Overview

(1) Every boy called his (own) mother.
Pronoun does not stand for the binder.

(2) Every boy called every boy’s mother.
Index-Binding: Pronouns are indexed variables (Quine, 1960).

(3) [Every boy]x called x’s mother.

Flat Binding: Pronouns are definite descriptions.

(4) Every boy talked to the boy’s mother.
Index-Binding (Frege, Tarski)

A recursive interpretive procedure assigns semantic values to constituents relative to a model and an assignment.

- Assignments are sequences (functions from indices to values).
- Bound elements are indices (Variables).
- Binder are indexed operators (specifically: $\lambda$).

Interpretation rules for pronouns, traces, and binders (Heim and Kratzer, 1998).

(5) a. $[\text{pro}]^g = [t]^g = [i]^g = g(i)$
   b. $[\lambda x \alpha]^g = \lambda x: [\alpha]^g[i \mapsto x]$
(6) Every boy called friends of his.

\[
\begin{align*}
\text{TP} & \quad \text{TP} \\
\text{DP} & \quad \lambda_1 \\
\text{every boy} & \quad \text{VP} \\
\text{called} & \quad \text{NP} \\
\text{friends} & \quad \text{his}_1
\end{align*}
\]
Index-Binding: Example, Step 2

(6) Every boy called friends of his.

For every boy a:

\[
\begin{array}{c}
\text{TP} \\
\lambda_1 \\
1 \\
called \\
\text{friends} \\
his_1 \\
\text{VP} \\
\text{NP}
\end{array}
\]
Index-Binding: Example, Step 3

(6) Every boy called friends of his.

For every boy $a$:

$\{(1\rightarrow a)\}$

```
  VP
   1   VP
     called   NP
           friends  his$_1$
```
Index-Binding: Example, Step 4/5

(6) Every boy called friends of his.

For every boy $a$:

\[ \text{called} \{\langle 1 \mapsto a \rangle \} \] (friends $a$)

For every boy \( a \): \( \text{called}(\text{friends}(a))(a) \)
Flat Binding

Assumption kept: A recursive interpretation procedure assigns semantic values relative to model and assignment. The following three assumptions, however, are different:

- Assignments are sets.
- Bound elements are definite descriptions.
- Binders are unindexed operators $\lambda$.

New interpretation rules for bound elements and binders:

\begin{align*}
(7) & \hspace{1cm} \\
(7a) & \quad [\text{the}]^\ell(P) = \iota x \in \ell : P(x) = 1 \\
(7b) & \quad [\lambda \alpha]^\ell = \lambda x : [\alpha]^{\ell \cup \{x\}}
\end{align*}
Flat binding: example 1, step 1

(8) Every boy called friends of his.
Flat Binding: Example 1, Step 2

(8) Every boy called friends of his.

For every boy \( a \):
Flat Binding: Example 1, Step 3

(8) Every boy called friends of his.

For every boy \( a \):

\[
\begin{array}{c}
\text{VP} \\
\text{DP} \quad \text{VP} \\
\text{the boy} \quad \text{called} \\
\text{NP} \\
\text{friends} \quad \text{DP} \\
\text{the boy}
\end{array}
\]
Flat Binding: Example 1, Step 4

(8) Every boy called friends of his.

For every boy $a$:

\[
\begin{array}{c}
\text{called} \\
\text{friends} \\
\text{the boy}
\end{array}
\quad (a) \quad (a)
\begin{array}{c}
\text{DP} \\
\text{the boy}
\end{array}
\]
Flat Binding: Example 1, Step 5/6

(8) Every boy called friends of his.

For every boy a:

\[
\text{called}(\text{friends}(a))\]

= For every boy a: \text{called}(\text{friends}(a))(a)
Flat Binding: Example 2, Step 1

(9) Every girl called every boy.
Flat Binding: Example 2, Step 2

(9) Every girl called every boy.

For every girl $a$:

```
(a)

TP
  \lambda
  TP
    DP
      every boy
    TP
      \lambda
      VP
        DP
          the girl
        called
          VP
            DP
              the boy
```
Flat Binding: Example 2, Step 3

(9) Every girl called every boy.

For every girl $a$:
Flat Binding: Example 2, Step 4

(9) Every girl called every boy.

