# An architecture for linking theory in LFG

Miriam Butt, Mary Dalrymple, and Anette Frank

Universität Konstanz/Xerox PARC/Xerox Research Centre Europe

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## 1 Introduction

With the introduction of *Lexical Mapping Theory* (LMT) (cf. Levin 1986, Bresnan and Zaenen 1990), the complex relationship between lexical predicate-argument structures and grammatical functions moved into the center stage of active investigation within work on Lexical-Functional Grammar. While this theory has been extremely successful in providing analyses for a wide variety of phenomena, such as locative inversion, causatives, and double-object constructions, the status of argument structure and its place within the architecture of grammar posited by LFG remains to be resolved.

We present a new view of the architecture of grammatical theory which makes concrete the form and function of argument structure. The argument structure provides *underspecified* information that is compatible with a range of possible relations between roles in the argument structure and grammatical functions in the functional structure. These possible relations are ranked by a set of preference constraints, taking into account both a ranking of grammatical functions and a ranking of possible relations between argument structure and f-structure. This ranked set of linking possibilities is then further constrained by semantic, morphological or syntactic information to arrive at the most optimal linking possibility for the argument structure array. The most preferred linking is the one that is chosen. In fact, there may be more than one most preferred linking, and in these cases we predict either that more than one form can be chosen freely or that other nonsyntactic factors may come into play in determining the choice of linking.

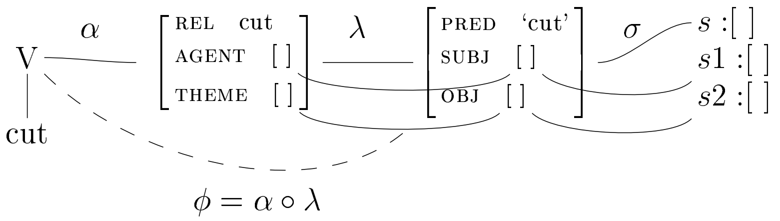
## 2 Argument structure and the projection architecture of LFG

### 2.1 The Big Picture

In its earliest formulations (Kaplan and Bresnan 1982), LFG assumed the existence of two parallel but separate levels of grammatical representation, the c-structure and the f-structure. In later work, Kaplan (1987) proposed that other levels of linguistic representation called *projections* can be related to the c-structure, the f-structure, or each other by functional correspondences similar to the relation between c-structure and f-structure.

We propose that argument structure is an additional level of representation, related directly to the c-structure and the f-structure and indirectly to other levels. We assume the overall grammatical architecture depicted in (1):

(1)




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

This architecture differs from usual assumptions in that argument structure is projected directly from c-structure — that is, the $\alpha$ projection function maps nodes of the c-structure tree to pieces of the argument structure. Argument structures are mapped to f-structures by the linking function $\lambda$, which, in a sense, represents the integration of linking theory into the projection architecture. Thus, the familiar $\phi$ projection relating the c-structure to the f-structure can be seen as a composition of the $\alpha$ and $\lambda$ functions.

In (1) the a-structure contains the information that the English verb *cut* has two arguments, an AGENT and a THEME. The f-structure is related to the a-structure through the $\lambda$ projection, just as the AGENT and THEME arguments of *cut* are related to the SUBJ and OBJ, respectively. In the case of complex predicates, the a-structure is more complex with (multiple) embedded REL features, while the f-structure corresponding to such complex, embedded a-structures is monoclausal. Thus, the relationship between a-structure and c-structure is many-to-one, as has been the case in 'traditional' LFG for the relationship between c-structure and f-structure.

The $\sigma$ function maps f-structures to s(emantic)-structures; we assume the theory of the syntax-semantics interface presented in Dalrymple et al. (1993). In our example, the f-structure for the verb *cut* and its SUBJ and OBJ are related to the semantic projections $s$, $s1$, and $s2$ by the projection function $\sigma$. These semantic structures bear the $\rightsquigarrow$ ('means') relation to their meanings, represented as $X$, $Y$, and $cut(X, Y)$. The meaning for a sentence is then assembled via logical deduction from the meanings of its parts.

In the example above, the argument structure information has been projected from the c-structure leaf V dominating the verb *cut*. In this case, the information at a-structure comes from just one c-structure location. Butt (1993) and Alsina (1996) propose that in the case of complex predicates, a complex argument structure may be contributed by multiple pieces or nodes of the c-structure, and thus that linking must apply dynamically in the syntax rather than in the lexicon. In contrast, Frank (1996) proposes that these cases may also be handled lexically. The architecture we propose is compatible with either of these views.

