Unbounded Dependency Constructions

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1 Basics

Unbounded Dependency Constructions (UDCs), aka Long Distance Dependencies (LDDs).

(1) On Kim, Sandy depends Δ.
(2) *Kim, Sandy depends Δ.
(3) On Kim, Chris believes [$_S$ Sandy depends Δ]
(4) *Kim, Chris believes [$_S$ Sandy depends Δ]

- unbounded
- syntactic dependency

1.1 Constraints

(5) *Who do you believe
[the claim that Sam likes Δ]
(6) *Who do you know [a man who likes Δ]
(7) *Who do you like [Sam and Δ] ?
(8) Who do you think
[[Sam likes Δ] and [Kim hates Δ]]?
(9) *Whose do you admire [Δbook]?
(10) *Who do you believe that Δlikes Sam?
(11) When do they *deny/?believe
[that Sam left Δ]

1.2 Strong vs Weak UDCs

Strong: antecedent in non-argument position (filler-gap constructions).

(12) Kim$_i$, Sandy loves Δ_i (Topicalization)
(13) I wonder [who$_i$ Sandy loves Δ_i] (Wh-Question)
(14) The person [who$_i$ Sandy loves Δ_i] (Wh-relative)
(15) It's Kim [who$_i$ Sandy loves Δ_i] (It-cleft)
(16) This is [what$_i$ Kim loves Δ_i] (Pseudo-cleft)

Weak: antecedent in argument position.

(17) Sandy$_i$ is hard to love Δ_i (Tough Movement)
(18) I bought it$_i$ for Sandy to eat Δ_i (Purpose Infinitive)
(19) This is the person$_i$ [Sandy loves Δ_i] (Relative)
(20) It's Kim$_i$ Sandy loves Δ_i (It cleft)

2 Approaches

2.1 Classical

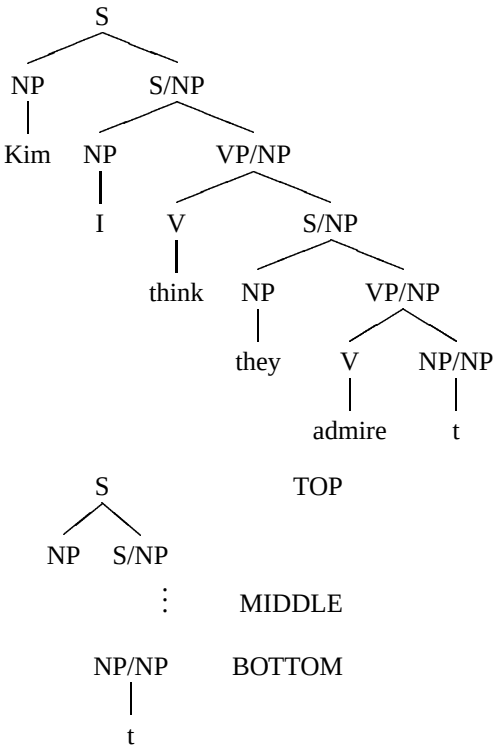
Movement rule, plus stipulated constraints.

2.2 Move-α

General movement rule, plus general constraints (trace theory, Government, Binding, etc.), empty operators for weak UDCs.

