Where are we and where should we go?*

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1 Introduction

- This is an unabashedly programmatic talk.
- I hope to stimulate
  - discussion of the state of play of unbounded dependencies in Lexical-Functional Grammar
  - reflection on current weaknesses and lacunae in LFG's treatment of unbounded dependencies
- Why is this a good idea?
  - Unbounded dependencies have not received as much attention in LFG as they have in sister frameworks, such as Head-Driven Phrase Structure Grammar (Pollard and Sag 1994, Sag 1997, Bouma et al. 2001, Ginzburg and Sag 2000) and Sign-Based Construction Grammar (Sag 2010).
  - Although there has been a not insubstantial number of publications that have in whole or in part concerned unbounded dependencies in LFG (broadly construed) (among others: Kaplan and Bresnan 1982, Zaenen 1980, 1985, Maling and Zaenen 1982, Falk 1983, 2000, 2001, 2002, 2006, 2007, 2011, Kaplan and Zaenen 1989, Bresnan 1995, 2001, King 1995, Dalrymple 2001, Dalrymple and King 2000, Dalrymple et al. 2001, 2007, Asudeh and Crouch 2002, Asudeh 2004, 2009, 2011a,b, 2012, Mycock 2004, 2006, Alsina 2008), only Kaplan and Zaenen (1989) is a sustained theoretical treatment of the subject in this theory.
  - Given the central role that unbounded dependencies have played in the development of transformational grammar, particularly from the publication of Chomsky (1977) onwards, the lack of LFG publications that focus particularly on unbounded dependencies may have artificially limited cross-theoretical fertilization.

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2 Outline

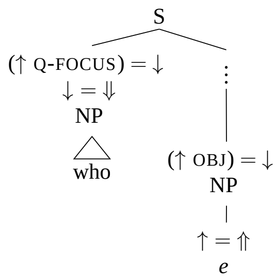
- Where are we?
  - Survey of LFG work on unbounded dependencies
    - C-structural approach
    - F-structural approach
    - Islands
    - Weak crossover
    - Tough movement
    - Across-the-board extraction
    - Parasitic gaps
    - Superiority
    - Nested dependencies
    - COMP-trace
    - Resumptive pronouns
  - Survey of formal tools
    - Functional control
    - Functional uncertainty (outside-in, inside-out)
    - Off-path constraints
    - Subsumption
    - Restriction
    - Correspondence architecture:
      - π-projection: linear precedence
      - σ-projection: resource-sensitive semantic composition
      - ι-projection: TOPIC/FOCUS in i-structure
- A case study that brings several strands together: Resumption
- Where should we go?
  - Elimination of traces
  - Elimination of economy
  - Elimination of discourse functions in syntax
  - Islands
  - Reconstruction/connectivity
  - Locality & successive cyclicity
  - Right dislocation

3 Unbounded dependencies in LFG

3.1 C-structure approach

- Kaplan and Bresnan (1982)
  constituent control and *bounded domination metavariables* (⇓ and ⇑)

(1)



- Issues
  - Requires empty categories
  - C-structure is the wrong level for stating generalizations about unbounded dependencies (Kaplan and Zaenen 1989)

3.2 F-structure approach

- Kaplan and Zaenen (1989)
  Regular language for functional descriptions: Kleene operators * and $^+$ give unboundedness
- Functional uncertainty
  - Outside-In: $(f\ \text{GF}) = (f\ \ \text{Path}\ \ \text{GF})$
  - Inside-out: $(f\ \text{GF}) = ((\text{Path}\ f)\ \text{GF})$
- Outside-In can eliminate traces (does not *need* to), inside-out most at home with traces (but does not *need* traces)
- Bresnan (1995, 2001): Inside-out with traces required for weak crossover
- Falk (2006): Both kinds are required — outside-in restricted to PIV(OT) extraction, inside-out restricted to non-PIVOT extraction (where PIV is one guise of SUBJ)
- Issues with f-structure approach
  - Embarrassment of riches, given outside-in and inside-out approaches (?)
  - Gives up locality (cf. the *Functional Locality Condition* of Kaplan and Bresnan 1982)

3.3 Islands

- Dalrymple (2001)
  Constraints on extraction in LFG can be captured by complex f-structure path specifications, including use of off-path constraints

(2) $$\{\underset{}{\text{XCOMP}} \mid \underset{(\rightarrow \text{UD}) = -}{\text{COMP}} \mid \underset{(\rightarrow \text{TENSE})}{\text{OBJ}}\}^* \ \{(\text{ADJ} \underset{\neg(\rightarrow \text{TENSE})}{\in})\ (\text{GF}) \mid \text{GF}\}$$

- Off-path metavariables
  - $\rightarrow :=$ the f-structure that is the value of the attribute that the constraint adorns
  - $\leftarrow :=$ the f-structure in which occurs the attribute that the constraint adorns
- Issues
  - Can we generalize (2)?
  - Why do these path constraints exist?
  - Are the path constraints syntactic (Falk 2009)?