### 2.2 Notational conventions

In the interests of maximal formal clarity, and following a suggestion by Ron Kaplan, we will make use of the following notational conventions:

(2) a. The current node of the phrase structure tree is represented by $*$, and its mother node is represented by $\widehat{*}$.

b. Grammatical structures reachable from c-structure nodes via a projection function, such as the argument structure and the f-structure, are represented by subscripted node names.

For example, the f-structure for the current node, the familiar $\downarrow$, is the $\phi$-projection of the current node, and thus can also be written as $*_{\phi}$. Similarly, the mother node's f-structure $\uparrow$ can be written as $\widehat{*}_{\phi}$. Since we have defined the $\phi$-projection function as the composition of the $\alpha$ and $\lambda$ projection functions, some other equivalences hold: $\downarrow$ can also be written as $*_{\alpha\lambda}$, and $\uparrow$ can also be written as $\widehat{*}_{\alpha\lambda}$. The following table explains the notation we will use:

(3)

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

### 2.3 A Lexical Entry

Assuming this new notational convention, we propose that the lexical entry for a verb like *cut* contains the information in (4):

(4) *cut*:

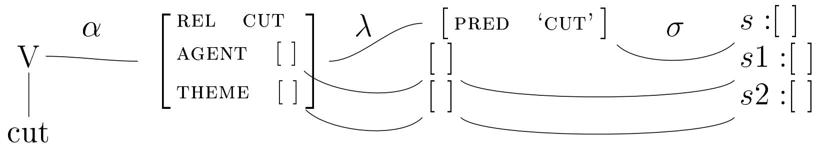
$$\forall X, Y.(\widehat{*}_\alpha\ \text{AGENT})_{\lambda\sigma} \rightsquigarrow X \otimes (\widehat{*}_\alpha\ \text{THEME})_{\lambda\sigma} \rightsquigarrow Y \multimap \widehat{*}_{\alpha\lambda\sigma} \rightsquigarrow cut(X, Y)$$

This formula can be paraphrased as:

> 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 following underspecified structure and instantiated formula:

(5) *cut*:




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

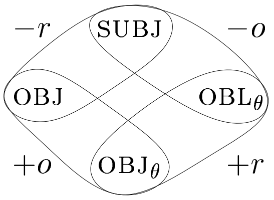
The role of linking theory is to augment this representation in order to fully specify the links between a-structure and f-structure, i.e., to supply further constraints to correlate a specific set of grammatical functions with the argument roles represented at a-structure.

## 3 Standard/classical assumptions about linking theory

Since the seminal work of Levin (1986), linking theory has been applied to various phenomena in a diverse set of languages. In its most common formulations (Zaenen et al. 1985, Bresnan and Kanerva 1989, Bresnan and Moshi 1990, Bresnan and Zaenen 1990, Alsina and Mchombo 1993), it assumes a hierarchy of thematic roles as shown in (6), and it relates the thematic roles in a given predicate-argument array to grammatical functions via the two features [±o] (objective) and [±r] (restricted), which classify the set of available grammatical functions as shown in (7).

(6) AGENT > BEN > EXP/GOAL > INST > PATIENT/THEME > LOCATIVE

(7)




Thematic roles are intrinsically associated with the [±r,o] features by means of a set of specifications which take into account both the type of the thematic role and its relative position in the hierarchy. Bresnan and Zaenen (1990) present the following assumptions about the intrinsic linking properties of specific roles:

(8) patientlike roles: [−r]
secondary patientlike roles: [+o]
other roles: [−o]

The assignment of [−o] to the nonpatientlike role AGENT, for example, both prevents an AGENT role from being linked to an objective function OBJ or $OBJ_\Theta$, and provides an *underspecified* representation of the grammatical function with which a given thematic role could be placed into correspondence: an AGENT must be linked either to a SUBJ or to an $OBL_\Theta$.

These intrinsic classifications are augmented by a set of *default mapping principles* which induce full specification of the grammatical function of the thematic role. That is, the default principles are taken to resolve the disjunctive possibilities specified by the intrinsic features. The default principles proposed by Bresnan and Zaenen (1990) are shown in (9), and can be read as: 'if available, the 'external' argument . . . has to be mapped onto the subject; if there is no external argument, an internal argument is mapped onto the subject. All other roles are mapped onto the lowest compatible function on the markedness hierarchy . . . '.

(9)
- $\underset{[-o]}{\hat{\Theta}}$ is mapped onto SUBJ; otherwise,
- $\underset{[-r]}{\Theta}$ is mapped onto SUBJ
- Other roles are mapped onto the lowest compatible function on the markedness hierarchy.

