Indefinites and Sluicing
A Type-Logical Approach

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Workshop Cross-modular approaches to ellipsis
Outline of talk

- Anaphora in Type Logical Grammar
- Extrapolation to indefinites
- Linguistic consequences:
  - Indefinites and scope
  - Sluicing
Anaphora in TLG

Jacobson’s proposal

- Semantics: pronouns denote identity functions
- Syntax: third slash: “$A|B$” is category of anaphoric expression
- Pronouns: category $np|np$
Adaptation to TLG

Natural Deduction rules for anaphora slash

\[ [M : A]_i \quad \cdots \quad \frac{N : B|A}{[NM : B]_i} \mid E, i \]

\[ \frac{M : A|B}{Mx : A}_i \quad \vdots \]

\[ \vdots \quad \vdots \quad \vdots \]

\[ np : C' \quad \lambda x N : C|B \mid I, i \]

Only constraint on anaphora resolution: The antecedent must precede the pronoun
(1) John said he walked

\[
\begin{array}{c}
\text{John} \quad \text{lex} \quad \frac{\lambda x. x : np|np[i]}{\text{SAY} : np\{s/s}} \quad \frac{\text{said} \quad \text{lex}}{\text{he} \quad \text{lex} \quad \frac{\text{walked} \quad \text{lex}}{\text{WALK} : np\{s}}}
\end{array}
\]
Percolation

\[
\begin{array}{c}
\frac{\text{John}}{\text{J'} \colon \text{np}} \quad \frac{\text{said}}{\text{SAY'} \colon \text{np}s/s} \quad \frac{\text{he}}{\lambda x \cdot x : \text{np|np} \quad \text{lex}} \quad \frac{\text{walked}}{\text{WALK'} : \text{np}s} \quad \text{lex} \\
\frac{\text{y : np}}{1} \quad \frac{\text{WALK'y : s}}{/E} \quad \frac{\text{SAY'(WALK'y)} : \text{np}s}{\text{\textbackslash E}} \quad \frac{\text{\lambda y.SAY'(WALK'y)J'} : s|np}{|I, 1}
\end{array}
\]
VP Ellipsis

(2) John revised his paper, and Harry did (too).

- stranded auxiliary *did* is treated as proverb
  \[ \lambda P. P : (np\less s)|(np\less s) \]

- the lexical entry for non-elliptical *did* is
  \[ \lambda P. P : (np\less s)/(np\less s) \]

- strict/sloppy ambiguity: pronoun is either identified with the actual subject or with a hypothetical premise that is discharged later
John lex revised his paper [\lambda x. R'(P'x)]_i \quad \text{(np\s)|np} \quad |E\quad \text{did lex} \quad [\lambda P.P]_j \quad \text{(np\s)|\text{np\s}} \quad |E\quad 

\begin{align*}
\text{[J']}_i & & \text{[R'(P'J')]}_j \\
\text{np} & & \text{np\s} & & \text{AND'} & & \text{\text{R'(P'J')H'}} & & s \\
\text{R'(P'J')J'} & & \text{s} & & \text{\text{AND'}(R'(P'J')H')} & & s|s & & \text{s} & & \text{\text{AND'}(R'(P'J')H')(R'(P'J')J')} & & s \\
\end{align*}
John revised his paper

\[ [\lambda x. R'(P'x)]_i \]

\[ (np\backslash s)|np \]

\[ [x]_i \]

\[ np \]

\[ R'(P'x) \]

\[ np\backslash s \]

\[ R'(P'x)x \]

\[ \frac{\text{John}}{\text{lex}} \]

\[ \frac{\text{J'}}{\text{I, 1}} \]

\[ \frac{\text{np}}{\text{np\backslash s}} \]

\[ R'(P'J') \]

\[ s \]

\[ \frac{\text{np\backslash s}}{\text{E}} \]

\[ \frac{\text{S\backslash s/s}}{\text{E}} \]

\[ \text{AND'()} \]

