



Universität Tübingen

Semantics 1 (Grundlagenmodul Semantik)

Wolfgang Sternefeld

Fourth Lecture: Determiners and Quantifiers
Additional Material

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

We will calculate the truth (or falsity) of (1) in a model.

(1) Ein Bild zierte jede Wand
a painting decorated every wall

(2) The model $M = \langle D, I \rangle$:
 $D = \{ A, B, C, D, a, b, c \}$
 $I(\text{Bild}) = \{ a, b, c \}$
 $I(\text{Wand}) = \{ A, B, C, D \}$
 $I(\text{zierte}) = \{ \langle a, A \rangle, \langle b, B \rangle, \langle c, C \rangle \}$

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

We will calculate the truth (or falsity) of (1) in a model.

(1) Ein Bild zierte jede Wand
a painting decorated every wall

(2) The model $M = \langle D, I \rangle$:
 $D = \{ A, B, C, D, a, b, c \}$
 $I(\text{Bild}) = \{ a, b, c \}$
 $I(\text{Wand}) = \{ A, B, C, D \}$
 $I(\text{zierte}) = \{ \langle a, A \rangle, \langle b, B \rangle, \langle c, C \rangle \}$

Intuitively, the sentence is false. The point is to formally **calculate** this by using the semantic rules we developed in the last lectures!

Let us first apply the *in situ* rule for $\vec{*}_2$ which gives us the **linear reading**:

$$(3) \quad \llbracket \text{zierte jede Wand} \rrbracket_S = \{x : \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S\}$$

Looking inside (3) we see that we have to determine whether (4) holds:

$$(4) \quad \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S$$

We can do this only by supplying values for x . Let us begin with $x = a$:

$$(5) \quad \{y : a \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S$$

iff

$$\{A\} \in \llbracket \text{jede Wand} \rrbracket_S$$

Let us first apply the *in situ* rule for $\vec{*}_\varrho$ which gives us the **linear reading**:

$$(3) \quad \llbracket \text{zierte jede Wand} \rrbracket_S = \{x : \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S\}$$

Looking inside (3) we see that we have to determine whether (4) holds:

$$(4) \quad \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S$$

We can do this only by supplying values for x . Let us begin with $x = a$:

$$(5) \quad \begin{aligned} \{y : a \text{ decorated } y\} &\in \llbracket \text{jede Wand} \rrbracket_S \\ \text{iff} \\ \{A\} &\in \llbracket \text{jede Wand} \rrbracket_S \end{aligned}$$

This is false, hence we have to try another value for x . But it is easy to see that no x gives a positive result, hence

$$(6) \quad \{x : \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S\} = \emptyset$$

Is the empty set an element of the denotation of $\llbracket \text{ein Bild} \rrbracket_S$?

Let us first apply the *in situ* rule for $\vec{*}_\mathcal{Q}$ which gives us the **linear reading**:

$$(3) \quad \llbracket \text{zierte jede Wand} \rrbracket_S = \{x : \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S\}$$

Looking inside (3) we see that we have to determine whether (4) holds:

$$(4) \quad \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S$$

We can do this only by supplying values for x . Let us begin with $x = a$:

$$(5) \quad \begin{aligned} \{y : a \text{ decorated } y\} &\in \llbracket \text{jede Wand} \rrbracket_S \\ \text{iff} \\ \{A\} &\in \llbracket \text{jede Wand} \rrbracket_S \end{aligned}$$

This is false, hence we have to try another value for x . But it is easy to see that no x gives a positive result, hence

$$(6) \quad \{x : \{y : x \text{ decorated } y\} \in \llbracket \text{jede Wand} \rrbracket_S\} = \emptyset$$

Is the empty set an element of the denotation of $\llbracket \text{ein Bild} \rrbracket_S$? No! Hence the sentence is false.