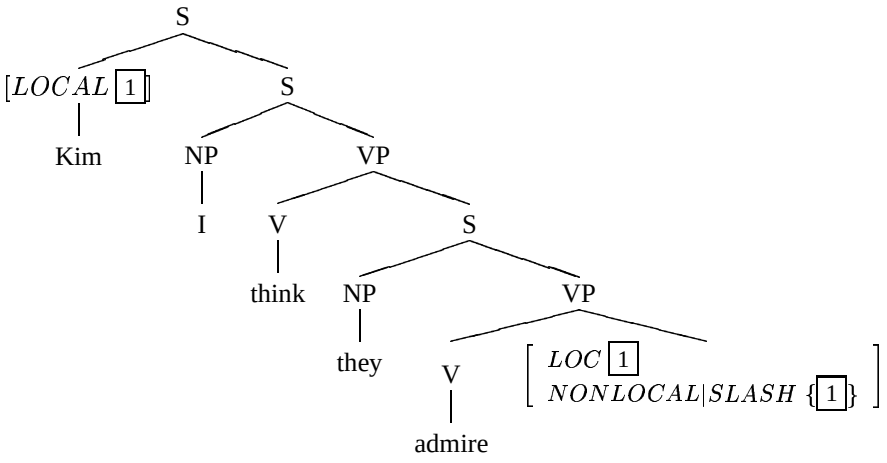
2.3 GPSG

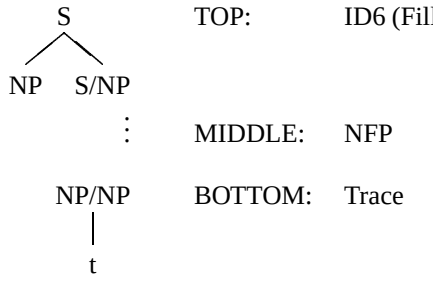
SLASH features; S/NP is an S with an NP hole in it.



3 HPSG: Overview

Similar to GPSG in spirit, but different in most technical details.





4 HPSG: Details

4.1 Outline: Basic Apparatus

- Nonlocal Feature Value
- Non-Local Feature Principle
- Trace (a lexical entry)
- Filler-Head ID Schema
- Lexical Entries (weak UDCs): *tough*
- Constraints
- Trace Principle, and Subject Extraction Lexical Rule (SELR)
- Coordination Principle

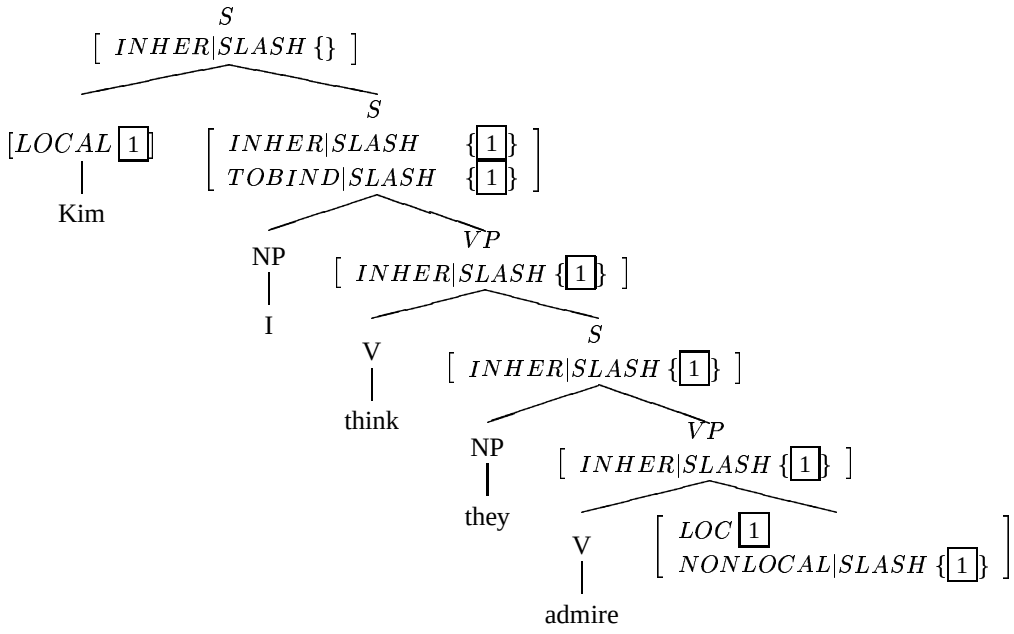
4.2 Nonlocal Values

HPSG employs three non-local attributes: SLASH, REL and QUE. Here we focus on SLASH (REL is used in relative clauses, QUE in questions).