Thus the intrinsic classification of thematic roles taken together with the set of default mapping principles predict, for example, the linking of thematic roles to grammatical functions displayed in (10).

(10)

| | | | | | |
|---|---|---|---|---|---|
| a-structure: | *pound* < | AGENT | THEME | > | (Bresnan and Zaenen 1990) |
| | | [−o] | [−r] | | |
| | | \| | \| | | |
| f-structure: | | S | O | | |

Argument structures can also be manipulated by morphosyntactic processes such as the passive, the applicative, or nominalization. As shown in (11), the passive serves to suppress the highest role in the a-structure.

(11) Passive: $\hat{\Theta}$ – NULL

In the next sections we follow the principles of LMT in their overall spirit, while reformulating the precise statement of linking in terms of a theory of underspecification and preference rankings.

## 4 Another Take on Intrinsic Role Classification

Based on the accumulated evidence in the LMT literature from double object constructions, applicatives, locative inversion and causatives in Bantu, Romance and English, as well as a consideration of our own work on Urdu and French causatives and the treatment of Dative Shift we present here, we assume the following set of intrinsic role classifications for the thematic roles AGENT and THEME. We assume a language particular parameterization for the other roles, such as LOCATION, GOAL and INSTRUMENT, examples of which will be presented below.

(12) a. AGENT links to [−o]:

$(\widehat{*}_\alpha\ \text{AGENT})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\widehat{*}_\alpha\ \text{AGENT})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{OBL}_{agent})$

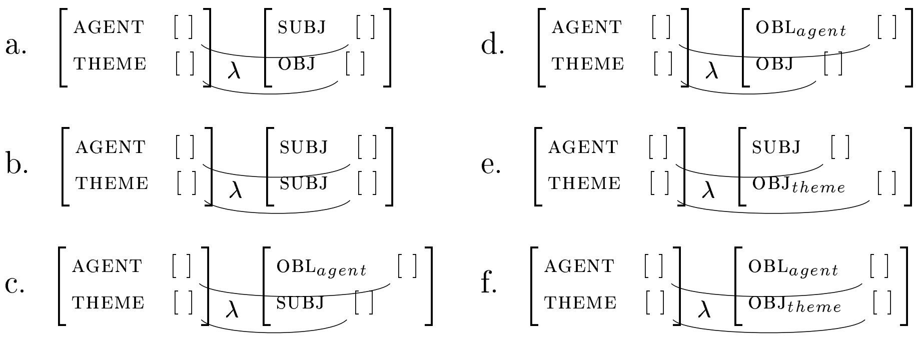
b. THEME links to [−r] ∨ [+o]:

$(\widehat{*}_\alpha\ \text{THEME})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\widehat{*}_\alpha\ \text{THEME})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{OBJ}) \vee$
$(\widehat{*}_\alpha\ \text{THEME})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{OBJ}_{theme})$

Note that the intrinsic linking possibilities for THEME are presented in terms of a disjunctive feature classification: either [−r] or [+o]. However, combining the linking possibilities for [−r] with those of [+o] gives us just one set of disjunctive linking possibilities, as is the case for the AGENT. This way of partitioning linking possibilities thus can be seen as conceptually simpler than the more direct statement in terms of the features, as has been the case in the previous LMT approaches.

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

(13)




We adopt a version of the Function-Argument Biuniqueness condition (Bresnan 1980) in that we require each argument structure filler of a nonsuppressed thematic role to be expressed by exactly one grammatical function, and vice versa.[1] This eliminates possibility (13b). We also assume the Subject Condition (Baker 1983, Bresnan and Kanerva 1989), according to which every lexical form must have a subject. In fact, as we shall see below, the Subject Condition actually falls out in our system from the principles of 'optimal linking', which replace the standard default classification principles.

## 4.1 Default classification – or 'Optimal Linking'

Our approach departs most radically from the LMT literature in that we do not assume that a-structure roles are deterministically and uniquely linked to grammatical functions via a set of default principles. Instead, we propose a set of preference constraints which impose an ordering on the available linking possibilities; the most preferred possibility or possibilities are chosen. It should be noted that although we will sometimes speak of our

[1] In some cases, there may be a single filler of more than one thematic role; for example, a single filler may fill both a CAUSEE role and an AGENT role in a causative construction. Alternatively, a role may be suppressed and become unavailable for linking through a variety of argument structure processes such as *Argument Fusion* in complex predicate formation (Butt To appear) or reflexivization (Alsina 1995).

approach as producing the 'optimal' solution, the approach we present here is not framed within Optimality Theory; we believe that a reformulation of our approach within Optimality Theory would be possible, though we have not attempted to do this.

