

# Semantic Theory

Summer 2005  
Presuppositions

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## Some elementary number theory

- Theorem:  
The set of prime numbers is infinite, i.e. for every prime number  $p$ , there exists another prime number  $q > p$ .
- True or false?  
*The greatest prime number is odd.*
- True or false?  
*The greatest prime number is not odd.*

## Some geography

- True or false?  
*The king of Buganda is 42.*
- True or false?  
*If Buganda has a king, then he was born in the 20th century.*
- Does Buganda have a king?

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## Today

- Such facts that must be satisfied by the context in order to make a sentence interpretable are called *presuppositions*.
- Definite NPs trigger presuppositions, and we must deal with them.
- First: Some linguistic facts about presuppositions, and the projection problem.
- Then: van der Sandt's theory of presupposition as anaphora (built on top of DRT).

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## Trying to deal with definite NPs

- An approximate meaning representation of definite NPs says that there is exactly one individual with a certain property:

– *the*

$$\Rightarrow \lambda F \lambda G \exists x [\forall y [F(y) \leftrightarrow x=y] \wedge G(x)]$$

$$\Leftrightarrow \lambda F \lambda G \exists x [F(x) \wedge G(x) \wedge \forall y [F(y) \rightarrow x=y]]$$

– *the chancellor*

$$\Rightarrow \lambda G \exists x (\forall y (\text{chancellor}'(y) \leftrightarrow x=y) \wedge G(x))$$

– *the chancellor decides*

$$\Rightarrow \exists x (\forall y (\text{chancellor}'(y) \leftrightarrow x=y) \wedge \text{decides}'(x))$$

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## Problem 1: Uniqueness doesn't have to be true

- *The chancellor decides*

$$\Rightarrow \exists x (\forall y (\text{chancellor}'(y) \leftrightarrow x=y) \wedge \text{decides}'(x))$$

“There is exactly one chancellor, and he decides.”

- *The student is late*

“There is exactly one student, and she is late.”

(?)

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## Problem 2: Interaction with negation

- *The chancellor doesn't decide*  
 $\Rightarrow \neg \exists x (\forall y (\text{chancellor}'(y) \leftrightarrow x=y) \wedge \text{decides}'(x))$   
“Either there is no chancellor, or more than one, or there is exactly one chancellor and he doesn't decide.”
- A correct representation for the sentence:  
 $\exists x (\forall y (\text{chancellor}'(y) \leftrightarrow x=y) \wedge \neg \text{decides}'(x))$   
“There is exactly one chancellor, and he doesn't decide.”

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## Problem 3: Falsity vs. uninterpretability

- *The greatest prime number is odd.*  
 $\Rightarrow \exists x (\forall y (\text{g-p-n}'(y) \leftrightarrow x=y) \wedge \text{odd}'(x))$
- The formula is false, because it claims that there is a greatest prime number.
- But the sentence is not true or false: It just doesn't make sense. (“What do you mean -- greatest prime number?”)

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## Presuppositions

- A sentence (with a definite NP) contains meaning information of two different types: the **presupposition** and the **assertion**.
    - **Presupposition**: the requirements that the context must satisfy so the utterance can be interpreted at all.
    - **Assertion**: the claims that are made, based on the context.
- $\exists x(\forall y(\text{chancellor}'(y) \leftrightarrow x=y) \wedge \text{decides}'(x) )$   
“There is exactly one chancellor, and he decides.”

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## Presupposition and negation

- Negation only applies to the assertion.
  - The presupposition isn't negated. It is *projected* upwards, outside of the usual rules of semantic composition.
- $\exists x(\forall y(\text{chancellor}'(y) \leftrightarrow x=y) \wedge \neg \text{decides}'(x) )$   
“There is exactly one chancellor, and he doesn't decide.”
- Such a "survival" of negation is the standard test for presuppositions.