\[ \text{AND'()} \]

\[ \text{AND'}(R'(P'H')H')(R'(P'J')J') \]

\[ s \]

\[ \frac{\lambda x. R'(P'x)x}{\text{did}} \]

\[ lex \]

\[ \frac{\lambda P.A}{\text{lex}} \]

\[ (np\backslash s)|np\backslash s \]

\[ \frac{\text{Harry}}{\text{lex}} \]

\[ \frac{\text{H'}}{\text{E}} \]

\[ \frac{\text{np\backslash s}}{\text{E}} \]

\[ \frac{\text{np\backslash s}}{\text{E}} \]

\[ \text{and} \]

\[ \frac{\text{np}}{\text{E}} \]

\[ \frac{\text{s\backslash s/s}}{\text{E}} \]

\[ \lambda x. R'(P'x)x \]

\[ \frac{\text{H'}}{\text{E}} \]

\[ \text{AND'}(R'(P'H')H') \]

\[ s \]

\[ \frac{\text{s\backslash s}}{\text{E}} \]

\[ \text{E} \]

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Interaction with Quantification

- Background: Moortgat’s *in situ* binder $q(np, s, s)$
  - to scope a quantifier, 1. insert an hypothetical $np$ into its position, 2. derive the local clause, 3. discharge the assumption, and 4. apply the quantifier to the resulting predicate
  - Hypothetical $np$ can serve as antecedent of a pronoun
(3) a. Everybody loves his mother

\[
\begin{array}{c}
\text{everybody} \quad \text{loves} \\
q(np, s, s) \\ EVERY' \\
\end{array}
\]

\[
\begin{array}{c}
his mother \\
[np|np]_i \\
\end{array}
\]

\[
\begin{array}{c}
\text{loves} \\
np\backslash s/np \\
\end{array}
\]

\[
\begin{array}{c}
\text{loves' (MOTHER'x)} \\
np\backslash s \\
\end{array}
\]

\[
\begin{array}{c}
\text{EVERY'}(\lambda x.\text{LOVE'}(\text{MOTHER'}x)x) \\
\end{array}
\]

b. [np]_i

\[
\begin{array}{c}
x \\
\end{array}
\]

\[
\begin{array}{c}
\text{LOVE'}(\text{MOTHER'}x) \\
\end{array}
\]

\[
\begin{array}{c}
\text{EVERY'}(\lambda x.\text{LOVE'}(\text{MOTHER'}x)x) \\
\end{array}
\]
Derivation of a bound reading for *His mother loves everybody* fails since the hypothetical *np* does not precede the pronoun \(\Rightarrow\) accounts for Crossover phenomena

bound readings only possible as long as quantifier isn’t scoped \(\Rightarrow\) bound pronouns are in the scope of the binder
(4) a. Everybody’s mother loves him

\[
\begin{array}{l}
\text{everybody} \quad \text{lex} \\
q(np, s, s) \\
\text{EVERY'} 1 \\
[np]_i \\
y \\
\text{OF'} \\
np/n \\
\text{OF'} y \\
\text{LOVES'} \\
\text{MOTHER'} \\
np\backslash s \\
\lambda x.x |E \\
\text{LOVE'} y \\
qE, 1 \\
\text{EVERY'} (\lambda y. \text{LOVE'} y (\text{OF'} y \text{MOTHER'}))
\end{array}
\]
Covering indefinites

Basic idea

(5)  a. It moved.
    b. Something moved.