Let us next calculate a **QR analysis**. By applying the QR-rule we have to determine whether or not (7) holds:

$$(7) \quad \llbracket \text{jede Wand} \rrbracket_S \ni \{y : \llbracket \text{ein Bild zierte } t_y \rrbracket_S\}$$

This is the **inverted reading**. Looking inside (7), we have to calculate

$$(8) \quad \begin{aligned} \llbracket \text{ein Bild zierte } t_y \rrbracket_S &= \\ \llbracket \text{ein Bild} \rrbracket_S * (\llbracket \text{zierte} \rrbracket_S \vec{*} \llbracket t_y \rrbracket_S) &= \\ \llbracket \text{ein Bild} \rrbracket_S * \{x : x \text{ decorates } y\} &= 1 \text{ iff} \\ \llbracket \text{ein Bild} \rrbracket_S \ni \{x : x \text{ decorates } y\} \end{aligned}$$

Again this must be calculated by supplying values for y :

$$(9) \quad \begin{aligned} \{x : x \text{ decorates } y\} \\ \text{a. } y = A : \{a\}; y = B : \{b\}; y = C : \{c\}; \\ \text{b. the empty set for all other values.} \end{aligned}$$

Next we must determine for each of these solutions, ie. the sets in (9-a) whether or not they are in $\llbracket \text{ein Bild} \rrbracket_S$.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

This holds, since each of these sets $\{a\}$, $\{b\}$, and $\{c\}$ contains a painting.
Accordingly:

$$(10) \quad \{y : \llbracket \text{ein Bild ziert } y \rrbracket_S\} = \{A, B, C\}$$

The last step is to determine whether or not this set is an element of
 $\llbracket \text{jede Wand} \rrbracket_S$. But is it?

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

This holds, since each of these sets $\{a\}$, $\{b\}$, and $\{c\}$ contains a painting.
Accordingly:

$$(10) \quad \{y : \llbracket \text{ein Bild zierte } y \rrbracket_S\} = \{A, B, C\}$$

The last step is to determine whether or not this set is an element of $\llbracket \text{jede Wand} \rrbracket_S$. But is it?

The extension of *jede Wand* contains all supersets of $\{A, B, C, D\}$, but the set in (10) is only a subset. Hence the sentence is false in the inverted reading as well.



Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

HOMEWORK 1:

Modify sentence (1) by replacing “decorate” with “touch” and add to D an element F — the floor — which touches every wall. Minimally modify the interpretation function I, so that the relation “touch” is symmetric and all the pictures that decorate the walls also touch the wall. (The fact that two adjacent walls touch is irrelevant here).

Calculate the truth or falsity of the following sentences along the lines suggested above (one in situ analysis, one QR analysis for the object):

- (11) a. Ein Bild berührt jede Wand
a painting touches every Wall
- b. Jede Wand berührt einen Boden
every wall touches a floor
- c. Der Boden berührt jede Wand
the floor touches every

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

HOMEWORK 2:

Add another painting d that decorates wall D. Now recalculate (1) using the in situ method and QR. Derive the linear reading without using the in situ method (hint: you will have to apply QR twice!).

We will now compare three different analyses of

(12) Jeder Junge mag Maria
every boy likes Mary

and show that they yield the same truth conditions.

First analysis (ordinary plugging):

(13) $\llbracket \text{jeder Junge} \rrbracket_s * \llbracket \text{mag Maria} \rrbracket_s$

Second analysis (higher order plugging):

(14) $\llbracket \text{jeder Junge} \rrbracket_s *_{\mathcal{Q}} \llbracket \text{mag Maria} \rrbracket_s$

Third analysis (Quantifier raising):

(15) a. Jeder Junge₁ [t₁ mag Maria]

b. $\llbracket \text{jeder Junge} \rrbracket_s * \{ x_1 : \llbracket x_1 \text{ mag Maria} \rrbracket_s = 1 \}$