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## Further properties of projection

- Presuppositions "survive" not only negation, but also other kinds of embedding:
  - *The chancellor decides, **or** he loses the election*  
>> *There is exactly one chancellor*
  - *John **possibly** regrets that Mary is married.*  
>> *Mary is married*
  - *Mary **believes** that John has stopped smoking.*  
>> *John used to smoke.*

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## Presupposition filtering

- But: There are contexts that can "neutralise" or filter some presuppositions; they block projection of these presuppositions.
  - *If John is out of town, then his wife is unhappy.*  
presupposes: *John is married*
  - *If John is married, then his wife is unhappy.*  
does not presuppose: *John is married*
  - *If John is married, then his daughter is unhappy.*  
presupposes: *John has a daughter.*

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## Presupposition cancellation

- Presupposition can also be overwritten or *cancelled* by explicitly claiming that they are false:
  - *John doesn't regret that Mary is married. This is because Mary isn't married.*
  - *The king of France isn't bald. France is a republic.*

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## Other types of presupposition triggers

- Discourse particles (*only, even, etc.*)  
*Only Peter came.*  
>> *Peter came (and nobody else came)*
- Factive verbs:  
*John regrets that Mary is married.*  
>> *Mary is married (and John regrets this)*
- Aspect verbs:  
*John has stopped smoking.*  
>> *John used to smoke (and he stopped doing it).*
- Cleft sentences:  
*It is Peter who ate the cake.*  
>> *Somebody ate the cake (and it was Peter who did it)*

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## Presuppositions: Summary

- Presupposition and assertion have a different status.
- Presuppositions behave differently than assertions in semantics construction: They are projected unchanged, rather than used in functional application.
- The problem of determining the presuppositions of a larger expression from the presuppositions of its subexpressions is called the *projection problem*.
- Presuppositions are triggered by a number of different words and linguistic constructions, including definite NPs.

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## Presupposition theories

- Since the 70s (and before that, since Russell 1905), there have been a number of very different theories of presupposition. They are more or less successful in explaining presuppositions, and in modelling the projection problem.
- Here we present Rob van der Sandt's analysis (1992), which is based on DRT. Basic idea: *Presuppositions are anaphora*.

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## Definite NPs and presuppositions in DRT

- Idea: Expressions that trigger presuppositions are anaphora.
- For example, the existential presupposition of a definite NP is the requirement that the context must provide a suitable discourse referent.

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## Presupposition as anaphora

$\exists x(\forall y(\text{chancellor}'(y) \leftrightarrow x=y) // \text{decides}'(\underline{x}))$

“There is a chancellor, and he decides.”

*John regrets that Mary is married.*

>> *Mary is married // John regrets this*

*John stopped smoking*

>> *John used to smoke // he has stopped doing it*

*It is Peter who ate the cake.*

>> *Somebody ate the cake // that was Peter*

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## Definite NPs and presuppositions in DRT

- Idea: Expressions that trigger presuppositions are anaphora.
- For example, the existential presupposition of a definite NP is the requirement that the context must provide a suitable discourse referent.
- Other presuppositions involve anaphoric references to facts, properties, events, etc.
- Viewing presuppositions as anaphora explains why they "survive" negation and other embeddings: The anaphoric reference is not negated.

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## Van der Sandt: Basic principles

- Introduce „ $\alpha$ -DRSs“ as a new type of complex condition.
- DRS construction proceeds in two steps:
  - Construction rules for definite NPs introduce  $\alpha$ -DRSs (this yields a "proto-DRS").
  - In a second step, the  $\alpha$ -DRSs are resolved (translation of a proto-DRS into a standard DRS)
- Presuppositions can be either bound or accommodated.
- Resolution of presuppositions is subject to a number of constraints, some of which encode Gricean maxims.

