The Development of Linking Theory in LFG

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1 The Early Days of Predicate-Argument Structure

- Chomsky's (1970) *Remarks on Nominalization*:

  1. Verbs and the nominals derived from them share lexical entries which are neutral with respect to syntactic category.
  2. This shared information is expressed in terms of *argument structure*
  3. Argument structure is structurally represented in terms of deep structure.

(1) a. John presented the medal to Mary.
    b. John's presentation of the medal to Mary.

- Rappaport (1983) was instrumental in showing that one had to go even further and not encode argument structure structurally: **deep structure $\neq$ argument structure**.
- This work was supported by a flurry of papers on nominalization, adjective formation, passivization, resultatives, polyadicity and unaccusative verbs, Bresnan (1982a,b), Baker (1983), Simpson (1983), Zaenen and Maling (1983), which argued that argument structure could not be encoded structurally (at deep structure).
- Instead, predicate-argument structures were encoded in the lexical entries and related thematic roles with grammatical functions.

From Bresnan (1982a:9)

(2) *Effects of Passivization on a Lexical Form*

a.	L((SUBJ),	(OBJ)) $\longrightarrow$	
	agent	theme	
b.	L((OBL/ϕ),	(SUBJ))	
	agent	theme	

From Rappaport (1983:121,124)

(3)

sell:	(agent	theme	goal)
	SUBJ	OBJ	OBL_{GOAL}
eat:	(eater,	eaten)	
	SUBJ	OBJ	

1.1 The Model of Architecture

Based on Baker 1983:

(4)

Semantic Representation				Prediate-Argument Structure				Lexical Entry		
sink(	x	y)	$\longleftrightarrow$	sink(		)	$\longrightarrow$	sink<	(SUBJ)	(OBJ) >
	sinker	sunk			AGENT	THEME			AGENT	THEME

From Bresnan 1996 — argument structure as an interface between the semantics and syntax of predicators.

(5) lexical semantics
$\downarrow$
a-structure
$\downarrow$
syntactic structure

2 Standard Mapping Theory Today

The following discussion is based on Bresnan and Zaenen (1990), Alsina and Mchombo (1993), Bresnan and Kanerva (1989) and Bresnan and Moshi (1990).

Further reading and discussion can be found in Bresnan (1990, 1994, 1996).

- Grammatical functions that are subcategorized for: SUBJ, OBJ, OBJ_θ, OBL_θ.
- The clausal functions COMP and XCOMP are linked to propositions (early linking theory) or events (Butt 1995).
- The linking of COMP and XCOMP seems to function much along the lines of themes to OBJ, but see Berman (1996) for a discussion on the status of COMP.
- Grammatical functions are grouped into classes by means of just two features: [$\pm$ r(estricted)], [$\pm$ o(bjective)].
- Thematic Roles are differentiated by the same features.
- The features thus mediate in which thematic roles and grammatical functions are mapped on to one another.

2.1 Grammatical Functions Classified by Features

(6)

Grammatical Functions	**Features**
SUBJ	[−r, −o]
OBJ	[−r, +o]
OBJ_θ	[+r, +o]
OBL_θ	[+r, −o]

(7)

Features	**Grammatical Functions**
[−o]	SUBJ, OBL
[+o]	OBJ, OBJ_θ
[−r]	SUBJ, OBJ
[+r]	OBJ_θ, OBL_θ

2.2 Thematic Roles Classified by Features

(8) **Thematic Hierarchy:**
agent < *beneficiary* < *experiencer/goal/recipient* < *instrument* < *patient/theme* < *locative*

- General Formulation (Bresnan and Zaenen 1990):

  Patientlike roles: [−r]

  Secondary patientlike roles: [+o]

  All others: [−o]

- Examples in terms of specific assignments (Bresnan and Kanerva 1989, Bresnan and Moshi 1990):

$$\begin{array}{cccl} \text{ag} & \text{th/pt} & \text{loc} & \\ [-\text{o}] & [-\text{r}] & [-\text{o}] & \\ | & | & | & \\ \text{SUBJ/OBL} & \text{SUBJ/OBJ} & \text{SUBJ/OBL} & \text{Possible Linkings} \end{array}$$

2.3 Mapping Principles

Bresnan and Zaenen (1990)

a. Subject roles:

(i) $\begin{array}{c}\hat{\theta}\\ [-\text{o}]\end{array}$ is mapped onto SUBJ; otherwise:

(ii) $\begin{array}{c}\theta\\ [-\text{r}]\end{array}$ is mapped onto SUBJ

b. Other roles are mapped onto the lowest compatible function on the markedness hierarchy in (9), where the subject is the least marked.