$$\textit{sign}\left[\begin{array}{ll}\text{PHON} & \ldots \\ \text{SYNSEM} & \textit{synsem}\left[\begin{array}{ll}\text{LOCAL} & \ldots \\ \text{NONLOCAL} & \textit{nonlocal}\left[\begin{array}{ll}\text{INHERITED}\,|\,\text{SLASH} & \left(\text{SET OF LOCAL STRUCTURES}\right) \\ \text{TO-BIND}\,|\,\text{SLASH} & \left(\text{SET OF LOCAL STRUCTURES}\right)\end{array}\right]\end{array}\right]\end{array}\right]$$

4.3 Nonlocal Feature Principle

For each nonlocal feature, the INHERITED value on the mother is the union of the INHERITED values on the daughters —



. . . minus the TO-BIND value on the HEAD daughter.

4.4 The bottom of the dependency: Trace

Lexical entry for *trace*:

$$\textit{sign}\left[\begin{array}{ll}\text{PHONOLOGY} & \langle\rangle \\ \text{SYNSEM} & \left[\begin{array}{ll}\text{LOCAL} & \boxed{1} \\ \text{NONLOCAL}\,|\,\text{SLASH} & \left\{\boxed{1}\right\}\end{array}\right]\end{array}\right]$$

Trace

$$\left[\begin{array}{ll}\text{PHONOLOGY} & \langle\rangle \\ \text{SYNSEM} & \left[\begin{array}{ll}\text{LOCAL} & \boxed{1} \\ \text{NONLOCAL} & \left[\begin{array}{ll}\text{INHERITED} & \left[\begin{array}{ll}\text{SLASH} & \left\{\boxed{1}\right\} \\ \text{REL} & \{\} \\ \text{QUE} & \{\}\end{array}\right] \\ \text{TO-BIND} & \left[\begin{array}{ll}\text{SLASH} & \{\} \\ \text{REL} & \{\} \\ \text{QUE} & \{\}\end{array}\right]\end{array}\right]\end{array}\right]\end{array}\right]$$

$$\left[\begin{array}{ll}\text{LOCAL} & \\ \text{NONLOCAL} & \left[\begin{array}{ll}\text{INHERITED} & \left[\begin{array}{lll}\text{SLASH} & \text{set-of-local-structures} \\ \text{REL} & \text{set-of-ref-indices} \\ \text{QUE} & \text{set-of-npro}\end{array}\right] \\ \text{TO-BIND} & \left[\begin{array}{lll}\text{SLASH} & \text{set-of-local-structures} \\ \text{REL} & \text{set-of-ref-indices} \\ \text{QUE} & \text{set-of-npro}\end{array}\right]\end{array}\right]\end{array}\right]$$

Since SLASH is set-valued, multiple extraction is permitted:

(21) It is easy to play these sonatas on these violins.
(22) These sonatas$_j$ are easy to play Δ_j on these violins.
(23) Which violins$_i$ are these sonatas$_j$ easy [to play Δ_j on Δ_i]?

4.5 Strong UDCs: Filler Head Schema (ID 6)

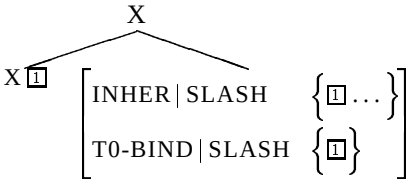
Schema 6 (ID6: FILLER HEAD SCHEMA)

a phrase with DTRS value of sort filler-head-structure, such that the head daughter's TO-BIND|SLASH value is a singleton set, whose member is token identical with the LOCAL value of the filler daughter.