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## Example: Binding [1]

- *A student works.*

x
student(x) works(x)

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## Example: Binding [2]

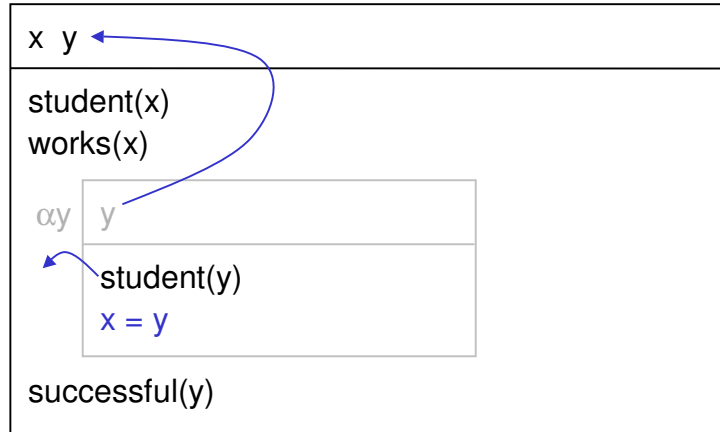
- *A student works. The student is successful.*

x		
student(x) works(x)		
$\alpha y$ <table border="1"><tr><td>y</td></tr><tr><td>student(y)</td></tr></table>	y	student(y)
y		
student(y)		
successful(y)		

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### Example: Binding [3]

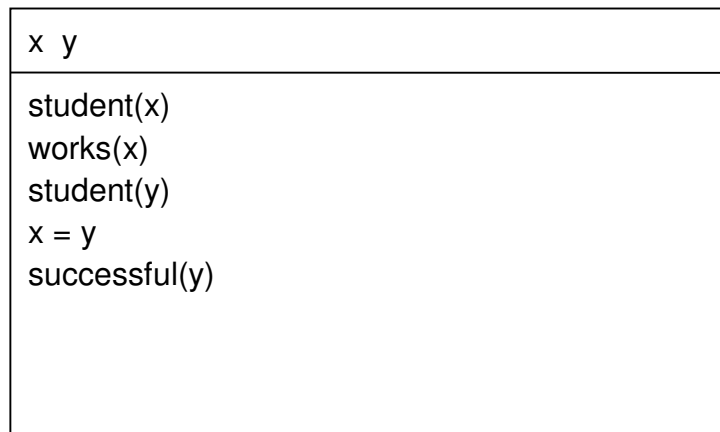
- *A student works. The student is successful.*



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### Example: Binding [4]

- *A student works. The student is successful.*



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## Accommodation

- *The king of Buganda decides.*
- *The movie I saw yesterday was really interesting.*
- *We regret that we have no free rooms.*

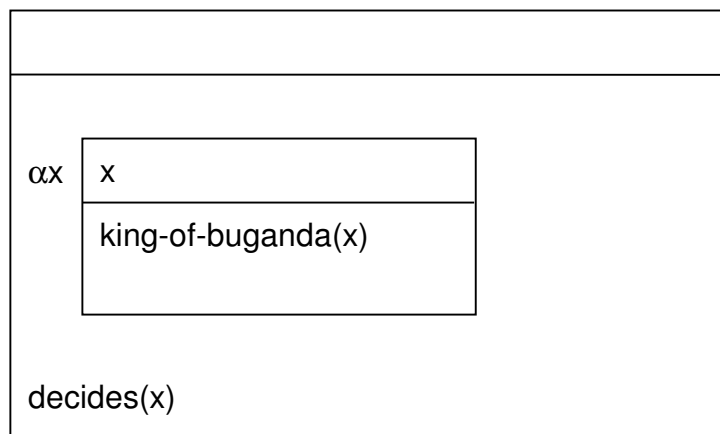
We can often use expressions that trigger presuppositions although the context doesn't satisfy the presupposition.

The missing information is silently added to the context ("accommodated") as we interpret the sentence.

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## Example: Accommodation [1]

- *The king of Buganda decides.*



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## Example: Accommodation [2]

- *The king of Buganda decides.*

x
king-of-uganda(x) decides(x)

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## DRS construction for definite NPs [1]

- A (proto-)DRS is a triple  $\langle U_K, C_K, A_K \rangle$  such that
  - $U_K$  is a set of discourse referents
  - $C_K$  is a set of (atomic or complex) conditions
  - $A_K$  is a set of "anaphoric" (alpha-) DRSs of the form  $\alpha z K'$ , where  $z$  is a discourse referent and  $K'$  is a proto-DRS.