Beforehand, check that the following equivalences hold:

$$(16) \quad \begin{aligned} \llbracket \text{jeder Junge} \rrbracket_s &= \\ \llbracket \text{jeder} \rrbracket_s \overset{\leftarrow}{*} \llbracket \text{Junge} \rrbracket_s &= \\ \{ Y : \llbracket \text{Junge} \rrbracket_s \subseteq Y \} &= \\ \{ Y : \{ x : x \text{ is a boy} \} \subseteq Y \} & \end{aligned}$$

Note: To be precise, we should say that $\llbracket \text{Junge} \rrbracket_s = \{ x : x \text{ is a boy in } s \}$. We omit the qualification *in s* since in the present context it is redundant.

$$(17) \quad \begin{aligned} \text{Assume that } \llbracket \text{Maria} \rrbracket_s &= \text{Mary and } \llbracket \text{mag} \rrbracket_s = \{ \langle x, y \rangle : x \text{ likes } y \}. \\ \text{Then} \\ \llbracket \text{mag Maria} \rrbracket_s &= \llbracket \text{mag} \rrbracket_s \overset{\rightarrow}{*} \llbracket \text{Maria} \rrbracket_s = \{ x : x \text{ likes Mary} \} \end{aligned}$$

Recall that

$$(18) \quad \begin{aligned} y * R = R * y &= \{ \langle \rangle \} (= \text{true} = 1, \text{ by convention}) \\ \text{iff } y \in R & \text{ (by definition).} \end{aligned}$$

First analysis (**ordinary plugging**):

$$\begin{aligned} (19) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S \\ & = \\ & \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} \\ & = \\ & \{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} \end{aligned}$$

Ooops !!! There must be something wrong here.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$\begin{aligned} (19) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S \\ & = \\ & \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} \\ & = \\ & \{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} \end{aligned}$$

Ooops !!! There must be something wrong here. The statement in the last but one line (involving $*$) describes a certain set in the model (either \emptyset equivalent to “false” by convention, or $\{\emptyset\}$ equivalent to “true” by convention). But the last line (involving \in) is a condition (in the meta language that we use to talk about the model. But a truth value cannot be identical to a condition! Or equivalently, a set cannot be equal to a proposition.

Something went wrong. So let us start again! What we rather wanted to say is...



First analysis (**ordinary plugging**):

$$(20) \quad \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1$$

iff

$$\{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1$$

iff

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$\begin{aligned} (20) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1 \\ & \text{iff} \\ & \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1 \\ & \text{iff} \\ & \{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} \\ & \text{iff} \end{aligned}$$

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$\begin{aligned} (20) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1 \\ & \text{iff} \\ & \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1 \\ & \text{iff} \\ & \{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} \\ & \text{iff} \\ & \llbracket \text{Junge} \rrbracket_S \subseteq \{ x : x \text{ likes Mary} \} \end{aligned}$$

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$\begin{aligned} (20) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1 \\ & \text{iff} \\ & \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1 \\ & \text{iff} \\ & \{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} \\ & \text{iff} \\ & \llbracket \text{Junge} \rrbracket_S \subseteq \{ x : x \text{ likes Mary} \} \\ & \text{iff} \\ & \{ x : x \text{ is a boy} \} \subseteq \{ x : x \text{ likes Mary} \} \\ & \text{iff} \end{aligned}$$

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$(20) \quad \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1$$

iff

$$\{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1$$

iff

$$\{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \}$$

iff

$$\llbracket \text{Junge} \rrbracket_S \subseteq \{ x : x \text{ likes Mary} \}$$

iff

$$\{ x : x \text{ is a boy} \} \subseteq \{ x : x \text{ likes Mary} \}$$

iff

for every y , if $y \in \{ x : x \text{ is a boy} \}$ then $y \in \{ x : x \text{ likes Mary} \}$

iff

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$(20) \quad \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1$$

iff

$$\{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1$$

iff

$$\{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \}$$

iff

$$\llbracket \text{Junge} \rrbracket_S \subseteq \{ x : x \text{ likes Mary} \}$$