Proposal: (a) and (b) have
- the same denotation: $\lambda x.\text{MOVE}' x$
- different syntactic categories
yet another substructural implication, “∼”

Intuition: $A \sim B$: category of $B$-sign containing an indefinite $A$

category of indefinite NPs: $np \sim np$

$it$ and $something$ both denote the identity function on individuals
indefinites function compose with their semantic environment

Natural deduction rule:

\[ \begin{align*}
M : A &\rightarrow B \\
\vdots & \vdots \\
Mx : B & \vdots \\
\vdots & \vdots \\
\vdots & \vdots \\
N : C & \lambda x N : A \rightarrow C \rightarrow i
\end{align*} \]
(6) a. John saw something.

\[
\begin{align*}
\text{John} &\quad \text{lex} \\
\text{np} &\quad (np\backslash s)/np \\
\text{SEE'}y &\quad np\backslash s
\end{align*}
\]

b. John

\[
\begin{align*}
\text{SEE'}y \text{JOHN'} &\quad \sim, i \\
\lambda y.\text{SEE'}y \text{JOHN'} &\quad np \sim \ s
\end{align*}
\]
Idea: descriptive content expresses domain restriction

\[ a \] = function that maps a property to the identity function over its extension

\[ \text{a cup} \] = identity function on the set of cups

\[ \text{a cup moved} \] = partial function \( f \) from individuals to truth values:

\[ f(x) = 1 \text{ iff } x \text{ is a cup that moved} \]

\[ f(x) = 0 \text{ iff } x \text{ is a cup that did not move} \]

\[ f(x) \text{ is undefined iff } x \text{ is not a cup} \]
Variable free existential closure

- Existential closure of a partial function: “big union” over its domain
- built in into the truth definition and the semantics of propositional operators (as in DRT)
- Relativization to syntactic categories to confine existential closure to indefinites
Truth is relativized to sequence of referents and syntactic category

**Definition 1 (Truth)**

\[
\begin{align*}
\bar{e} \vdash \alpha : s & \quad \text{iff} \quad \alpha = 1 \\
\bar{c}\bar{e} \vdash \alpha : S|np & \quad \text{iff} \quad \bar{e} \vdash (\alpha c) : S \\
\bar{e} \vdash \alpha : np \sim S & \quad \text{iff} \quad \bar{e} \vdash (\bigcup_{\alpha c \text{ is defined}} (\alpha c)) : S
\end{align*}
\]
(7) A cup moved.

\[ \tilde{e} \models \| \lambda x \text{CUP'}_x \cdot \text{MOVE'}_x \|_g : np \sim s \quad \iff \quad \tilde{e} \models \bigcup_{a \in \| \text{CUP'}_g \|} \| \text{MOVE'}_g(a) \|_g : s \quad \iff \quad \bigcup_{a \in \| \text{CUP'}_g \|} \| \text{MOVE'}_g(a) \|_g = 1 \quad \iff \quad \exists a. a \in \| \text{CUP'}_g \|_g \cap \| \text{MOVE'}_g \|_g \]
Negation

Negation is polymorphic

indefinites in its scope are (optionally) existentially closed

anaphora slots are passed through unchanged

Definition 2 (Negation)

\[ \sim \alpha : s = \lambda c. \sim (\alpha c) \]

\[ \sim \alpha : S|A = \lambda c. \sim (\alpha c) \]

\[ \sim \alpha : A \Rightarrow S = \sim (\bigcup_{c \in Dom(\alpha)} \alpha c) \]
Linguistic consequences

Indefinites and scope

(8) John didn’t see a cup move.

First option: existential closure by negation:

\[ \neg \lambda x \text{CUP}'_x \cdot \text{SEE}'(\text{MOVE}'_x)\text{JOHN}' \]

\[ \equiv \]

\[ \neg \exists x (\text{CUP}'_x \land \text{SEE}'(\text{MOVE}'_x)\text{JOHN}') \]

Second option: existential closure at matrix level:

\[ \lambda x \text{CUP}'_x \cdot \neg \text{SEE}'(\text{MOVE}'_x)\text{JOHN}' \]

\[ \equiv \]

\[ \exists x (\text{CUP}'_x \land \neg \text{SEE}'(\text{MOVE}'_x)\text{JOHN}') \]
Properties of the analysis

No island effects

- An indefinite can take scope over each clause it is contained in
- Indefinites scopally interact with operators like negation, but:
  - No movement involved → not constrained by constraints on movement
  - Scoping mechanism is independent from quantifier scoping → not constrained by constraints on quantifier scope
No split between existential force and descriptive content