3.4 Weak crossover

- Bresnan (1995, 2001) argues that two notions of prominence are relevant to weak crossover and that languages are differentiated by whether both notions are relevant or only one or the other.
  - Syntactic rank according to grammatical function hierarchy
    (SUBJ ≻ OBJ ≻ OBL ≻ COMP/XCOMP . . .)
  - Linear order according to f-precedence
- F-precedence: f f-precedes g iff the c-structure correspondent of f precedes the c-structure correspondent of g
- Issues
  - How is the grammatical function hierarchy independently motivated?
  - Can the effects of the linear precedence constraint be derived without postulating traces (Dalrymple et al. 2001, 2007)?
  - Is linear precedence a real syntactic condition or is it derivative of processing constraints or compositional constraints on binding?

3.5 Tough movement

- (Dalrymple and King 2000) propose a theory of tough movement in which the matrix subject is anaphorically related to the TOPIC of the tough-predicate's COMP. The topic in turn is lexically specified by the tough-predicate to functionally control a grammatical function embedded somewhere in the complement to the tough-predicate; this is an unbounded dependency.
- Issues
  - How natural is it for a predicate to a functional control relation within its complement?
  - The tough-complement is a COMP, since the relation between the tough-subject and the topic is anaphoric, not functional. However, it is realized as an infinitival. Do we need a better theory of the morphosyntax of COMP/XCOMP?

3.6 Across-the-board extraction

- The standard theory of coordination in LFG (Kaplan and Maxwell 1988) treats a coordination as a set of the coordinated elements. Unbounded dependency paths that are specified outside-in distribute into the conjuncts, thus predicting the ATB effect.
- Issues
  - If there are inside-out unbounded dependencies, the ATB prediction is lost.
  - Even on the outside-in account, the prediction only goes through if grammatical functions are stipulated to be distributive features, since non-distributive features would contribute to the coordination as a whole, not to its parts. While this is a natural assumption, it *is* an additional stipulation without which the prediction does not go through.
  - The ATB generalization has been disputed (see Kehler 2002 for discussion of references). An alternative approach was developed in Asudeh and Crouch (2002), although both this approach and Kehler's observations were subsequently criticized by Steedman (2007), who attributed the effects to a lexical ambiguity for *and*.

3.7 Parasitic gaps

- As far as I am aware, there are two analyses of parasitic gaps in LFG (although also see Alsina 2008). Falk (2011), which is by far the fuller analysis of the phenomenon (note that Falk rightly prefers the term *multiple gap*), takes a syntactic approach. PGs are also discussed briefly in Asudeh (2004), where I give an analysis based on resource-sensitive semantic composition, similar in spirit to Steedman (1987). This derives the parasitic nature of the gap from how its composition works.
- Issues
  - Although Falk rightly observes that, in a theory like LFG, multiple gaps need pose no special problem (it's trivial for one element to functionally control multiple elements), capturing the parasitic nature of the 'second gap' does not strike me as trivial.
  - The semantic approach treats adjunct parasitic gaps as lexically controlled. Is this the right approach? Can it generalize to subject parasitic gaps?
  - How much commonality is there really between subject and adjunct parasitic gaps? How are the common and divergent aspects to be captured in a principled fashion?

3.8 COMP-trace

- Falk (2006) provides an analysis of COMP-trace/*that*-trace/Specified Subject effects in terms of realization of the grammatical function PIVOT. In Asudeh (2009), I provide an alternative analysis in terms of linear precedence in the c-structure string (via the π projection).
- Issues
  - The Falk analysis is attractive because it contextualizes the effect as part of a broader theory of subjects. However, it is not descriptively adequate, since it cannot account for the pernicious Adverb Effect.
  - The Asudeh analysis was designed to account for the Adverb Effect and is also attractive in how it highlights the Correspondence Architecture of LFG. However, it is not quite sufficiently general (there's a case that it misses). Also, it is not explanatory adequate until it is framed in the context of a larger theory of linear precedence that makes correct predictions about other phenomena.