For every girl a and for every boy b:

```
(\lambda a)(\lambda b) \forall a \exists b \forall x \exists y \forall z (a(x) \land b(y) \land z(x) \land \text{called}(y, z))
```

```
\lambda \lambda \forall \exists \forall \exists \forall
```
Flat Binding: Example 2, Step 5

For every girl \( a \) and for every boy \( b \):

$$\begin{align*}
\text{(9)} & \quad \text{Every girl called every boy.} \\
\text{For every girl } a \text{ and for every boy } b: \\
\text{VP} & \quad \text{DP} \\
\text{the girl} & \quad \text{called} \\
\text{VP} & \quad \text{DP} \\
\text{the boy} & \quad \text{[a, b]} 
\end{align*}$$
Flat Binding: Example 2, Step 6/7

(9) Every girl called every boy.

For every girl \(a\) and for every boy \(b\):

\[
\text{called(} \{a, b\} \text{)(the boy)} \cdot \text{called(} \{a, b\} \text{)(the girl)}
\]

\[= \text{For every girl } a \text{ and for every boy } b:\]

\[\text{called(b)(a)}\]
Evidence for Lexical Content

One important difference of the two theories:

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Elements</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>principle C ellipsis</td>
<td>traces</td>
<td>(Chomsky, 1993; Fox, 1999)</td>
</tr>
<tr>
<td>ellipsis</td>
<td>traces</td>
<td>(Sauerland, 1998, 2004a)</td>
</tr>
<tr>
<td>focus</td>
<td>pronouns</td>
<td>(Merchant, 1998)</td>
</tr>
<tr>
<td>focus</td>
<td>traces</td>
<td>(Sauerland, 2000, 2004b)</td>
</tr>
<tr>
<td>gramm. gender</td>
<td>pronouns</td>
<td>(Sauerland, 2001)</td>
</tr>
</tbody>
</table>

The lex. content
Pronouns and Focus

Contrastive focus marks meaning differences (see Schwarzschild 1999):

(10) On Monday, Mary praised Bill, and . . .
    a. . . . on [Tuesday]_F, Mary praised [JOHN]_F.
    b. #on [Tuesday]_F, [MARY]_F praised [JOHN]_F.

Two bound pronouns can be contrasted, if and only if their lexical content is different (Sauerland, 1998, 2000, 2004b).

(11) On Monday, every boy called his mother, and . . .
    a. . . . on [Tuesday]_F, every [TEACHER]_F called [HIS]_F mother.
    b. #. . . on [Tuesday]_F, every boy called [HIS]_F mother (again).
Flat binding explains this contrast:

(12) every boy λ the boy called the boy’s mother, and . . .
a. . . . every teacher λ the teacher called [the teacher]F’s mother
b. # . . . every boy λ the boy called [the boy]F’s mother

Index-binding has no explanation for the contrast:

(13) every boy λ1 1 called 1’s mother, and . . .
a. . . . every teacher λ1 1 called [1]F’s mother
b. # . . . every boy λ1 1 called [1]F’s mother
Traces and Ellipsis

VP-Deletion requires an antecedent with identical interpretation (Tancredi, 1992).

(14)  Kai waved at him and Lina did, too.

VP-deletion in (15) is only possible, if both traces have the same lexical content (Sauerland, 2004a):

(15)  a. *Polly visited every town that is near the lake Erik did.
    b.  Polly visited every town that is near the one Erik did.
Flat binding predicts the contrast:

(16)  a. “[every town that is near the lake λ Erik
   visited the lake] λ Polly visited the town
   elided antecedent
   b. [every town that is near the one λ Erik
      visited the town] λ Polly visited the town
      elided antecedent

Index-binding doesn’t predict the contrast:

(17)  [every town that is near the lake/one λ₁ Erik
       visited 1] λ₁ Polly visited 1
       elided antecedent
Overlap

(18) Every student called every boy.
Overlap

(18) Every student called every boy.

= For every student a and for every boy b:

\[
\begin{align*}
\text{called} & \quad (\text{DP} \{a, b\}) \quad \text{the boy} \\
& \quad (\text{DP} \{a, b\}) \quad \text{the student}
\end{align*}
\]

If a is a student and a boy and b is another boy, the boy doesn't refer.
Example (18) is only sensibly interpretable if there is no overlap between students and boys.
Principle B

Principle B rules out coreference in (19a):

(19)  a. Zelda is talking to her. (her \( \neq \) Zelda)
    b. Zelda is talking to herself.

Why doesn’t (20) violate Principle B (Evans, 1980; Heim, 1998)?

(20)  A: Is Zelda the author of this paper?
      B: How can you doubt it? She is praising her
to the sky. No other author would do that.