- descriptively part is interpreted as domain restriction of partial function
- is inherited by superconstituents in semantic composition:

\[ \text{Dom}(f) \subseteq \text{Dom}(f \circ g) \]

- Existential closure entails non-emptiness of domain
- Thus existential and descriptive scope are always identical
Avoids

“Donald Duck Problem” of naive long-distance existential closure analysis:

(9) a. Max will be offended if we invite a certain philosopher.
   b. $\exists x (\text{PHILO}' x \land (\text{INVITE}' x \text{WE'} \rightarrow \text{OFFENDED}' \text{M'}))$
   c. $\not\exists x (\text{PHILO}' x \land \text{INVITE}' x \text{WE'} \rightarrow \text{OFFENDED}' \text{M'})$
(10) a. A cup moved, and Bill wonders which cup.
b. A cup moved, and Bill wonders which cup moved.

**Syntax:**
- Sluicing involves a bare *wh*-phrase
- needs a declarative clause containing an indefinite as antecedent

**Semantics:**
- “missing” material is identical to antecedent except that indefinite is replaced by *wh*-trace
Proposal: *which cup* has two types (but only one meaning):

\[(11)\]

\begin{align*}
\text{a. } & q/(s \uparrow np) : \lambda P.\exists x \text{CUP}' x \land Px \\
\text{b. } & q|(np \rightsquigarrow s) : \lambda P.\exists x \text{CUP}' x \land Px
\end{align*}

Antecedent clause has exactly the denotation that is needed to complete the elliptical question
John lex

\( np \) lex

\( \text{invited} \)

\( np \sim np /n \)

\( lex \)

\( n /E \)

\( s \)

\( \sim, i \)

\( (np/s) \)

\( s \)

\( \sim, k \)

\( np \sim s \)

\( np \sim np \)

\( i \)

\( np \sim np \)

\( /E \)

\( s/q \)

\( s/q \)

\( s \)

\( \sim, j \)

\( s/q \)

\( s/q \)

\( s \)

\( /E \)

\( s/q \)

\( s/q \)

\( s \)

\( /E \)

\( s/q \)

\( s/q \)

\( s \)

\( /E \)
Predictions

Antecedent must contain an indefinite

(12) *The cup moved, and Bill wonders which cup.

- First conjunct has category $s$
- *which cup* requires antecedent of category $np \leadsto s$
- |-elimination not applicable
Sluicing is island insensitive

- No transformational connection to non-elliptical counterpart
- No restrictions on scope of indefinites ⇒ no restrictions on embedding depth of antecedent indefinites in Sluicing

(13) a. The administration has issued a statement that it is willing to meet with one of the student groups, but I’m not sure which one
b. *The administration has issued a statement that it is willing to meet with one of the student groups, but I’m not sure which one the administration has issued a statement that it is willing to meet with

from Chung, Ladusaw and McCloskey 1995
Morphological sensitivity

Er will jemandem schmeicheln, aber sie wissen nicht {wem / *wen}

He wants someone\(_{\text{DAT}}\) flatter but they know not \{WHO\(_{\text{DAT}}\) / *WHO\(_{\text{ACC}}\}\}

‘He wants to flatter someone, but they don’t know whom’

- morphological information coded in syntactic category
- indefinite NP in dative has category \(np(\text{dat}) \leadsto np(\text{dat})\)
- clause containing dative indefinite: \(np(\text{dat}) \leadsto s\)
- Sluicing remnant in dative: \(q| (np(\text{dat}) \leadsto s)\)
Conclusion

- Indefinites and pronouns are interpreted as (partial) identity functions
- Pronoun binding via syntactic deduction
- Existential impact of indefinites is buried in truth definition/semantics of negation etc.
- Descriptive content of indefinites is interpreted as domain restriction
- Empirical coverage: specificity and sluicing