$$\begin{bmatrix} \text{DTRS} & \begin{bmatrix} \text{FILLER-DTR} \mid \text{SYNSEM} \mid \text{LOCAL} \boxed{1} \\ \text{COMPLEMENT-DTRS} \langle\rangle \\ \text{H-DTR} \mid \text{SYNSEM} & \begin{bmatrix} \text{LOC} \mid \text{CAT} & \begin{bmatrix} \text{HEAD} & \text{verb} \begin{bmatrix} \text{VFORM} & \text{fin} \end{bmatrix} \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER} \mid \text{SLASH} & \{\boxed{1}, \ldots\} \\ \text{TO-BIND} \mid \text{SLASH} & \{\boxed{1}\} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\text{X} \rightarrow \text{FILLER:[1]} \quad \text{HEAD:} \begin{bmatrix} \text{INHER} \mid \text{SLASH} & \{\boxed{1}, \ldots\} \\ \text{TO-BIND} \mid \text{SLASH} & \{\boxed{1}\} \end{bmatrix}$$

(24)



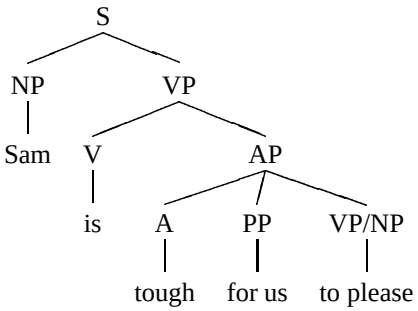
For example:

(25) $$\text{S[fin]} \rightarrow \text{XP} \boxed{1} \quad \text{S[fin]} \begin{bmatrix} \text{INHER} \mid \text{SLASH} & \{\boxed{1}\} \\ \text{T0-BIND} \mid \text{SLASH} & \{\boxed{1}\} \end{bmatrix}$$

4.6 Weak UDCs (e.g. *tough*)

(26) Sam$_i$ is tough (for us) to please t$_i$

tough: SUBCAT: $< NP_i, (PP), VP/NP_i >$



(27) Sam is tough to please.

$$\left[\begin{array}{l} \text{LOCAL} \mid \text{CAT} \left[\begin{array}{ll} \text{HEAD} & \text{adjective} \\ \text{SUBCAT} & \left\langle \text{NP}_{\boxed{1}}, \left(\text{PP}[\text{FOR}]\right), \text{VP}[\text{INF}, \text{INHER} \mid \text{SLASH} \left\{ \boxed{2}\text{NP}[\text{ACC}]:\text{PPRO}_{\boxed{1}}, \ldots \right\}] \right\rangle \end{array}\right] \\ \text{NONLOCAL} \mid \text{TO-BIND} \mid \text{SLASH} \left\{ \boxed{2} \right\} \end{array}\right]$$

4.7 Constraints

4.7.1 Trace Principle

Every trace must be subcategorized by a substantive head.

For English: Every trace must be *strictly* subcategorized by a substantive head;

i.e. every trace must be a non-subject complement of the appropriate head.

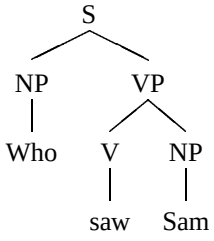
Hence:

1. No extraction of adjuncts:
   (28) When do they *deny/?believe [that Sam left Δ]
2. No extraction of subjects:
   (29) *Who did you claim that Δleft?
   (30) Whose did you read Δbook?

But:

1. Extraction of adjuncts is sometimes possible.
   (31) How long ago do you believe that Kim left?
   (32) When did they say [that Sam left Δ]?
   (33) How did they say [(?that) Sam died Δ]?
2. Subjects appear to move:
   (34) Who did Kim claim left?
   (35) Who did Kim claim [$_{VP}$ left]
   (36) *Who did Kim claim [$_{S}$ Δleft]?

   Notice that questions involving the *matrix* subject are not counter examples:



4.7.2 Extraction of "Subjects": SELR

The structure of (37) is not (38), but (39):

(37) Who did you claim Δleft?

(38) Who_1 did you claim [$_S$ Δ_1 left]?
(39) Who_1 did you claim [$_{VP}$ left]?