(9) SUBJ < OBJ, OBL_θ < OBJ_θ

2.4 Further Wellformedness Conditions

(10) *Subject Condition:* Every (verbal) lexical form just have a subject.

(11) *Function-argument biuniqueness:* Each a-structure role must be associated with a unique function, and conversely.

(12) **Asymmetric Object Parameter (AOP)**:

$$* \begin{array}{ccc} \theta & \ldots & \theta \\ | & & | \\ [-\text{r}] & & [-\text{r}] \end{array}$$

This paramenter applies to asymmetric object languages like Chicheŵa but is not in effect for languages with allow double objects, such as Kichaga.

2.5 Operations on Argument Structure

(13) **Passive** $\begin{array}{c}\hat{\theta}\\ |\\ \emptyset\end{array}$

(14) **Theme Suppression** $\begin{array}{c}\text{th}\\ [-\text{r}]\\ |\\ \emptyset\end{array}$

(15) **Applicative** $\begin{array}{c}\emptyset\\ |\\ <\theta \ldots \theta_{appl} \ldots >\end{array}$

(16) **Reciprocalization** $\begin{array}{ccccccc} < & \theta_i & \ldots & \theta_i & \ldots & > \\ & & & | & & \\ & & & \emptyset & & \end{array}$

3 The Development of the Linking Idea

- Ostler (1979) is generally credited with first coming up with the idea of linking.
- Ostler in turn credits Carter (1977) with first using the term.
- The early LFG papers as in Bresnan (1982a,b) assumed that grammatical functions were associated with thematic roles via lexical assignment.

  From Bresnan (1982a):

(17)

$$\begin{array}{llll} & (\text{SUBJ}) & (\text{OBJ}) & \\ & \mid & \mid & \\ \text{‘LOVE}(& \text{arg } 1, & \text{arg } 2 \quad) & \Leftarrow \text{lexical assignment of grammatical functions} \\ & (\text{agent}) & (\text{theme}) & \Leftarrow \text{predicate argument structure} \end{array}$$

- But — there was no clear specification as to how this assignment of grammatical functions worked.

3.1 The Formulation of Association Principles

- The current Mapping Theory grew out of loosely formulated Association Principles.
- Some clear examples come from Zaenen and Maling (1983) on Icelandic and German

Zaenen and Maling (1983:176,182), Zaenen, Maling and Thráinsson (1985:467,479)

- **Icelandic Association Principles**

  1. AGENTS are linked to SUBJ (Universal)
  2. Casemarked THEMES are assigned to the lowest available GF. (Language Specific)
  3. If there is only one thematic role, it is assigned to SUBJ; if there are two, they are assigned to SUBJ and OBJ; if there are three, they are assigned to SUBJ, OBJ, 2OBJ. This principle applies after principle 2 and after the assignment of restricted GFs. (Universal)
  4. Default Case-Marking: the highest available GF is assigned NOM case, the next highest ACC. (Universal)

- **German Association Principles**

  1. AGENTS are linked to SUBJ (Universal)
  2. Casemarked THEMATIC ROLES are assigned to OBJ2. (Language Specific)
  3. If there is only one thematic role, it is assigned to SUBJ; if there are two, they are assigned to SUBJ and OBJ; if there are three, they are assigned to SUBJ, OBJ, 2OBJ. This principle applies after principle 2 and after the assignment of restricted GFs. (Universal)
  4. Default Case-Marking: the highest available GF is assigned NOM case, the next highest ACC. (Universal)

3.2 The Introduction of Explicit Features

- Grammatical functions were classified as either *semantically restricted* or *semantically unrestricted* on the basis of data from control and complementation (Bresnan 1982c).

(18) **Semantically Unrestricted:** SUBJ, OBJ, OBJ2
Semantically Restricted: OBL_θ

- Levin (1987, 1988) uses this classification as a feature in the formulation of linking rules.

“Linking rules produce grammatical relations by assigning grammatical functions to thematic roles” (Levin 1987:11)

- **The Agent Rule:** Assign SUBJ to agent.
- **The Goal Rule:** Assign OBL-goal to goal.
- **The Passive Agent Rule:** Assign OBL-ag or $\emptyset$ to agent.
- **The Theme Rule:** Assign +unrestricted to theme.