4 Resumption

4.1 Two kinds of grammatically licensed resumption

1. *Syntactically active resumptives* (SARs)
   Do not display gap-like properties
   Sample languages: Irish, Hebrew, varieties of Arabic, . . .

(3) an ghirseach a-r ghoid na síogaí <u>í</u> (Irish; McCloskey 2002: 189)
the girl COMP-PAST stole the fairies her
'the girl that the fairies stole away'

2. *Syntactically inactive resumptives* (SIRs)
   Do display gap-like properties.
   Sample languages: Vata, Swedish

(4) Vilket ord kommer du aldrig i håg hur många 'm' <u>det</u> stavas med?
which word come you never in mind how many 'm' it spell.PASS with
'Which word do you never remember how many m's it's spelled with?'

	Syntactically Active RPs	Syntactically Inactive RPs
Grammatically Licensed	Yes	Yes
Island-Sensitive	No	Yes
Weak Crossover Violation	No	Yes
Reconstruction Licensed	No	Yes
ATB Extraction Licensed	No	Yes
Parasitic Gap Licensed	No	Yes
Non-Specific/*De Dicto* Interpretation	No	No
Pair-List Answers	No	No

Table 1: Some properties of SARs and SIRs

- Syntactic representation of SARs and SIRs (English used purely for exposition)

Target: [*Who did Jane see <u>him</u>?*]

RP is syntactically active

$$\left[\begin{array}{ll} \text{PRED} & \text{`see}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{UDF} & \left[\begin{array}{ll} \text{PRED} & \text{`pro'} \\ \text{PRONTYPE} & \text{Q} \end{array}\right] \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`Jane'} \end{array}\right] \\ \text{OBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`pro'} \\ \text{PERSON} & 3 \\ \text{NUMBER} & \text{SG} \\ \text{GENDER} & \text{MASC} \end{array}\right] \end{array}\right]$$

RP is syntactically inactive

$$\left[\begin{array}{ll} \text{PRED} & \text{`see}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{UDF} & \left[\begin{array}{ll} \text{PRED} & \text{`pro'} \\ \text{PRONTYPE} & \text{Q} \\ \text{PERSON} & 3 \\ \text{NUMBER} & \text{SG} \\ \text{GENDER} & \text{MASC} \end{array}\right] \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`Jane'} \end{array}\right] \\ \text{OBJ} & \underline{\qquad\qquad} \end{array}\right]$$

4.2 Irish

(5) an ghirseach a-r ghoid na síogaí <u>í</u> (McCloskey 2002: 189, (9b))
the girl COMP-PAST stole the fairies her
'the girl that the fairies stole away'

(6) *í*, D $(\uparrow \text{PERSON}) = 3$
$(\uparrow \text{NUMBER}) = \text{SG}$
$(\uparrow \text{GENDER}) = \text{FEM}$
@PRONOUN

(7) $@\text{PRONOUN} = (\uparrow \text{PRED}) = \text{`pro'}$
$(\uparrow_\sigma \text{ANTECEDENT}) \multimap [(\uparrow_\sigma \text{ANTECEDENT}) \otimes \uparrow_\sigma]$

(8) an fear a dtabharann tú an tairgead <u>dó</u> (McCloskey 1979: 6, (3))
the man COMP give you the money to.him
'the man to whom you give the money'

(9) *dó*, P $(\uparrow \text{PRED}) = \text{`to}\langle\text{OBJ}\rangle\text{'}$
$(\uparrow \text{OBJ PRED}) = \text{`pro'}$
$(\uparrow \text{OBJ PERSON}) = 3$
$(\uparrow \text{OBJ NUMBER}) = \text{SG}$
$(\uparrow \text{OBJ GENDER}) = \text{MASC}$

(10) [$_{CP}$ *aL* ... [$_{CP}$ *aL* ... [$_{CP}$ *aL* ... _ ...]]]

a. an t-ainm a hinnseadh dúinn a bhi _ ar an áit (McCloskey 2002: 190, (13a))
the name *aL* was-told to-us *aL* was _ on the place
'the name that we were told was on the place'

(11) [$_{CP}$ *aN* ... [$_{CP}$ *go* ... [$_{CP}$ *go* ... *Rpro* ...]]]