Claim has two subcategorizations:

1. $\langle NP, S[unmarked] \rangle$
2. $\langle S, VP \rangle$

related by a lexical rule: the Subject Extraction Lexical Rule (SELR) SELR:

$$\text{X}\left[\text{SUBCAT} \quad \left\langle \text{Y, S[UNMARKED], ...} \right\rangle\right] \mapsto$$

$$\text{X}\left[\begin{array}{ll}\text{SUBCAT} & \left\langle \text{Y, VP[SUBCAT}\left\langle \text{[LOC } \boxed{1}\text{]} \right\rangle\text{], ...} \right\rangle \\ \text{INHER}\,|\,\text{SLASH} & \boxed{1}\end{array}\right]$$

4.7.3 Extraction of Adjuncts

Similarly, to allow extraction of adjuncts, one could have lexical rule along the following lines:[1]

Adjunct Extraction Lexical Rule:

$$\left[\begin{array}{ll}\text{SUBCAT} & \left\langle \ldots, \text{S}\boxed{2}, \ldots \right\rangle \\ \text{INHER}\,|\,\text{SLASH} & \{\}\end{array}\right] \mapsto$$

$$\left[\begin{array}{ll}\text{SUBCAT} & \left\langle \ldots, \text{S}\boxed{2}, \ldots \right\rangle \\ \text{INHER}\,|\,\text{SLASH} & \left\{ \text{YP}\left[\text{MOD} \quad \boxed{2}\right]\text{:}\boxed{3} \right\} \\ \text{CONTENT}\,|\,\text{SOA-ARG} & \boxed{3}\end{array}\right]$$

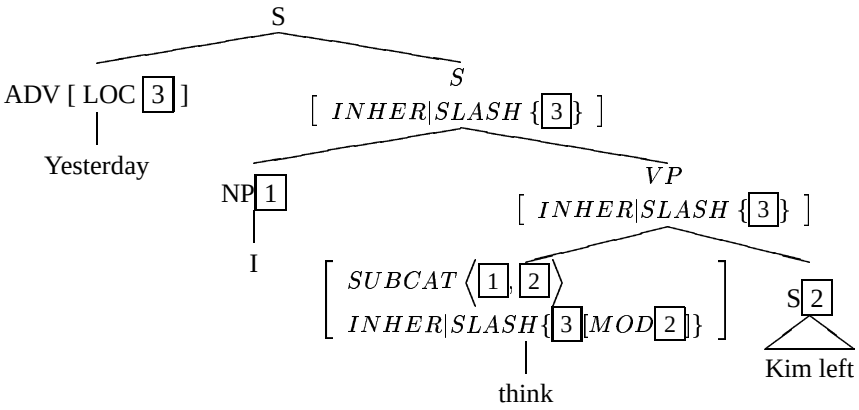
think:$\langle NP, S \rangle / \{\} \mapsto$ *think*:$\langle NP, S \rangle / \{YP\}$

The YP here is something that can modify (have as its MOD value) something like the original S, and the CONTENT of the S is identified with that of the adjunct (the adjunct 'absorbs' the semantics of the S via the MOD feature).

The effect is to make the following have the same content:

(40) Yesterday, I think [*Kim left*].
(41) I think [*Kim left yesterday*].

[1] This is not what Pollard and Sag (1994, 385ff) actually propose, but the idea is similar.



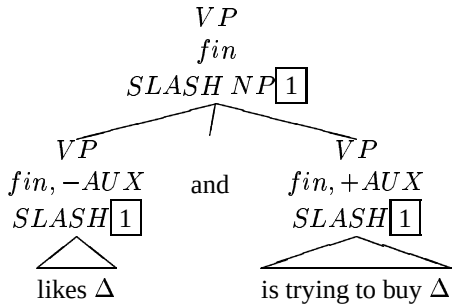
4.7.4 Coordination Principle

The trace principle forbids:

(42) *Who do you like [Sam and Δ]

Coordination of unlike constituents, and ATB extraction is allowed by the Coordination Principle

Coordination Principle: In a coordinate structure, the CATEGORY and NONLOCAL value of each conjunct daughter is subsumed by (is an extension of) that of the mother.