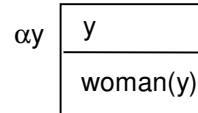
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## DRS construction for definite NPs [2]

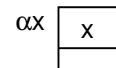
- The DRS construction rules for all definite NPs introduce alpha-DRSs:

- Definite descriptions

*the woman*

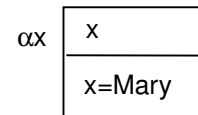


- pronouns



- proper names

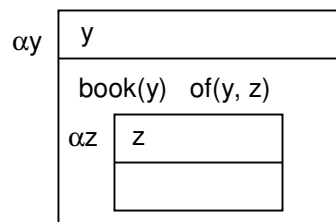
*Mary*



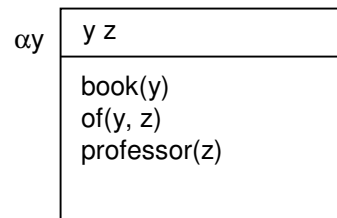
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## Complex Alpha-DRSs

- his book*



- the book of a professor*



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## Resolution by binding

- Let
  - $K, K'$  DRSs,  $K' \leq K$
  - $\gamma = \alpha x K_s \in K'$ ,  $K_s$  is  $\alpha$ -free
  - $K_t \leq K$  a DRS that is accessible for  $\gamma$ ,  
and  $y \in U_{K_t}$  a discourse referent that is suitable for  $\gamma$ .
- Remove  $\gamma$  from  $K'$  and extend  $K_t$  with  $U_{K_s}$ ,  $C_{K_s}$ , and the condition  $x=y$ .

Note: Because  $K_s$  must be  $\alpha$ -free, complex Alpha-DRSs are always resolved from the inside out.

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## Resolution by accommodation

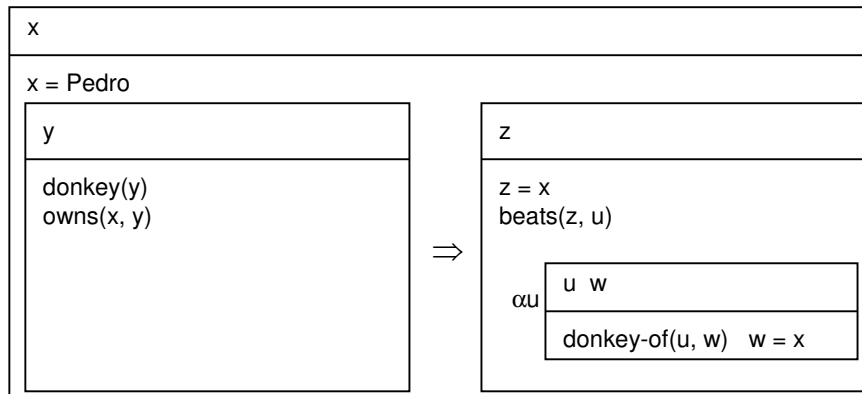
- Let
  - $K, K'$  DRSs,  $K' \leq K$
  - $\gamma = \alpha x K_s \in K'$ ,  $K_s$  is  $\alpha$ -free
  - $K_t \leq K$  a DRS that is accessible for  $\gamma$ .
- Remove  $\gamma$  from  $K'$  and extend  $K_t$  with  $U_{K_s}$  and  $C_{K_s}$ .

