

# Long-distance dependencies in continuation grammar

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The Barker & Shan (B&S) framework: Shan and Barker 2006, Barker and Shan 2014, a.o. develop a Combinatory Categorical Grammar that uses *continuations* to model semantic scope.

(1) **Multi-level tower notation:**

$$\frac{C \mid B}{A} \quad C \parallel (A \setminus B)$$

expression := expression

$$\frac{f[\ ]}{a} \quad \lambda \kappa . f(\kappa(a))$$

(2) **Composition with multi-level towers:**

$$\frac{C \mid D}{A} \quad \frac{D \mid E}{A \setminus B} \quad \frac{C \mid E}{B}$$

left-exp right-exp = left-exp right-exp

$$\frac{g[\ ]}{x} \quad \frac{h[\ ]}{f} \quad \frac{g(h[\ ])}{f(x)}$$

(3) **LIFT:**

$$\frac{A}{\text{exp}} \xrightarrow{\text{LIFT}} \frac{B \mid B}{A}$$

$$\frac{a}{\text{exp}} \xrightarrow{\text{LIFT}} \frac{[\ ]}{a}$$

(4) **LOWER:**

$$\frac{A \mid S}{S} \quad \frac{A}{\text{exp}} \xrightarrow{\downarrow} \frac{A}{\text{exp}}$$

$$\frac{f[\ ]}{a} \quad \frac{f(a)}{f(a)}$$

(5) **BIND:**

$$\frac{A \mid B}{\text{DP}} \xrightarrow{\text{BIND}} \frac{A \mid \text{DP} \triangleright B}{\text{DP}}$$

$$\frac{f[\ ]}{x} \quad \frac{f([\ ]x)}{x}$$

One advertised feature of B&S's proposal is its explanation for *crossover effects* (Postal 1971) as in (6) — schematized in (7) — using linear evaluation.

- (6) a. Which girl<sub>i</sub> did John introduce \_\_\_ to her<sub>i</sub> second cousin?  
 b. ?? Which girl<sub>i</sub> did John introduce her<sub>i</sub> second cousin to \_\_\_?
- (7) a.  $\checkmark wh_i \dots \_i \dots pro_i$   
 b.  $*wh_i \dots pro_i \dots \_i$

## Scope-taking across clause boundaries

(8) # Someone said [everyone is married to Sue].  $\# \exists > \forall, * \forall > \exists$  (from Fox 2000: 62)

(9) **Scope Island Evaluation:** (codifying an idea in Charlow 2014: 65)

If the expression is a scope island, apply LOWER as many times as possible ( $\downarrow^*$ ).

- (10) a.  $\checkmark$  Which girl<sub>i</sub> did you say [Mary saw \_\_\_<sub>i</sub>]? b.  $\checkmark$  Every girl<sub>i</sub> said [Mary saw her<sub>i</sub>].

► Scope Island Evaluation (9) blocks the binding of gaps (10a) and pronouns (10b) in embedded tensed clauses, contrary to fact.

(11) **For embedded gaps: Intermediate gaps**

$$\frac{DP \setminus S \mid S}{DP} \left( \frac{S \mid S}{DP \setminus S} \right) = \frac{DP \setminus S \mid S}{S}$$

$$\frac{\lambda y . [\ ]}{y} \left( \frac{\text{Mary saw } \_}{[\ ]} \right) = \frac{\_ \text{ Mary saw } \_}{\lambda y . \text{ saw } y \text{ m}}$$

(12) **For embedded pronouns: PROLIFT**

$$\frac{B \mid C}{DP \triangleright A} \xrightarrow{\text{PROLIFT}} \frac{DP \triangleright B \mid C}{A}$$

$$\frac{f[\ ]}{\lambda x . g(x)} \xrightarrow{\text{PROLIFT}} \frac{\text{expression}}{\lambda x . f[\ ]}$$

$$\frac{f[\ ]}{\lambda x . g(x)} \xrightarrow{\text{PROLIFT}} \frac{\lambda x . f[\ ]}{g(x)}$$

**The revised B&S framework predicts the crossover violation in (13b) to be grammatical.**

- (13) a. Which girl<sub>i</sub> do you think [\_\_\_ loves her<sub>i</sub> mother]?  
 b. ?? Which girl<sub>i</sub> do you think [her<sub>i</sub> mother loves \_\_\_]?