iff

$$\{ x : x \text{ is a boy} \} \subseteq \{ x : x \text{ likes Mary} \}$$

iff

for every y , if $y \in \{ x : x \text{ is a boy} \}$ then $y \in \{ x : x \text{ likes Mary} \}$

iff

for every y , if y is a boy, then y likes Mary

iff

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

First analysis (**ordinary plugging**):

$$(20) \quad \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S = 1$$

iff

$$\{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \} * \{ x : x \text{ likes Mary} \} = 1$$

iff

$$\{ x : x \text{ likes Mary} \} \in \{ Y : \llbracket \text{Junge} \rrbracket_S \subseteq Y \}$$

iff

$$\llbracket \text{Junge} \rrbracket_S \subseteq \{ x : x \text{ likes Mary} \}$$

iff

$$\{ x : x \text{ is a boy} \} \subseteq \{ x : x \text{ likes Mary} \}$$

iff

for every y , if $y \in \{ x : x \text{ is a boy} \}$ then $y \in \{ x : x \text{ likes Mary} \}$

iff

for every y , if y is a boy, then y likes Mary

iff

every boy likes Mary

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Second Analysis (**higher order plugging**):

$\llbracket \text{jeder Junge} \rrbracket_S *_{\mathcal{Q}} \llbracket \text{mag Maria} \rrbracket_S$

We repeat the definition of $*_{\mathcal{Q}}$:

(21) Let R be an n -place relation and \mathcal{Q} a set of sets.

$$R \overrightarrow{*}_{\mathcal{Q}} = \mathcal{Q} \overrightarrow{*} R = \{ \langle x_1, \dots, x_{n-1} \rangle : \{ y : \langle x_1, \dots, x_{n-1}, y \rangle \in R \} \in \mathcal{Q} \}$$

We apply the definition to the case at hand:

Let R be the 1-place relation $\llbracket \text{mag Maria} \rrbracket_S$ and $\mathcal{Q} = \llbracket \text{jeder Junge} \rrbracket_S$.

$$\begin{aligned}
 (22) \quad \mathcal{Q} \overrightarrow{*} R &= \llbracket \text{jeder Junge} \rrbracket_S *_{\mathcal{Q}} \llbracket \text{mag Maria} \rrbracket_S = \\
 &= \{ \langle \rangle : \{ y : \langle y \rangle \in \llbracket \text{mag Maria} \rrbracket_S \} \in \llbracket \text{jeder Junge} \rrbracket_S \} = \\
 &= \{ \langle \rangle : \llbracket \text{mag Maria} \rrbracket_S \in \llbracket \text{jeder Junge} \rrbracket_S \} \\
 &= \{ \langle \rangle : \llbracket \text{mag Maria} \rrbracket_S \in \llbracket \text{jeder Junge} \rrbracket_S \} = \{ \langle \rangle \} \text{ (by def. = 1)} \\
 &\text{iff} \\
 &\llbracket \text{mag Maria} \rrbracket_S \in \llbracket \text{jeder Junge} \rrbracket_S \\
 &\text{iff} \\
 &\text{every boy likes Mary (as above)}
 \end{aligned}$$

Third analysis: Quantifier Raising

$$\begin{aligned}
 (23) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : \llbracket t_1 \text{ mag Maria} \rrbracket_S\} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : \llbracket t_1 \rrbracket_S * \llbracket \text{mag Maria} \rrbracket_S\} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : x_1 * \llbracket \text{mag} \rrbracket_S \vec{*} \llbracket \text{Maria} \rrbracket_S\} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : x_1 * \{x : x \text{ likes Mary}\}\} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : x_1 \in \{x : x \text{ likes Mary}\}\} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{x_1 : x_1 \text{ likes Mary}\} = \\
 & \{Y : \{x : x \text{ is a boy}\} \subseteq Y\} * \{x_1 : x_1 \text{ likes Mary}\} \\
 & \{Y : \{x : x \text{ is a boy}\} \subseteq Y\} * \{x_1 : x_1 \text{ likes Mary}\} = 1 \text{ iff} \\
 & \{x : x \text{ is a boy}\} \subseteq \{x_1 : x_1 \text{ likes Mary}\} \text{ iff} \\
 & \text{for every } y, \text{ if } y \in \{x : x \text{ is a boy}\} \text{ then } y \in \{x_1 : x_1 \text{ likes Mary}\} \\
 & \text{iff} \\
 & \text{for every } y, \text{ if } y \text{ is a boy, then } y \text{ likes Mary} \\
 & \text{iff} \\
 & \text{every boy likes Mary}
 \end{aligned}$$