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## Example: Binding [1]

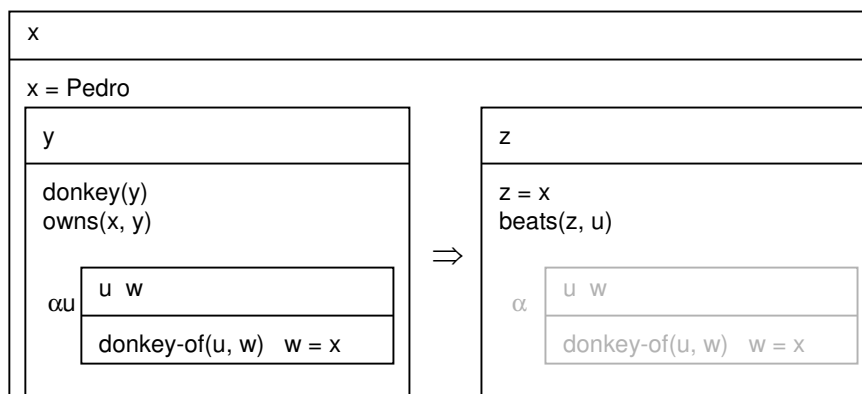
- *If Pedro owns a donkey, he beats his donkey.*



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## Example: Binding [2]

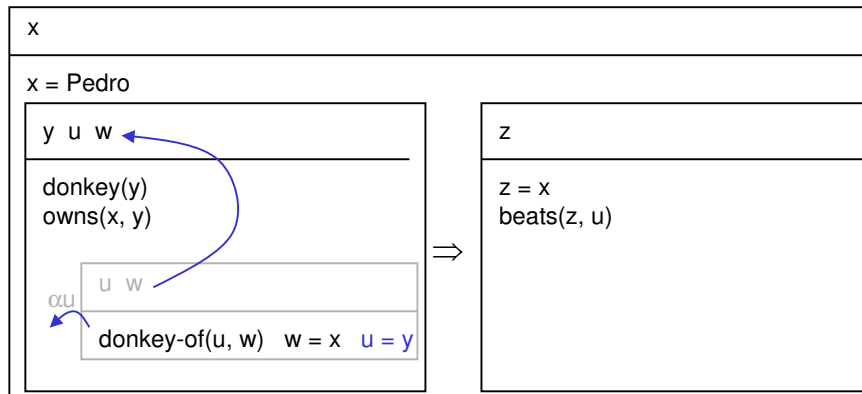
- *If Pedro owns a donkey, he beats his donkey.*



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### Example: Binding [3]

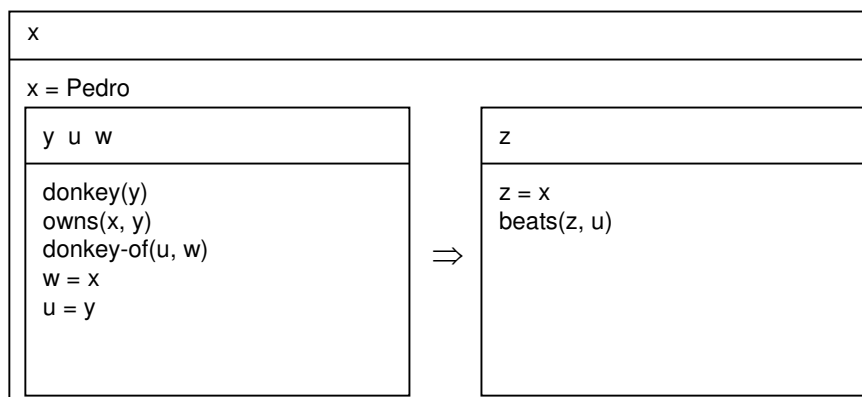
- *If Pedro owns a donkey, he beats his donkey.*



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### Example: Binding [4]