(13b) ?? Which girl<sub>i</sub> do you think [her<sub>i</sub> mother loves \_\_\_]?

Calculate the embedded clause:

$$\begin{array}{c}
 \frac{DP \triangleright (DP \setminus S) \mid DP \setminus S}{DP} \\
 \text{her mother} \\
 \frac{\lambda d . []}{\mathbf{mother } d}
 \end{array}
 \quad
 \frac{DP \setminus S \mid DP \setminus S}{(DP \setminus S) / DP} \\
 \text{loves} \\
 \frac{[]}{\mathbf{loves}}
 \end{array}
 \quad
 \frac{DP \setminus S \mid S}{DP} \\
 \text{___} \\
 \frac{\lambda x . []}{x}
 \end{array}
 =
 \frac{DP \triangleright (DP \setminus S) \mid S}{S} \\
 \text{her mother loves ___} \\
 \frac{\lambda d . \lambda x . []}{\mathbf{loves } x (\mathbf{mother } d)}$$
  

$$\begin{array}{c}
 \downarrow^* \\
 \Rightarrow
 \end{array}
 \frac{DP \triangleright (DP \setminus S)}{\lambda d . \lambda x . \mathbf{loves } x (\mathbf{mother } d)}
 \quad
 \xRightarrow{\text{LIFT}}
 \frac{S \mid S}{DP \triangleright (DP \setminus S)} \\
 \text{her mother loves ___} \\
 \frac{[]}{\lambda d . \lambda x . \mathbf{loves } x (\mathbf{mother } d)}
 \quad
 \xRightarrow{\text{PROLIFT}}
 \frac{DP \triangleright S \mid S}{DP \setminus S} \\
 \text{her mother loves ___} \\
 \frac{\lambda d . []}{\lambda x . \mathbf{loves } x (\mathbf{mother } d)}$$

(We optionally shift  $A \setminus B$  categories on the lower level to  $A \setminus B$  with no change in denotation.)

Then calculate the higher clause, with the embedded clause and an intermediate, BIND-ing gap:

$$\begin{array}{c}
 \frac{DP \setminus S \mid DP \setminus S}{DP} \\
 \text{you} \\
 \frac{[]}{\mathbf{you}}
 \end{array}
 \quad
 \frac{DP \setminus S \mid DP \setminus S}{(DP \setminus S) / S} \\
 \text{think} \\
 \frac{[]}{\mathbf{think}}
 \end{array}
 \quad
 \frac{DP \setminus S \mid DP \triangleright S}{DP} \\
 \text{___} \\
 \frac{\lambda y . [] y}{y}
 \end{array}
 \quad
 \frac{DP \triangleright S \mid S}{DP \setminus S} \\
 \text{her mother loves ___} \\
 \frac{\lambda d . []}{\lambda x . \mathbf{loves } x (\mathbf{mother } d)}$$
  

$$=
 \frac{DP \setminus S \mid S}{S} \\
 \text{you think ___ her mother loves ___} \\
 \frac{\lambda y . []}{\mathbf{loves } y (\mathbf{mother } y)}
 \quad
 \xRightarrow{\downarrow^*}
 \frac{DP \setminus S}{DP \setminus S} \\
 \text{you think ___ her mother loves ___} \\
 \frac{\lambda y . \mathbf{loves } y (\mathbf{mother } y)}{\lambda y . \mathbf{loves } y (\mathbf{mother } y)}$$

Finally, combine with the *wh*-phrase:

$$\begin{array}{c}
 S / (DP \setminus S) \\
 \text{which girl} \\
 \lambda \kappa . \mathbf{wh}(\lambda g . \mathbf{girl } g \wedge \kappa(g))
 \end{array}
 \quad
 \frac{DP \setminus S}{DP \setminus S} \\
 \text{you think ___ her m. loves ___} \\
 \lambda y . \mathbf{loves } y (\mathbf{mother } y)
 \end{array}
 =
 \frac{S}{S} \\
 \text{wh girl [do] you think ___ her m. loves ___} \\
 \mathbf{wh}(\lambda g . \mathbf{girl } g \wedge \mathbf{loves } g (\mathbf{mother } g))$$

## References

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