  Domain: All verbs.

(19) a. $(\uparrow\text{PRED}) = \text{‘break} < \begin{array}{c}\text{theme}\\ +\text{unr.}\end{array} >\text{’}$

b. $(\uparrow\text{PRED}) = \text{‘break} < \begin{array}{cc}\text{agent} & \text{theme}\\ \text{SUBJ} & +\text{unr.}\end{array} >\text{’}$

By wellformedness principles such as the subject condition, the theme in (19a) must be mapped to SUBJ and the theme in (19b) to an OBJ.

3.3 A Few Sample Applications of the Theory

- Laczko (1990) applies the theory for a treatment of derived nominals in Hungarian.
- Markantonatou (1995) applies LMT (Lexical Mapping Theory) to an analysis of Greek nominalization and also refutes some of Grimshaw's (1990) claims on the argument structure of nominalizations in the process.
- Lødrup (1996) analyzes Norwegian existentials and resultatives in terms of LMT.

4 Subsequent Alternative Formulations

- The above sections charted the course from relatively loose formulations of argument and grammatical function association to a well defined set of principles which are based on just two features: [±r,o].
- This section describes some alternative approaches that have grown out of the same tradition.

4.1 Zaenen 1993

- Zaenen addresses the general dissatisfaction with the use of thematic roles (what do they really mean?):

  1. Incorporation of Dowty's (1991) theory of proto-roles into her analysis of Dutch unaccusatives.
  2. Dispensing with the thematic role hierarchy in (8).

Association of Features with Participants (Zaenen 1993:150,152)

1. If a participant has more patient properties than agent properties, it is marked −r.
2. If a participant has more agent properties than patient properties it is marked −o.
3. Assumption: If a participant has an equal number of properties, it is marked −r.
4. Stipulation: If a participant has neither agent nor patient properties, it is marked −o.

5. **Typological Principle:** In languages in which SUBJ (and OBJ?) is encoded through case-marking and agreement (and not via word order) lexically case marked participants are always +r.

Association of Features with Grammatical Functions (Zaenen 1993:151)

(20) order the participants as follows according to their intrinsic markings:

$-\text{o} < -\text{r} < +\text{o} < +\text{r}$

order the GR [grammatical functions] as follows:

SUBJ < OBJ < OBJ_θ (< OBL)

Starting from the left, associate the leftmost participant with the leftmost GR it is compatible with.

4.2 Alsina 1996

- Alsina (1996:19) observes that many phenomena crosslinguistically single out the subject in opposition to the other grammatical functions.
- He therefore assumes two different features: [± subj(ect)] and [± obl(ique)].
- Note: This classification reverts to the original classification of Bresnan (1982) and Levin (1988) whereby [± oblique] is equivalent to [± unrestricted].
- Alsina also incorporates a notion of Proto-Roles.

Subject Sensitive Grouping of Grammatical Functions (Alsina 1996:19)

(21)

		[subj +]	←subject
direct→	[obl −]		
		[subj −]	←nonsubject
indirect→	[obl +]		

Only three types of Grammatical Functions

- OBJ and OBJ_θ are collapsed.
- The feature combination [subj +, obl +] is ruled out.

(22)

Grammatical Functions	Features
SUBJ	[subj +, obl −]
OBJ	[subj −, obl −]
OBL	[subj −, obl +]

The Incorporation of Proto-Roles (Alsina 1996:42)
• P-A = Proto-Agent, P-P = Proto-Patient

(23) *Direct argument:* [P-A] and [P-P]
Internal argument: [P-P]
External argument: 'X < [P-A] . . . >

Mapping Principles (Alsina 1996:44)

(24) a. *External Argument Mapping Principle:*
[PRED 'X<[P-A]$_1$ . . . >']$_2$ ⟶ [[subj +, obl −] [ ]$_1$]$_2$

b. *Internal Argument Mapping Principle:*
[PRED 'X< . . . [P-P]$_1$ . . . >']$_2$ ⟶ [[obl −] [ ]$_1$]$_2$

4.3 Ackerman 1990, 1992

- Based on Hungarian, Ackerman makes a distinction between Locative Inversion and Locative Alternation.
- Locative Alternation is sensitive to aspectual factors and is prompted by the use of preverbs.
- Dowty's Proto-Roles are used as a part of the Linking Theory.