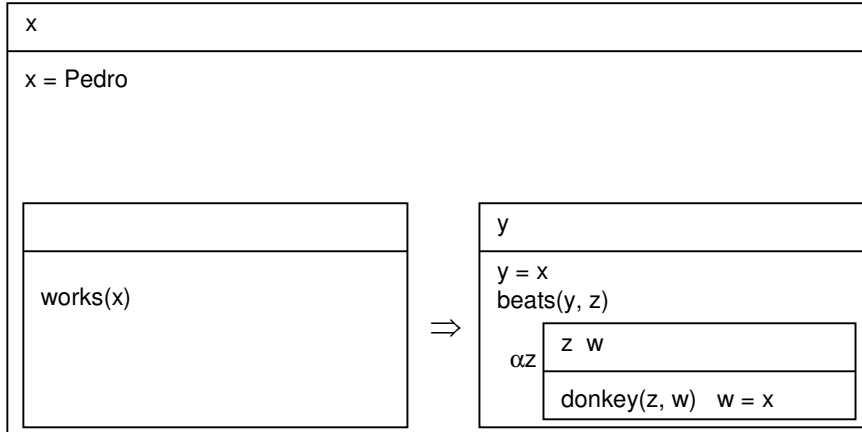
- *If Pedro owns a donkey, he beats his donkey.*



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### Example: Accommodation [1]

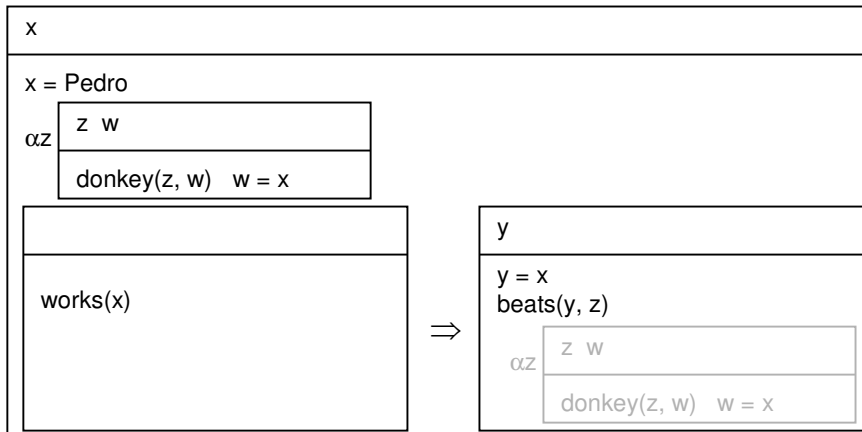
- *If Pedro works, he beats his donkey.*



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### Example: Accommodation [2]

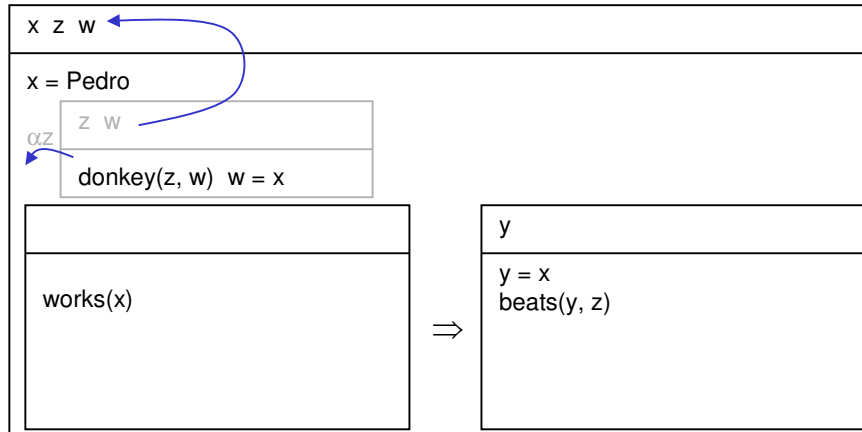
- *If Pedro works, he beats his donkey.*



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### Example: Accommodation [3]