a. fir ar shíl Aturnae an Stáit go rabh <u>siad</u> díleas do'n Rí
men *aN* thought Attorney the State *go* were they loyal to-the King
'men that the Attorney General thought were loyal to the King'
(McCloskey 2002: 190, (16))

(12) [$_{CP}$ *aN* ... [$_{NP}$ N [$_{CP}$ *aL* ... _ ...]]] **Pattern 1**

a. rud a raibh coinne agam a choimhlíonfadh _ an aimsir
thing *aN* was expectation at-me *aL* fulfill.COND _ the time
'something that I expected time would confirm'
(McCloskey 2002: 196, ∼(28))

(13) [$_{CP}$ *aL* ... [$_{CP}$ *aN* ... *Rpro* ...]] **Pattern 2**

a. Cé is dóigh leat a bhfuil an t-airgead <u>aige</u>?
who *aL*.COP.PRES likely with-you *aN* is the money <u>at-him</u>
'Who do you think has the money?'
(McCloskey 2002: 198, (35))

(14) [$_{CP}$ *aN* ... [$_{CP}$ *aN* ... *Rpro* ...]] **Pattern 3**

a. na cuasáin thiorma ar shíl sé a mbeadh contúirt ar bith uirthi tuitim síos <u>ionnta</u>
the holes dry *aN* thought he *aN* would-be danger any on-her fall.[−FIN] down into-them
'the dry holes that he thought there might be any danger of her falling down into them'
(McCloskey 2002: 199, (44))

	Role Relative to Position			
	Not bottom	**Bottom**	**Method**	**Cyclic?**
aL	Passing	Grounding	Functional equality	Yes
aN	Passing	Grounding	Anaphoric binding	No

Table 2: The role of the Irish complementizers *aL* and *aN* in unbounded dependencies

(15) a. [$_{CP}$ *aL* ... [$_{CP}$ *aL* ... _ ...]]] Core *aL* multi-clause pattern
(pass) (ground)

b. [$_{CP}$ *aN* ... [$_{CP}$ *aL* ... _ ...]]] Pattern 1
(pass) (ground)

c. [$_{CP}$ *aL* ... [$_{CP}$ *aN* ... *Rpro* ...]]] Pattern 2
(pass) (ground)

d. [$_{CP}$ *aN* ... [$_{CP}$ *aN* ... *Rpro* ...]]] Pattern 3
(pass) (ground)

(16) *aL*, C ...
$(\uparrow \text{UDF}) = (\uparrow \text{CF}^* \ \text{GF})$
$(\rightarrow \text{UDF}) = (\uparrow \text{UDF})$

(17) *aN*, C ...
$\%\text{Bound} = (\uparrow \text{GF}^* \{ \text{UDF} \mid [\text{GF} - \text{UDF}] \})$
$@\text{MR}(\rightarrow)$
$(\uparrow \text{UDF})_\sigma = (\%\text{Bound}_\sigma \ \text{ANTECEDENT})$

(18) $@\text{MR}(f) = \lambda P \lambda y.y : [(\uparrow \text{UDF})_\sigma \multimap ((\uparrow \text{UDF})_\sigma \otimes f_\sigma)] \multimap ((\uparrow \text{UDF})_\sigma \multimap (\uparrow \text{UDF})_\sigma)$

(19) *go*, C ...
$\neg(\uparrow \text{UDF})$

4.3 Swedish

(20) $+\textsc{comp}: \quad C^0 \quad \left(\begin{array}{l} \%RP = (\uparrow \textsc{subj}) \\ (\uparrow \textsc{udf})_\sigma = (\%RP_\sigma \ \textsc{antecedent}) \\ @MR(\%RP) \end{array}\right)$

(21) $@MR(f) = \lambda P \lambda y.y : [(\uparrow \textsc{udf})_\sigma \multimap ((\uparrow \textsc{udf})_\sigma \otimes f_\sigma)] \multimap ((\uparrow \textsc{udf})_\sigma \multimap (\uparrow \textsc{udf})_\sigma)$

(22) $\emptyset{+}\textsc{comp}: \quad C^0 \quad (\uparrow \textsc{udf})_\sigma =_c ((\uparrow \textsc{subj})_\sigma \ \textsc{antecedent})$

(23) $(\uparrow \textsc{udf})\backslash\textsc{pred} =$
$(\uparrow \ \textsc{gf}^* \ \underset{((\rightarrow \textsc{pred}) = (\uparrow \textsc{udf pred}))}{\textsc{gf}} \ )\backslash\textsc{pred}$