(25) a. *rak* 'load'

<	ag,	th,	loc	>
	[−o]	[−r]	[−o]	
	SUBJ	OBJ	OBL	

b. *tele=rak* 'full-load'

<	ag,	th,	loc	>
	[−o]	[−o]	[−r]	
	SUBJ	OBL$_\theta$	OBJ	
	TELIC = +			

- In order to be able to engineer this "replacement" of intrinsic [±r,o] features, Ackerman proposes a distinction between *Morphosyntactic* and *Morpholexical* operations.
- **Morphosyntactic**: This type is part of the standard Mapping Theory and takes care of passivization, applicatives, theme suppression, etc. It assigns features supplemental to the intrinsic classification of roles.

- **Morpholexical:** This is defined as a function which takes a verbal form and the associated information and outputs another verbal form and associated information as a value.
- In a further development, Ackerman and Moore (1999) refine the interaction of aspect with linking by using the notion of a Telic Object.

4.4 Butt 1998

- Butt also proposes to incorporate aspectual affectedness into linking.
- This allows an analysis of a causative alternation that is tied to case marking and the semantic notion of affectedness.
- A distinction between aspectually inert objects (due to Ramchand 1997) and objects that aspectually active objects is adopted:
  - aspectually inert = semantic unrestrictedness = OBJ
  - aspectually active = semantically restricted = OBJ$_\theta$

(26) **Revised Intrinsic Classifications**
Themes: [−r] (aspectually inert) or [+r]
Secondary patientlike roles: [+o]
All others: [−o]

The Causative Alternation

(27) a. anjum=ne **saddaf=ko** masaalaa cak^h-**va**-yaa
Anjum.F=Erg Saddaf.F=Acc spice.M.Nom taste-Caus-Perf.M.Sg
'Anjum had Saddaf taste the seasoning.' (Object Causee)

b. anjum=ne **saddaf=se** masaalaa(=ko) cak^h-**va**-yaa
Anjum.F=Erg Saddaf.F=Inst spice.M.Nom/(Acc) taste-Caus-Perf.M.Sg
'Anjum had the seasoning tasted by Saddaf.' (Oblique Causee)

Object Causee

(28) a-structure	CAUSE <	ag	th	TASTE <	ag	th	>>
		[−o]	[+r]/[−r]			[−r]/[+r]	
Default		[−r]	[+o]			[+o]	
GF		SUBJ	OBJ_θ/*OBJ			OBJ/*OBJ_θ	
Case			Acc/*Nom			Nom/*Acc	

Oblique Causee

(29) a-structure	CAUSE <	ag	th	TASTE <	ag	th	>>
		[−o]	[−o]			[−r]/[+r]	
Default		[−r]				[+o]	
GF		SUBJ	OBL			OBJ/OBJ_θ	
Case			Inst			Nom/Acc	

4.5 Markantonatou and Sadler 1995

- Locative Alternations (*spray/load* verbs) are analyzed in terms of a contribution from both prepositions and the verbs.
- The use of lexical rules for argument alternations is rejected.
- Instead, inheritance hierarchies are used to achieve the desired linking effects (in the general style of Wechsler 1995, Davis and Koenig 1995).

5 The Role of Case Marking

- Case marking in Butt's (1998) approach
  - Contributes to clausal semantics.
  - Constrains the linking possibilities.
- This idea is not new.

5.1 Inherent/Quirky Case — Constrains Linking

Levin and Simpson (1981) — Icelandic

- *Structural Case*: is assigned productively to c-structure trees and is associated with SUBJ, OBJ, OBJ2.
- *Quirky Case*: Displacement of structural case by non-nominative marking on subjects and non-accusative marking on objects.

Zaenen, Mailing and Thráinsson (1985) — Icelandic

- *Quirky Case*: an idiosyncratic property of a lexical item, assigned by a verb, preposition or adjective.
- Quirky Case is associated with a particular thematic role.
- Case marking is assigned before thematic roles are associated with grammatical functions.

An Example — Zaenen, Mailing and Thráinsson (1985:470–471)

(30) Þú hefur óskað (henni) þess
you have wished her(D) this(G)
'You have wished this on/for her.'