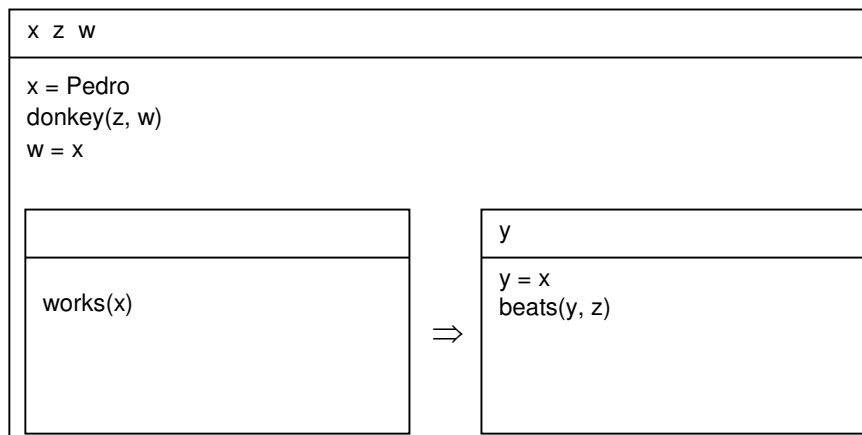
- *If Pedro works, he beats his donkey.*



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### Example: Accommodation [4]

- *If Pedro works, he beats his donkey.*



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## Constraints and preferences on projection

- The two resolution rules specify possible places where  $\alpha$ -DRSs can be bound or accommodated.
- But so far, we can bind or accommodate almost anywhere!
- This is why the van der Sandt theory also contains:
  - hard constraints that restrict where binding or accommodation is admissible
  - principles that say in which order we should try the possible binding and accommodation options.

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## Preference principles

- Binding is preferred over accommodation.
- Binding works "upwards" along the accessibility relation: The "closest" possible antecedent is preferred.
- Accommodation works "downwards" along the accessibility relation. It is preferred to accommodate into the highest possible DRS.

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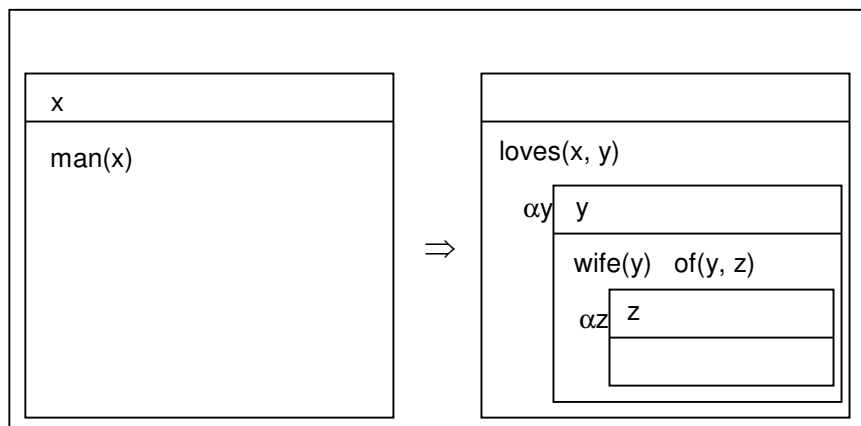
## Constraints on projection

- Free variable constraint:
  - The resolved DRS may not contain any free discourse referents.
- Constraints motivated by Gricean maxims
  - (Local) consistency
  - (Local) informativity

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## The Free Variable Constraint

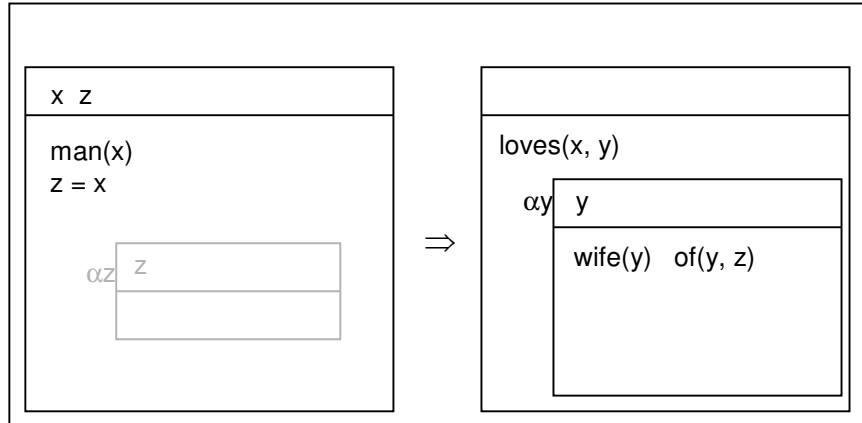
*Every man loves his wife.*



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## The Free Variable Constraint