Main result: All three analyses are equivalent in the sense that they yield the same truth conditions in the case at hand.

However, as we have seen (and will illustrate below), there are some differences:

- Ordinary plugging cannot be used for an in situ analysis of quantified object expressions, here we can use higher order plugging.
- On the other hand, we do not need higher order plugging in case we use Quantifier Raising.
- We need Quantifier Raising as an easy way to account for non-linear scope dependencies.
- We need Quantifier Raising as an easy way to account for bound pronouns.

We will illustrate the last point next.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Sentence (24) has two readings:

(24) every boy loves his father.

his can be used either referentially, as referring to a particular person, or as a bound variable pronoun, saying that for every boy it holds that he (that boy) loves that boy's (his own) father.

In Lecture 4 we have shown how to analyse this reading via QR: The Logical Form

(25) LF: $\boxed{\boxed{\text{jeder Junge}_x \text{ } t_x \text{ liebt } \boxed{\boxed{\text{seinen}_x \text{ Vater}}}}$

was interpreted in the following way:

$$\begin{aligned}
 (26) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : \llbracket t_x \text{ liebt seinen}_x \text{ Vater} \rrbracket_S = 1 \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \in \llbracket \text{liebt} \rrbracket_S \xrightarrow{*} \llbracket \text{seinen}_x \text{ Vater} \rrbracket_S \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \in \llbracket \text{liebt} \rrbracket_S \xrightarrow{*} \llbracket \text{Vater} \rrbracket_S (\llbracket \text{seinen}_x \rrbracket_S) \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \in \llbracket \text{liebt} \rrbracket_S \xrightarrow{*} \llbracket \text{Vater} \rrbracket_S (x) \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \in \llbracket \text{liebt} \rrbracket_S \xrightarrow{*} x\text{'s father} \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \in \{ y : y \text{ loves } x\text{'s father} \} \} = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \text{ loves } x\text{'s father} \} \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \text{ loves } x\text{'s father} \} = 1 \\
 & \{ x : x \text{ is a boy} \} \subseteq \{ x : x \text{ loves } x\text{'s father} \} \text{ iff} \\
 & \text{every boy } x \text{ loves } x\text{'s father}
 \end{aligned}$$

Hence, the LF is basically interpreted as something like:

(27) Every boy is such that **he** loves **his** father

with the important twist that *he* and *his* are interpreted by using the same variable.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark



Important note: Binding would **not** be possible **without** QRing (the subject). In fact, any construction that involves BVPs requires some sort of QR in this kind of theory.

The reason for this should be obvious: Quantifying expressions in this theory are construed as so called **Generalized Quantifiers**, ie. as relations between sets. Relations cannot bind. But the set forming operation does bind. Without QR there would be no set formation and no binder for the variable. For assume we do not QR the subject:

$$\begin{aligned}
 (28) \quad & \llbracket \text{jeder Junge} \rrbracket_S * \llbracket \text{liebt seinen}_x \text{ Vater} \rrbracket_S = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * (\llbracket \text{liebt} \rrbracket_S \vec{*} \llbracket \text{seinen}_x \text{ Vater} \rrbracket_S) = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * (\llbracket \text{liebt} \rrbracket_S \vec{*} \llbracket \text{Vater} \rrbracket_S (\llbracket \text{seinen}_x \rrbracket_S)) = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * (\llbracket \text{liebt} \rrbracket_S \vec{*} \llbracket \text{Vater} \rrbracket_S(x)) = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * (\llbracket \text{liebt} \rrbracket_S \vec{*} x\text{'s father}) = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * (\{\langle y, z \rangle : y \text{ loves } z\} \vec{*} x\text{'s father}) = \\
 & \llbracket \text{jeder Junge} \rrbracket_S * \{y : y \text{ loves } x\text{'s father}\} \\
 & \text{which is true iff every boy loves } x\text{'s father}
 \end{aligned}$$