She and her refer to two different concepts: the author
and Zelda.
(Individual-)Concepts are functions from possible worlds to individuals.
We can understand definite descriptions as concepts:

(21) the author, the person named Zelda

(22) a. $x_{\text{author}}: w \mapsto \text{the author in } w$
    b. $x_{\text{Zelda}}: w \mapsto \text{the person with name Zelda in } w$

A concept $x$ has property $P$, if the following holds:

(23) $\forall w \in \text{domain}(x): P(x(w))$
Maximal Concepts

(24) Definition: A concept $x$ is maximal for property $P$, if:
\[ \text{domain}(x) = \{ w | \exists y : P(y(w)) \} \]

A maximal $P$-Concept possesses no author properties other than $P$ worth mentioning:

(25) If $x$ is a maximal concept for property $P$, the following holds for every property $Q$ other than $P$: $Q$ is a logical consequence of $P$, or $Q(x)$ is false.

For example: $P =$ girl, $Q =$ under 20 years old
We can imagine a possible world where humans first live as genderless caterpillars underground before they hatch. A maximal girl-concept must select a 20-year old individual in this world.
Quantifier Binding Without Overlap

(18) Every student called every boy.

For every maximal student-concept $a$ and for every maximal boy-concept $b$:

A maximal student-concept $a$ never has the property boy and a maximal boy-concept $b$ never has the property student.
Identitical Restrictors

Sentence with identical restrictors can be reduced to overlap.

(26) Every coach voted for every coach.

Quantifier can always have additional, elided restrictors (Westerståhl, 1985; Stanley and Zsabo, 2000): (27) can mean that the sailors on board wave to the sailors on shore.

(27) Every sailor waved to every sailor. (Stanley and Williamson, 1995)

In (26), the elided restrictors can be extensionally equivalent. (28) is a possible representation:

(28) Every coach with permission to vote voted for every candidate coach.
Contextual Concepts

(29) Context set $C = \text{Set of all possible worlds, in which all propositions are true that all discourse participants agree are true (Stalnaker, 1978).}$

(30) Definition: A concept $x$ is contextual if:
\[
\text{domain}(x) = C
\]

Contextual concepts generally have many properties. For example, a contextual girl-concept also has the property *younger than 20 years.*
Discourse Binding

Discourse vs. Quantifier Binding:

(31) a. The assignment set at the beginning of interpreting a sentence contains the discourse-salient concepts. Discourse-salient concepts are always contextual.

b. $\lambda$-operators add in the course of sentence interpretation new concepts to the assignment set. Quantifier binding (or the $\lambda$-operator) always add maximal concepts.
Discourse Binding

(32) A: Is Zelda the author of this paper?
B: How can you doubt it? She is praising her to the sky. No competing candidate would do that.
A: *You’re right, I agree with you. Oh look, here she is praising her again.

Discourse before B’s utterance: no coreference:
(33) $C, \{x_{\text{author}}, x_{\text{Zelda}}\}$

Discourse after B’s utterance: Coreference:
(34) $C' = C \cap \{ w \mid x_{\text{author}} = x_{\text{Zelda}} \}, \{ x_{\text{author}}/\text{Zelda} \}$

Namely: $x_{\text{author}}|C' = x_{\text{Zelda}}|C'$.

General principle:
(35) Update of $\langle C, d \rangle$ with $\phi$: $\langle C \cap \phi, \{ c \cap \phi \mid c \in d \} \rangle$
Summary

- Binding in Language: Storage in a set, reference by unequivocal description of a stored element
- Quantifier binding uses maximal concepts, discourse binding uses contextual concepts.
Predictions and Directions

- All bound elements must be of type $e$ (Landman, 2004) (cf. no QR of verbs, obligatory reconstruction of VPs (Heycock, 1995))
- Conservativity, *only*
- Ellipsis licensing in DPs
- Binding into Intensional Contexts
- Dynamic Binding
- Agreement on Bound Elements
- Binding Theory
Incorporating Dynamic Binding

Contextual Concepts can also be added during the evaluation.

(36) Every farmer who owns a donkey feeds it.

(37) Every farmer who owns a donkey feeds the donkey of the farmer.

Idea: a donkey leads to the accommodation of a contextual donkey concept per farmer, which is added to the assignment set.
Binding Theory

Condition A/B

(38)  a. John/Every boy talked to him.
     b. John/Every boy talked to himself

Pragmatic principle: Use *self* as much as possible.

Condition C

(39)  a. He read that John is sick.
     b. He read that he is sick.

Pragmatic principle: Elide as much as possible (cf. Schlenker 2004)
Both pragmatic principles might follow from maximize presupposition.
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