's account does not allow to determine the accommodation site lexically, as his α-structure together with his accommodation algorithm predict that all presuppositions are accommodated in a uniform way, depending only on the structure of the present discourse.
- As far as grammar architecture is concerned, our account has the advantage of readily offering an interface to other components of the grammar:

[17]However, extensions of the van der Sandtian account are conceivable which assume a component that triggers a revision of the accommodation site if this is necessitated by incoming new information. In such an approach, van der Sandt's mechanism would only compute the preferred accommodation site, without actually fixing it. However, this results in a non-monotonic system.

inferencing components or modules dealing with pragmatic or world knowledge can simply add UDRS-conditions or subordination constraints to the UDRSs built by the syntacticosemantic component, thus extending or disambiguating the discourse representations.[18]

2.2 Empirical Issues

Certain empirical consequences follow from the assumption that unresolved presuppositional anaphora remain underspecified in scope, rather than being accommodated. In this section, we will provide some data to support this view on anaphora.

2.2.1 Disambiguation by Anaphora Resolution

The resolution of an anaphor can disambiguate the scope of its antecedent. A standard example for this is:

(30) Every classmate of mine fancies a girl in the sixth form. Well, it is true, she is very attractive. (Kamp et al. 1995)

The indefinite *a girl* is no presupposition trigger, i.e., no anaphora resolution is performed when the first sentence of (30) is processed. The resulting structure is analogous to the one in (14), where the scope of the indefinite remains underspecified. But when the second sentence is processed, the need to find an antecedent for *she* disambiguates the indefinite *a girl* to its wide scope reading: it is accessible for the pronoun only if it takes wide scope.

Consider an analogous example involving a presupposition trigger:

(31) * Every man loves his wife. Well, it is true, she is very attractive.

The UDRS for the first sentence of (31) is given in (25): the presupposition *his wife* triggers anaphora resolution, and once it is bound to *every man*, the presupposition is no longer accessible to pronouns in the following discourse. Hence *she* cannot be bound and (31) is ungrammatical. Formally, this is achieved by the accessibility constraint in the resolution function: condition

[18]The data presented by Beaver (1994b) seems to point in this direction: he argues that intermediate accommodation is not triggered by presuppositional information (as van der Sandt predicts), but rather by a more general mechanism of topic accommodation. In our account, this could be implemented by assuming a separate module which handles topics in Beaver's sense and contributes subordination constraints for intermediate accommodation where adequate.

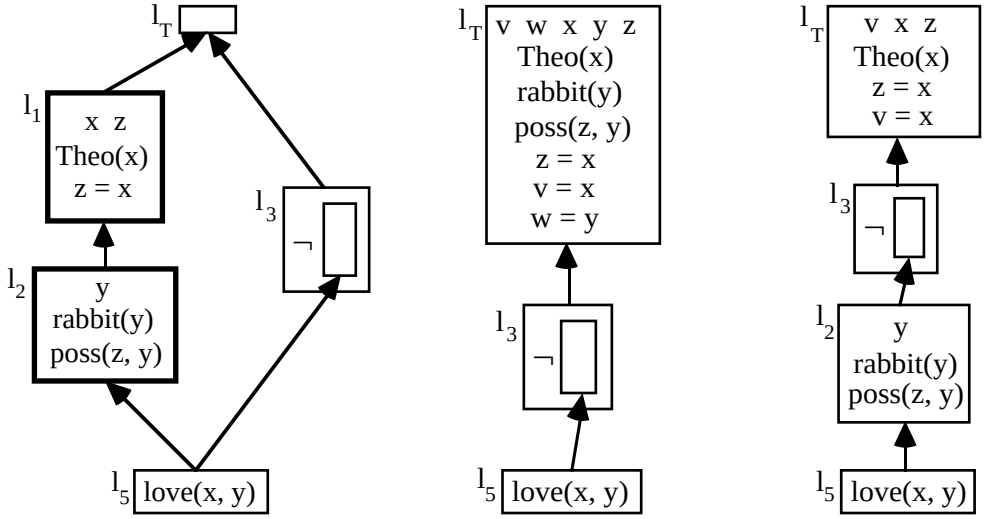
(19c) allows resolution only if the antecedent is directly accessible to the anaphor (which is not the case here) or if it can be made accessible by adding a label equation: this possibility is blocked since the restrictor box is strictly subordinate to the top UDRS ($l_T \geq l_1$ and $l_1 > l_{11}$ in (24)).