The core of preference constraints is formed by two basic considerations. One is a preference ranking of the individual grammatical functions, as illustrated in (14). Subjects are most highly ranked in that they represent the function that is universally required in every clause (the Subject Condition). Next come objects, and then obliques and semantically restricted objects, on a par.

(14)

$$\text{SUBJ} > \text{OBJ} > \begin{array}{l} \text{OBJ}_\Theta \\ \text{OBL}_\Theta \end{array}$$

This preference ranking can be restated as in (15) and reflects the intuition that unrestricted functions ([−r]) are more preferred than restricted functions, and that within those unrestricted functions, it is the non-objective functions (that is, the subjects) which are more highly preferred:

(15) a. [−r] > [+r]
b. [−o] > [+o]

We also propose another kind of preference constraint, one that is sensitive to the relation between a-structure and f-structure: the SUBJ is preferentially linked to the highest non-suppressed argument. This constraint crucially relies on the notion of the thematic hierarchy and makes use of the relation of *outranking* given in (6).

Thus, we propose that the linking that will be chosen is the one that best satisfies the preference constraints on linking given above. In addition, as is shown below, language particular preference constraints can be added to these basic constraints in order to reflect the case-marking or syntactic properties peculiar to each individual language.[2]

### 4.2 A Simple Example

We will illustrate the system by looking at a simple English example, the transitive verb *cut*. In order to illustrate our system concretely and transparently, we have chosen to express the preference constraints formulated above in terms of explicit numeric weights. This provides a simple and basic way to check our results. Of course, other means of encoding a preference ranking could also have be chosen.

(16)

| | |
|---|---|
| SUBJ: | +3 |
| OBJ: | +2 |
| $\text{OBJ}_\Theta$: | +1 |
| $\text{OBL}_\Theta$: | +1 |
| SUBJ linked to thematically highest argument: | +1 |

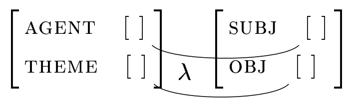
[2]One way of making this preference mechanism explicit is to introduce a further projection from the c-structure called $\omega$ to record 'preference marks' for the various linking possibilities. Comparison of the $\omega$-structures reveals which linking(s) are 'optimal', i.e. contain the highest number of these equally ranked preference constraints. The Xerox Linguistic Environment (XLE) developed at Xerox PARC provides for the inclusion of such a preference mechanism.

Adding up the weights associated with specific grammatical functions and the preference constraint for linking the subject to the highest unsuppressed thematic role then gives us the following ranked list of linking possibilities for the verb *cut*.

(17)

| *cut*: | AGENT | THEME | Subject preference | Total | Optimal |
|---|---|---|---|---|---|
| (a) | SUBJ (3) | SUBJ (3) | +1 | 7 | *out (F-A Biuniqueness) |
| (b) | SUBJ (3) | OBJ (2) | +1 | 6 | √ |
| (c) | SUBJ (3) | $\text{OBJ}_\Theta$ (1) | +1 | 5 | |
| (d) | $\text{OBL}_\Theta$ (1) | SUBJ (3) | | 4 | |
| (e) | $\text{OBL}_\Theta$ (1) | OBJ (2) | | 3 | |
| (f) | $\text{OBL}_\Theta$ (1) | $\text{OBJ}_\Theta$ (1) | | 2 | |

For a simple transitive verb like *cut*, then, an evaluation of the set of preference constraints yields the result that the linking possibility in (18) is the 'optimal' one within the set of well-formed linkings in (13).

(18)



The above set of possible linkings is actually not the full set: the AGENT may also be linked to the NULL grammatical function. These possibilities are ranked lower than the active linkings above. However, we assume that the passive construction introduces a requirement for the thematically highest argument to be linked to NULL.[3] In light of this requirement, the possible linkings in (13) are unavailable, leaving the set of linking possibilities in (19).

(19)

| *cut*: | AGENT | THEME | Subject preference | Total | Optimal |
|---|---|---|---|---|---|
| (a) | NULL (0) | SUBJ (3) | +1 | 4 | √ |
| (b) | NULL (0) | OBJ (2) | | 2 | |
| (c) | NULL (0) | $\text{OBJ}_\Theta$ (1) | | 1 | |

The most optimal one which satisfies the NULL requirement is exactly the expected one.

We are thus able to account for both the active and passive versions of a given predicate within our system, and in fact treat the passive as the more *marked* option which is only chosen in case it is required independently (as signaled by the presence of passive morphology). The full space of linking possibilities for a given argument array can thus be constrained through other requirements of the clause, allowing for a more flexible correlation between argument arrays and possible linkings to grammatical functions.