(31) **óska**:	V<	*agent*	*theme*	(*goal*) >
			[+gen]	[+dat]
a.		SUBJ	2OBJ	OBJ
b.		SUBJ	OBJ	

- The verb óska 'to wish' may be transitive or ditransitive.
- If the theme were not marked idiosyncratically, it would be an OBJ in both cases.
- However, the idiosyncratic case marking determines the non-default association of theme with 2OBJ, as per principle 2 below.
- This fits the facts as only the *þess* 'this' in the transitive version passivizes (when it is linked to OBJ).

- **Icelandic Association Principles** (Repeated)

  1. AGENTS are linked to SUBJ (Universal)
  2. Casemarked THEMES are assigned to the lowest available GF. (Language Specific)
  3. If there is only one thematic role, it is assigned to SUBJ; if there are two, they are assigned to SUBJ and OBJ; if there are three, they are assigned to SUBJ, OBJ, 2OBJ. This principle applies after principle 2 and after the assignment of restricted GFs. (Universal)
  4. Default Case-Marking: the highest available GF is assigned NOM case, the next highest ACC. (Universal)

5.2 K.P. Mohanan 1982

- The case features are contributed by the morphological case markers themselves.
- Grammatical functions are determined through the association with case.

K.P. Mohanan (1982:542)

(32) *Principles of Case Interpretation*
   a. Interpret accusative case as the direct object (OBJ)
   b. Interpret dative 2 case as the indirect object (OBJ2)
   c. Interpret datvie 1 case as either the indirect object (OBJ2)
   or the subject (SUBJ).
   d. Interpret nominative case as either the subject (SUBJ)
   or the direct object (OBJ) if the NP is [−animate];
   otherwise, interpret nominative case as the subject (SUBJ).

5.3 Nordlinger 1998

- Nordlinger proposes that case markers themselves "construct" the grammatical functions in a clause.
- This is in order to account for discontinuous constituents as in (33) and case stacking as in (34) in Australian languages.

Discontinuous Constituents — Warlpiri

(33)

Kurdu-jarra-rlu	ka-pala	maliki	wajili-pi-nyi	wita-jarra-rlu.
child-DU-ERG	PRES-3.DU.SUBJ	dog(ABS)	chase-NPST	small-DU-ERG

'The two small children are chasing the dog.'
Nordlinger (1998:115) from Austin and Bresnan (1996:225)

Case Stacking — Kayardild

(34)

Ngada	mungurru,	[maku-ntha	yalawu-jarra-ntha	yakuri-naa-ntha
I	know	[woman-C.OBL	catch-PST-C.OBL	fish-M.ABL-C.OBL

thabuju-karra-nguni-naa-ntha
brother-GEN-INST-M.ABL-C.OBL
mijil-nguni-naa-nth].
net-INST-M.ABL-C.OBL]
'I know that the woman caught the fish with brother's net.'
Nordlinger (1998a:134) from Evans (1995b:406)

(35) **Lexical Entry for an Ergative:** *rlu*
-ERG
$(\uparrow \text{CASE}) = \text{ERG}$
$(\text{SUBJ} \uparrow)$

The principle of Morphological Composition allows for case stacking while still passing on the information contributed by the case markers.

(36) **Principle of Morphological Composition:**
Where x is a string of attributes:

$$\underset{(\text{GF}^n \uparrow)}{\text{Stem}} \quad \underset{((\text{GF}^m \ \uparrow) \quad x)}{\text{Aff}} \quad \Longrightarrow \quad \underset{(\text{GF}^n \uparrow)}{\text{Stem}} \quad \underset{((\text{GF}^m \ (\text{GF}^n \uparrow))x)}{\text{Aff}}$$

5.4 Summary

- In Nordlinger 1998 as in K.P. Mohanan 1982, case morphology and grammatical relations are put in a direct correspondence with one another without the mediation of argument structure.
- In Butt's 1998 approach to Urdu causatives, in contrast, case marking interacted with linking principles, but did not wholly determine them.
- For other applications within the latter approach, also see Butt and King (1991) and T. Mohanan (1994).