A more interesting example is the following:

(32) Theo doesn't love his rabbit. His rabbit is grey.

After anaphora resolution, we get the UDRS in (33a) for the first sentence of (32):

(33) a. b. c.



The scope of the negation is underspecified at this stage. But as soon as the second sentence of (32) is processed and its presuppositional anaphor *his rabbit* gets bound, an unambiguous representation ensues: the boxes labeled l_1 and l_2 have to be raised to top level to make them accessible, which yields (33b).

Given the ambiguity of the UDRS in (33a), we expect that the negation can take wide scope over the boxes labeled l_1 and l_2. Evidence for this comes from examples with presupposition denial as in (34). Here, the UDRS in (33a) is disambiguated to yield the structure in (33c):[19]

(34) Theo doesn't love his rabbit. In fact, he doesn't have a rabbit.

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[19]The question arises whether the existential presupposition of proper names can be denied in the same way. This seems to be the case. Consider the following slightly macabre example:

(i) Peter doesn't love Mary anymore. She was killed in a traffic accident yesterday.

2.2.2 Presupposition Denial

Examples of presupposition denial as the one in (34) are not covered by van der Sandt and Geurts (1991) and van der Sandt (1992): in their account, one sentence is processed at a time and a fixed accommodation site is computed for each unbound presuppositional anaphor. A presupposition cannot be canceled once its site is fixed, and the subsequent discourse should not be able to influence its scope. Therefore, they predict examples such as (35a) (analogous to (34) above) and (35b) to be ungrammatical, since the denial of the existential presupposition should lead to inconsistency:

(35) a. The king of France is not bald. France does not have a king. (Van der Sandt 1991:332)

b. If John invites the king of France for dinner, he will come. But there is no king of France, of course.

The underspecified analysis proposed here can cope with examples like these. The definite description *the king of France* introduced by the first sentence in (35a) and (35b) is initially ambiguous between global and intermediate accommodation (in the top box or in the restrictor/negation box). The second sentence then disambiguates the scope of the definite by excluding global accommodation, since this would lead to inconsistency (the existence of the king of France both being asserted and denied).

A similar effect is found in (36), where the existential presupposition is not directly negated, but part of a conditional:

(36) If John invites the king of France for dinner, he will come. If there is a king of France, that is.

In this case, the second sentence forces disambiguation on grounds of informativity: if the existence of a king of France was already given by the first sentence (global accommodation), then the second sentence would be uninformative, since the existential assertion is embedded in the restrictor of a conditional.[20] Again, intermediate accommodation of *the king of France* offers

[20]Van der Sandt uses an analogous argumentation in terms of informativeness to rule out examples like:

(i) * John has a dog. If he has a dog, he has a cat. (van der Sandt 1992:368)

a way out and renders (36) grammatical.[21]

As mentioned earlier, Beaver (1994a,b, 1995) gives data that cast doubt on the existence of intermediate accommodation for presuppositions embedded inside universal quantifiers or conditionals. He assumes that an example like the one in (37a) can only be interpreted as accommodating *her Cadillac* locally, i.e., (37a) can only have the reading glossed in (37b).

(37) a. Every woman who buys a car will sell her Cadillac. (Beaver 1995:117)

b. Every woman who buys a car owns a Cadillac and will sell it.