(43) Which picture do you think....
  a. Sam likes Δand is trying to buy Δ
  b. *Sam likes it and is trying to buy Δ

NB such structures are not ‘complete’, i.e. not *totally* well typed or sort resolved.

$$\left[\begin{array}{l} \text{LOC}\,|\,\text{CAT} \quad \left[\begin{array}{l} \text{HEAD} \quad \text{ADJ} \\ \text{SUBCAT} \quad \left\langle \text{NP}_{\boxed{1}},\ \text{VP}[\ \text{INF},\ \text{INHER}\,|\,\text{SLASH} \quad \left\{\boxed{2}\ \text{NP[ACC]}_{\ \text{PPRO}\ \boxed{1}}\right\}\right] \right\rangle \end{array}\right] \\ \text{NONLOCAL}\,|\,\text{TO-BIND}\,|\,\text{SLASH} \quad \left\{\boxed{2}\right\} \end{array}\right]$$

4.7.5 Complex NP Constraint

One case of the CNPC forbids extraction from relative clauses:

(44) *Who did Kim see a person who admires Δ

Extraction from Relative Clauses is blocked because lexical entries for relativizers permit only *single* slashes on relative clauses.

(Intuitively, this slash corresponds to the NP that heads the relative clause; see Pollard and Sag (1994, ch5) for details).

4.7.6 Other Constraints

Subject Condition (parasitic gaps) — also considered, but rejected: SIP (Slash Inheritance Principle), and Incomplete Constituent Constraint.

5 Further Issues

- The account in Pollard and Sag (1994) actually assumes several different mechanisms for extraction of non-subject arguments, subjects, and adjuncts. However, this seems wrong: e.g. 'local encoding' on the extraction path seems to work the same for all kinds of extraction (Hukari and Levine (1991)). This is addressed in Bouma et al. (2001).
- lots of issues of detail, precise formulations of constraints, proper treatment of adjuncts, problems of connectivity, etc.
  For example: 'connectivity', sometimes 'preposing' makes something grammatical, which is a mystery if local values of trace and filler are the same:
  (45) *You can rely on that Kim will help you.
  (46) That Kim will help you, you can rely on.
- parasitic gaps, ...
  (47) a. Who_i did my talking to t_i bother t_i ?
  b. * Who_i did my talking to t_i bother Sam?
  c. * Who_i did my talking to Sam bother t_i ?
  (48) a. Those reports_i, I filed t_i without reading t_i.
  b. Those reports_i, I filed t_i without reading your letter.
  c. ? Those reports_i, I filed your letter without reading t_i.
- A traceless account:
  Pollard and Sag (1994, 376ff), Sag and Fodor (1994), Bouma et al. (2001), and Sag and Wasow (1999) provide accounts where instead of having the trace lexical item, there is a lexical rule, or general principle that allows a complement to be removed from the list of complements, and placed in SLASH:
  (49) $\textit{kiss}\langle NP, NP\rangle/\{\} \mapsto \textit{kiss}\langle NP\rangle/\{NP\}$
  (The extracted item should remain on the SUBCAT list, for reasons to do with binding theory, inter alia, so this analysis requires a slightly different treatment of subcategorization. This is argued for independently in Pollard and Sag (1994, Ch 9).)

References

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Thomas E Hukari and Robert D Levine. On the disunity of unbounded dependency constructions. *Natural Language and Linguistic Theory*, 9(1):97–144, 1991.

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Ivan A Sag and Thomas Wasow. *Syntactic Theory: a Formal Introduction*. Number 92 in CSLI Lecture Notes. CSLI Publications, 1999.