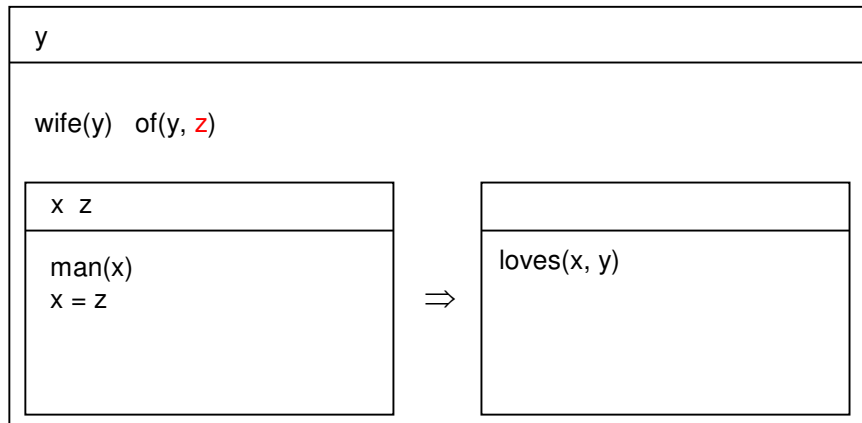
*Every man loves his wife.*



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## The Free Variable Constraint

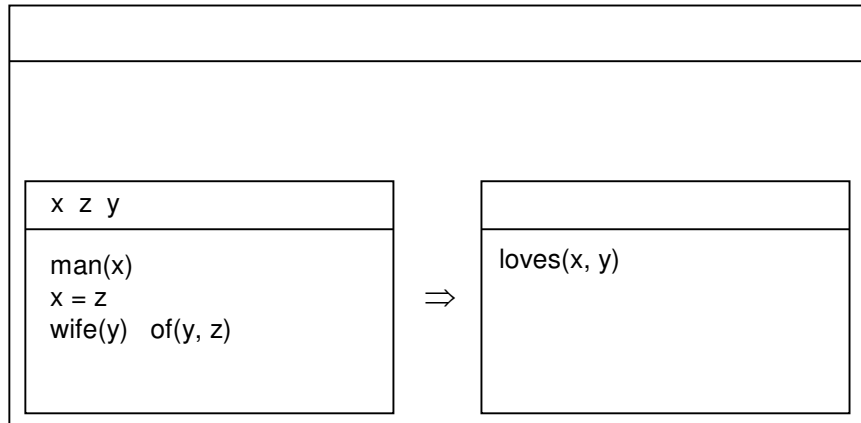
Inadmissible resolution:



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## The Free Variable Constraint

Admissible resolution:



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## Constraints motivated by Gricean maxims

- When we interpret an utterance, we assume that the speaker observes the *Gricean maxims*: Says something reasonable and relevant, in an appropriate way, etc.
- We can see accommodation as an application of these maxims: The speaker probably referred felicitously to an antecedent we just didn't know about.

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## Constraints motivated by Gricean maxims

- Another application is the constraint that the resolved DRS must be *consistent* and *informative*.
  - Consistency: The resolved DRS must be satisfiable (taking background knowledge into account).
  - Informativity: The resolved DRS may not be entailed by our background knowledge.
  - Local consistency: No sub-DRS must be inconsistent with any superordinate DRS.
  - Local informativity: No sub-DRS must be entailed by any superordinate DRS.

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## Summary

- Presupposition:
  - Preconditions for interpretability of a sentence
  - survives embedding in negation and other contexts
  - not subject to compositional semantics construction, but is projected upwards
- Van der Sandt's presupposition theory:
  - presuppositions as anaphora
  - extend DRS with markers for unresolved presuppositions
  - resolve by binding or accommodation
  - subject to constraints and preferences

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