Objection:

It seems we have chosen the wrong variable: suppose that instead of $\langle y, z \rangle$ for the relation, we chose $\langle x, z \rangle$:

- (29) a. $\llbracket \text{jeder Junge} \rrbracket_S * (\{ \langle x, z \rangle : x \text{ loves } z \} \vec{*} x\text{'s father}) =$
b. $\llbracket \text{jeder Junge} \rrbracket_S * \{ x : x \text{ loves } x\text{'s father} \}$
which is true iff every boy loves his own father

HOWEVER:

As this reasoning shows, the choice of variables might matter. So it seems to make a difference whether a set is characterized as $\{ x : \dots x \dots \}$ vs. $\{ y : \dots y \dots \}$, or in that case, whether we characterize *lieben* as $\{ \langle y, z \rangle : y \text{ loves } z \}$ or as $\{ \langle x, z \rangle : x \text{ loves } z \}$

But this is not intended: in fact the choice of variables must be irrelevant!!!

Accordingly, in set theory, the choice of variables is in fact immaterial, but the step from (29-a) to (29-b) is not allowed! In other words, the denotations differ, there is no equality of denotations.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

In general, plugging can **not** turn an arbitrary two place relation into a one place reflexive predicate:

$$(30) \quad \{ \langle x, y \rangle : \text{some relation holds between } x \text{ and } y \} \vec{*} x \neq \\ \{ x : \text{some relation holds between } x \text{ and } x \}$$

Rather, the result is:

$$(31) \quad \{ \langle x, y \rangle : \text{some relation holds between } x \text{ and } y \} \vec{*} x = \\ \{ z : \text{some relation holds between } z \text{ and } x \}$$

where z is a variable that does not occur (free) in (30). This is an important fact about our use of variables in our (conventionally regimented formal mathematical) language. In particular:



- A statement like $P(x)$ expresses the same idea as $P(y)$, choice of variables being irrelevant; likewise in Predicate Logic, $\exists xP(x)$ expresses the same idea as $\exists yP(y)$.
- Hence, a particular choice of a variable should influence the meaning of an expression only in special circumstances, e.g. in expressions like $R(x,x)$ as opposed to $R(x,y)$, in which x and y are so-called **free variables**.

The topic is far from trivial, we here only report the standard view in mathematics, logic, and linguistics.

To summarize: The idea of using the variable x as the interpretation of a pronoun and simultaneously using the same variable in stating the relation *liebt* is possible but does not yield the intended interpretation. In contrast, using the variable x both as the object of a relation R and as its subject does the job. But then we must use x as the value for the subject in the above example, and this is possible only after QR and indexing both the antecedent and the trace with x . This works, because at the time of combining x as the subject with the an VP, x is a free variable.

Summary of findings:

- Quantifying expressions, i.e. DPs cannot per se bind variables
- Certain pronouns should be interpreted as bound variables
- Only after QR can quantifying expression have binding force, since QR creates a binding configuration
- QR is needed to get inversed readings
- Linear readings can always be analysed by using in situ methods
- Lifting (or type shifting) is unnecessary as far as truth conditions are concerned, the theory also works without Lifting
- The only purpose for introducing lifting is to achieve uniformity: all DPs should have the same logical type

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Critical Assessment:

In some theories there is no in situ strategy, hence QRing of objects is obligatory. As we have seen, we get the somewhat strange result that the linear reading (which is sometimes the only possible one in German) requires a more complex analysis (two applications of QR) than the inverted reading (one application of QR). One could compensate for this by requiring that each QDP must be QRed (two applications of QR for both readings).