Example (38) seems to provide counter-evidence: it suggests that the subsequent discourse can enforce intermediate accommodation:[22]

(38) Every woman who buys a car will sell her Cadillac. Only if she owns a Cadillac, of course.

Just like in (36), the utterance of the second sentence of (38) forces intermediate accommodation for the first sentence: local accommodation would lead an inconsistent discourse. We take this as evidence that intermediate accommodation is indeed an option in certain marked cases, and hence that our account is right in allowing it (but local binding seems to be the default case, as argued for convincingly by Beaver).

The question remains how to formalize the notions of consistency and informativity. A suitable suggestion is van der Sandt's (1992:367) concept of admissible resolutions, and its reformulation by Beaver (1995:107), which can easily be integrated into the present account (cf. Keller 1995 for details).

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[21]However, the proposed approach to presuposition denial is counter-intuitive in that it treats denial in the same way as ambiguity resolution, i.e., in a completely monotonic fashion. Intuitively, denying a presupposition involves retracting information which is already established. This intuition is not captured by the proposed account and it might be argued that a van der Sandtian approach plus a non-monotonic mechanism for denial is more adequate (cf. footnote 17).

[22]Examples involving generics are interesting in this respect: cf. (i), which seems to allow for an intermediate reading even without a particular context:

(i) Everybody takes their pram into the supermarket. (Beaver 1995:118)

2.2.3 Lexical Restrictions on Accommodation

An advantage of the presented approach is that it allows to specify lexical restrictions on the accommodation and binding of presuppositions. The lexical entry of a presupposition trigger introduces a set of subordination restrictions that determines its accommodation behavior. This gives us a handle on lexical variation in presupposition triggers, which can be used, for instance, to account for the diverse properties of sentential complement verbs.

According to Karttunen (1974:185), three classes of sentential complement verbs have to be distinguished according to their projection properties:

(39) a. Verbs of saying: *say*, *ask*, *tell*, *announce*, etc.
b. Verbs of propositional attitude: *believe*, *fear*, *think*, *want*, etc.
c. Other complementizable verbs: factives, semi-factives, modals, aspectual verbs, etc.

Karttunen's generalization is that verbs of type (39c) require that the context of the matrix clause satisfies the presuppositions of the complement clause, whereas this is not the case for verbs of type (39a) and (39b): verbs of saying impose no restrictions on the context of utterance, while propositional attitude verbs require that the subject of the matrix clause holds a belief which satisfies the presupposition of the complement clause. In the framework of underspecified presuppositions, this generalization can be captured by making use of lexically introduced subordination restrictions. A tentative account along these lines is presented in Keller 1995.

3 Conclusion

We presented a reconstruction of the van der Sandtian account of presupposition in Underspecified Discourse Representation Theory. Our account is non-procedural and fully monotonic. In particular, it eliminates van der Sandt's α-structure and replaces his rather procedural notion of anaphora binding. Furthermore, it requires no special mechanism for presupposition accommodation and provides an underspecified representation for ambiguities arising from multiple accommodation sites. This was shown to have empirical advantages over the use of fully resolved structures as of van der Sandt's.

In the framework proposed here, three components of the grammar contribute subordination constraints and UDRS-conditions to the semantic representation of a discourse:

- The lexical entries provide an initial set of UDRS constraints and conditions. This can be used to account for lexical variation among presupposition triggers, an example being the variance in the presuppositional behavior of sentential complement verbs (cf. section 2.3.3).
- Syntactic principles add further subordination constraints. This possibility is not used in the approach outlined here, but is necessary, e.g., to account for syntactic restrictions on quantifier scope or for scrambling phenomena (Frank and Reyle 1995a,b).
- Finally, the semantic component can contribute additional UDRS constraints and conditions. This is used by our anaphora resolution function and can be illustrated with respect to disambiguation by anaphora resolution (cf. section 2.3.1) and presupposition denial (cf. section 2.3.2).

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