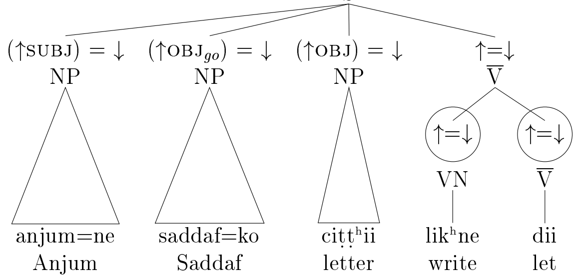
6 From the Lexicon to the Syntax

- Mapping Theory as originally formulated up until Bresnan and Zaenen 1990 was assumed to apply with the Lexicon.
- Alsina 1996 and Butt 1995 show that Mapping Theory needs to be extended to instances of *complex predicates* in which two syntactically independent heads contribute to the predication.
- Some well known examples from Romance are
  - restructuring verbs: *volere andare* 'want to go'
  - causatives: *fare riparare* 'have repaired'
- The Urdu permissive shows the clearest evidence for complex predication by separate syntactic constituents (Butt 1995).

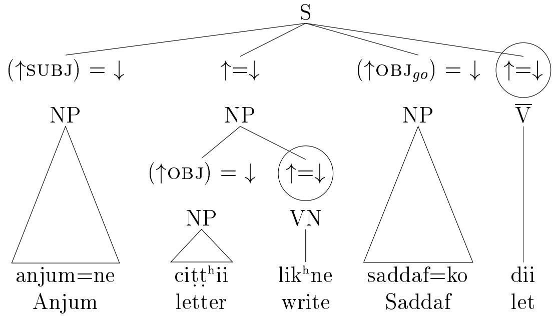
The Urdu Permissive

- The predicational heads can be non-adjacent, as in (37b).

(37) a.



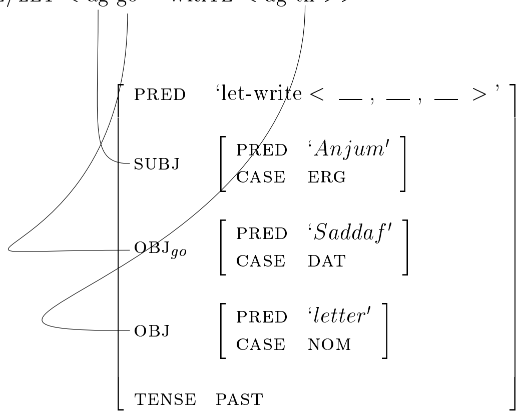
b.



- A complex argument structure links to a combined (flat) f-structure.

(38) GIVE/LET < ag go WRITE < ag th >>

(39)



- Butt 1995 mainly assumes the "standard" linking principles of section 2.
- However, as argument structure must be combined "outside" of the lexicon in the c-structure, a revision of the architectural model is called for.
- Further work on complex predicates which addresses architectural and linking issues (among others) is represented by Manning and Andrews (1999), Wilson (1999). This is not discussed here.

7 Towards Optimal Linking

The developments over the last few years within linking theory in conjunction with the advent of Optimality Theory has prompted a fresh look at some of the basic assumptions and mechanisms.

7.1 Butt, Dalrymple, and Frank 1997

- Assume a model of architecture in which semantics is not directly linked to predicate-argument structure anymore.
- Argument structure is projected directly from c-structure in order to be able to account for the complex predicate facts.

Notational Conventions

(40)

Current node:	$*$
Mother node :	$\hat{*}$
Argument structure of mother node:	$\hat{*}_{\alpha}$
F-structure of mother node:	$\hat{*}_{\alpha\lambda}$
Semantic structure of mother node:	$\hat{*}_{\alpha\lambda\sigma}$

A Sample Lexical Entry

- Compact Form

(41) *cut*:

$$\forall X, Y.(\hat{*}_{\alpha}\ \textsc{agent})_{\lambda\sigma} \rightsquigarrow X \otimes (\hat{*}_{\alpha}\ \textsc{theme})_{\lambda\sigma} \rightsquigarrow Y \multimap \hat{*}_{\alpha\lambda\sigma} \rightsquigarrow cut(X, Y)$$

- Paraphrase

If my AGENT's f-structure's semantic projection means X
and my THEME's f-structure's semantic projection means Y,
then my f-structure's semantic projection means $cut(X, Y)$.

- This information gives rise to the underspecified structure and instantiated formula in (42).