However, this makes QR an operation that seems neither syntactically nor semantically motivated unless it induces scope reversal. Moreover, QR **overgenerates**. Here are three examples:



- (32) a. Fritz küsste nicht jede Frau
F. kissed not every woman
F didn't kiss every woman
b. *Für jede Frau gilt: Fritz küsste sie nicht
- (33) a. Sein Vater vermachte jedem Verwandten ein Vermögen
His father bequeathed each relative a fortune
His father bequeathed a fortune to each relative
b. *Für jeden Verwandten gilt: der Vater des jeweiligen Verwandten vermachte ihm ein Vermögen
- (34) a. Ein Student beklagte, dass er jedes Buch lesen muss
a student complained that he every book read must
a student complained that he must read every book
b. *Für jedes Buch gilt: es gibt einen Studenten der sich beklagt, dass er es lesen muss

We need much additional (syntactic?) machinery to block unwarranted applications of QR.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Due to the operation of Lifting, names can have the logical type of quantifiers. Does it make sense to QR lifted names?

Let's see what happens when QRing the lifted *John*:

(35) Before QR: $[... \{ X : \text{John} \in X \} ...]$

(36) QR:
 $\{ X : \text{John} \in X \} \ni \{ y : [... y ...] \} =$
 $\text{John} \in \{ y : [... y ...] \} = [... \text{John} ...]$

Hence it seems that it makes no sense to QR names.

However, QRing of names has been applied in the context of ellipsis:

(37) John loves his car, and Bill does too

This has a reading in which Bill loves his own (Bill's car).

(38) **Axiom:** Ellipsis can only delete identical semantic material.

The common part is “loves his car”, which is analysed as

(39) $\{ x : x \text{ loves } y\text{'s car} \}$.

This does not allow an analysis of the desired reading. What we want to get is

(40) $\{ x : x \text{ loves } x\text{'s car} \}$, or
 $\{ y : y \text{ loves } y\text{'s car} \}$

When applying this property to John, we get: John loves John's car;
applying it to Bill we get: Bill loves Bill's car — the desired result. How can we turn (39) into (40)? By moving *John*!

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

$$\begin{aligned}
 (41) \quad & \left[\left[\text{John}_y \boxed{t_y \text{ loves his}_y \text{ car}} \right] \right]_s = \\
 & \text{John} * \{ y : \left[y \right]_s \in \left[\text{loves } y\text{'s car} \right]_s \} = \\
 & \text{John} * \{ y : \left[y \right]_s \in \{ x : x \text{ loves } y\text{'s car} \} \} = \\
 & \text{John} * \{ y \text{ loves } y\text{'s car} \}
 \end{aligned}$$

$$\begin{aligned}
 (42) \quad & \dots \text{ and Bill does too:} \\
 & \text{Bill} * \{ y \text{ loves } y\text{'s car} \}
 \end{aligned}$$

This reading is called the **sloppy identity** reading. This is analysed as a bound variable reading. To get a bound variable, the name has raised. This can be seen as a subcase of QR. But whether the name is lifted or not does not matter, both analysis yield the same result.

Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark



Ein Bild
zierte jede
Wand

Subject +
Predicate:
3 Analyses

Bound
Variable
Pronouns

Summary
and
Discussion

A note on
QR of
names

Final
remark

Personal remark: I find it somewhat strange that a **syntactic** (LF-)operation is required to get a bound variable reading. This is due to the nature of Generalized Quantifiers: they are not binders.

I would prefer a more conservative theory and I argued against the theory of Generalized Quantifiers elsewhere. Nonetheless, although there are alternatives we cannot discuss here, the theory of GQs is widely accepted as a standard.

An alternative in which NL quantifiers still have quantifying force would require that we quantify not over individuals but over sets. It is another weakness of the theory of Generalized Quantifiers that it only allows to quantify over individuals.

Nonetheless we will give a preliminary analysis of the plural in the next lecture.