(24) *han*: D^0
$(\uparrow \textsc{pred}) = \text{'pro'}$
$(\uparrow \textsc{person}) = 3$
$(\uparrow \textsc{number}) = \textsc{sg}$
$(\uparrow \textsc{gender}) = \textsc{masc}$
$(\uparrow \textsc{case}) = \textsc{nom}$
$(\uparrow_\sigma \textsc{antecedent}) \multimap ((\uparrow_\sigma \textsc{antecedent}) \otimes \uparrow_\sigma)$

(25) a. Vem$_i$ trodde Maria $\_\_{}_i$ skulle fuska?
who thought Maria __ would cheat
'Who did Maria think would cheat?'

b. $\begin{bmatrix} \textsc{pred} & \text{'think'} \\ \textsc{udf} & \begin{bmatrix} \textsc{pred} & \text{'pro'} \\ \textsc{pers} & 3 \\ \textsc{num} & \textsc{sg} \\ \textsc{wh} & + \end{bmatrix} \\ \textsc{subj} & [\text{"Maria"}] \\ \textsc{comp} & \begin{bmatrix} \textsc{pred} & \text{'cheat'} \\ \textsc{subj} & \underline{\quad} \end{bmatrix} \end{bmatrix}$ (COMP SUBJ linked to UDF)

(26) a. Vem$_i$ trodde Maria att han$_i$ skulle fuska?
who thought Maria that he would cheat
'Who did Maria think that (he) would cheat?'

b. $\begin{bmatrix} \textsc{pred} & \text{'think'} \\ \textsc{udf} & \begin{bmatrix} \textsc{pred} & \text{'pro'} \\ \textsc{pers} & 3 \\ \textsc{num} & \textsc{sg} \\ \textsc{gend} & \textsc{masc} \\ \textsc{case} & \textsc{nom} \\ \textsc{wh} & + \end{bmatrix} \\ \textsc{subj} & [\text{"Maria"}] \\ \textsc{comp} & \begin{bmatrix} \textsc{pred} & \text{'cheat'} \\ \textsc{subj} & \underline{\quad} \end{bmatrix} \end{bmatrix}$ (COMP SUBJ linked to UDF)

4.4 Restriction

- F-structures are sets of attribute-value pairs (attribute-value matrices).
- The restriction of some f-structure f by an attribute a, designated $f\backslash a$, is the f-structure that results from deleting the attribute a and its value v from f-structure f (Kaplan and Wedekind 1993: 198): the pair $\langle a, v\rangle$ is removed from the set of pairs that constitutes the f-structure in question.

(27) **Restriction** (Kaplan and Wedekind 1993: 198)
If f is an f-structure and a is an attribute:
$f\backslash a = f|_{\text{Dom}(f)\text{-}\{a\}} = \{ \langle s, v\rangle \in f \mid s \neq a \}$

- The restriction of an f-structure is itself an f-structure, so the operation can be iterated, but the outcome is not order-sensitive; restriction is associative and commutative in its attribute argument: $[f\backslash a]\backslash b = [f\backslash b]\backslash a = f\backslash\{a \ b\}$ (Kaplan and Wedekind 1993: 198).
- Restriction is defined in terms of set complementation: restriction of an f-structure by an attribute that the f-structure does not contain vacuously succeeds.

(28) a. $f = \begin{bmatrix} \textsc{pred} & \text{'pro'} \\ \textsc{case} & \textsc{nom} \end{bmatrix}$

b. $f\backslash\textsc{pred} = \begin{bmatrix} \textsc{case} & \textsc{nom} \end{bmatrix}$

- $f\backslash a$ subsumes f ($f\backslash a \sqsubseteq f$)
- As an operation on f-structures, restriction can be combined with usual function-application as follows (Kaplan and Wedekind 1993: 198):

(29) If f and g are f-structures, then $f\backslash a = g\backslash a$ is true if and only if f and g have all attributes and values in common other than a; they may or may not have values for a and those values may or may not be identical.

5 Where should we go?

- Elimination of traces
- Elimination of economy
- Elimination of discourse functions in syntax
- Islands
- Reconstruction/connectivity
- Locality & successive cyclicity
- Right dislocation

6 Conclusion

- LFG has developed a number of analyses of unbounded dependency phenomena.
- This has also involved interesting applications of LFG's well-defined formal tools.
- However, it is time to take stock of the various developments and draw them together in high-profile (in terms of venue), big-picture works that focus specifically on unbounded dependencies.

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