(42) *cut*:

$$\begin{array}{c} \mathrm{V} \\ | \\ \mathrm{cut} \end{array} \overset{\alpha}{\text{———}} \begin{bmatrix} \textsc{rel} & \textsc{cut} \\ \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \overset{\lambda}{\frown} \begin{array}{l} [\textsc{pred}\ \ \text{`}\textsc{cut}\text{'}] \\ [\ ] \\ [\ ] \end{array} \overset{\sigma}{\smile} \begin{array}{l} s:[\ ] \\ s1:[\ ] \\ s2:[\ ] \end{array}$$

$$\forall X, Y.s1 \rightsquigarrow X \otimes s2 \rightsquigarrow Y \multimap s \rightsquigarrow cut(X, Y)$$

- Thematic Role Classifications are explicitly treated as a disjunctive space of possibilities.

(43) a. AGENT links to $[-\text{o}]$:
$(\hat{*}_{\alpha}\ \text{AGENT})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\hat{*}_{\alpha}\ \text{AGENT})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{OBL}_{agent})$

b. THEME links to $[-\text{r}] \vee [+\text{o}]$:
$(\hat{*}_{\alpha}\ \text{THEME})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\hat{*}_{\alpha}\ \text{THEME})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{OBJ}) \vee$
$(\hat{*}_{\alpha}\ \text{THEME})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{OBJ}_{theme})$

- For a verb like *cut* this then gives us the following space of possible linkings:

(44)

a. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{subj} & [\ ] \\ \textsc{obj} & [\ ] \end{bmatrix}$ d. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{obl}_{agent} & [\ ] \\ \textsc{obj} & [\ ] \end{bmatrix}$

b. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{subj} & [\ ] \\ \textsc{subj} & [\ ] \end{bmatrix}$ e. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{subj} & [\ ] \\ \textsc{obj}_{theme} & [\ ] \end{bmatrix}$

c. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{obl}_{agent} & [\ ] \\ \textsc{subj} & [\ ] \end{bmatrix}$ f. $\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix} \lambda \begin{bmatrix} \textsc{obl}_{agent} & [\ ] \\ \textsc{obj}_{theme} & [\ ] \end{bmatrix}$

- A set of preferences is stated over this disjunctive space of possibilities (the definition of these preferences essentially builds on the old insights in the linking literature).
  - Subjects are preferably linked before objects.
  - Objects are preferably linked before obliques and secondary objects.

(45)

$$\textsc{subj} > \textsc{obj} > \begin{array}{c} \textsc{obj}_{\Theta} \\ \textsc{obl}_{\Theta} \end{array}$$

- The preferences can also be restated as
  - unrestricted thematic roles are preferably linked before restricted ones
  - non-objective ones are preferably linked before objective ones.

(46) a. $[-\text{r}] > [+\text{r}]$
b. $[-\text{o}] > [+\text{o}]$

- Butt, Dalrymple and Frank compute the optimal linking candidate by
  - assigning weights to these preferences
  - taking the wellformedness conditions such as the Subject Condition and Function-argument Biuniqueness into account.
  - For the verb *cut* this then yields (47) as the optimal candidate.

(47) $$\begin{bmatrix} \textsc{agent} & [\ ] \\ \textsc{theme} & [\ ] \end{bmatrix}_{\lambda} \begin{bmatrix} \textsc{subj} & [\ ] \\ \textsc{obj} & [\ ] \end{bmatrix}$$

7.2 Newer Developments within Optimality Theory (OT)

7.2.1 Some General Ideas

- Sells (1999)
  - Integrates a notion of Prominence with LMT linking preferences in an OT approach to Grammatical Voice systems (with focus on Cebuano).
  - The intrinsic classifications of thematic roles are restated as constraints (which differ in their ranking across languages):

    (48) a. agent is not object: *a=OBL
    b. patient is not object: *p=OBJ
    c. agent is not oblique: *a=OBL
    d. patient is not oblique: *p=OBL

- Lødrup (1999)
  - Argues that agent objects do occur (contrary to the predictions of LMT), but are typologically marked (Joan Bresnan, pc, July 1999).
  - This can be captured in terms of a violable constraint:

    (49) $$\begin{array}{c} ^{*}\text{ag} \\ | \\ [-\text{o}] \end{array}$$

7.2.2 Further Work

- Asudeh (1999) integrates the notion of Optionality within OT to account for optional linking in some Marathi verb classes (based on an LMT account by Joshi (1993)) and also makes use of Dowty's notion of Proto-Roles.
- Morimoto (1999) formulates an OT-account in which information packaging interacts with English locative inversion.

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