## 5 Linkings with Equal Rank

It is well known that some verb classes allow for alternations in the surface realization of arguments. Two famous examples involving such variable subcategorization are locative inversion and dative shift (for an extensive list of references see Levin 1993). Our theory

[3]The AGENT can still, of course, be expressed by an adjunct (*by*-phrase in English) to reflect its status as a presupposed event participant.

allows a fairly natural account of such phenomena by allowing for multiple 'optimal linkings', several linking possibilities that are equally highly ranked and are thus equivalently 'optimal' in terms of the relation between argument structure and f-structure. As the differing linkings can be associated with differing semantic (and pragmatic) interpretations, we propose that semantic or pragmatic information may serve to 'filter' the possible alternative linkings in very much the same manner as morphosyntactic information constrains various linking possibilities in the case of the passive. This view accords well with the general architecture of LFG, which posits independent, mutually constraining levels of representation.

### 5.1 Locative Inversion

As demonstrated by Bresnan and Kanerva (1989) and Bresnan (1994), locative inversion can be characterized as a phenomenon sensitive to unaccusativity at a-structure, that is, to the presence of a THEME which may surface alternately as a subject or object. In addition, the thematic role of LOCATION must be able to surface as a subject (intrinsic [−o]).

Given the underlying similarity between locative inversion in English and Chicheŵa (Bresnan 1994), we assume the same intrinsic classification for LOCATION for both languages:

(20) In English and Chicheŵa, LOC links to [−o]:
$(\hat{*}_{\alpha}\ \text{AGENT})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\hat{*}_{\alpha}\ \text{AGENT})_{\lambda} = (\hat{*}_{\alpha\lambda}\ \text{OBL}_{loc})$

With our set of preference constraints, this yields the ranking shown in table (21) for theme-location argument arrays.

(21)

| | THEME | LOC | Subject preference | Total | Optimal |
|---|---|---|---|---|---|
| (a) | SUBJ (3) | $\text{OBL}_{\Theta}$ (1) | +1 | 5 | √ |
| (b) | OBJ (2) | SUBJ (3) | | 5 | √ |
| (c) | $\text{OBJ}_{\Theta}$ (1) | SUBJ (3) | | 4 | |
| (d) | OBJ (2) | $\text{OBL}_{\Theta}$ (1) | | 3 | |
| (e) | $\text{OBJ}_{\Theta}$ (1) | $\text{OBL}_{\Theta}$ (1) | | 2 | |

Both the (a) and (b) options satisfy the preference constraints equally well, thus allowing for a surface alternation in arguments. The linking possibility that is actually realized in a given clause is determined on the basis of semantic/discourse information at another level of representation. In both English and Chicheŵa, for example, locative inversion is only compatible with a reading in which the inverted theme is in presentational focus (as an OBJ). In English the locative SUBJ is also topicalized, but not in Chicheŵa.

In both English and Chicheŵa, locative alternations can occur with passivized transitive verbs with unexpressed agents. For these cases our approach also makes the right predictions, as shown in the (excerpted) space of possible linkings in (22). In the active version only one possible linking is optimal, but in the passive the locative alternation is again possible.

(22)

| | AGENT | THEME | LOCATION | Subject preference | Total | Optimal |
|---|---|---|---|---|---|---|
| (a) | SUBJ (3) | OBJ (2) | $OBL_\Theta$ (1) | +1 | 7 | √ (active) |
| (b) | SUBJ (3) | $OBJ_\Theta$ (1) | $OBL_\Theta$ (1) | +1 | 6 | |
| (c) | $OBL_\Theta$ (1) | SUBJ (3) | $OBL_\Theta$ (1) | | 5 | |
| (d) | $OBL_\Theta$ 1 | $OBL_\Theta$ (1) | SUBJ (3) | | 5 | |
| (e) | NULL | SUBJ (3) | $OBL_\Theta$ (1) | +1 | 5 | √ (passive) |
| (f) | NULL | OBJ (2) | SUBJ (3) | | 5 | √ (passive) |
| (g) | NULL | $OBJ_\Theta$ (2) | $OBL_\Theta$ (1) | | 3 | |
| (h) | NULL | OBJ (2) | $OBL_\Theta$ (1) | | 3 | |
| | ... | | | | | |

## 5.2 Dative Shift

The English Dative Shift represents a fairly complex argument alternation, as not all of its properties are completely understood (i.e., the impossibility of Dative Shift with Latinate verbs, the animacy requirement on the goal), and it has received a variety of analyses in differing frameworks (cf. Larson 1988 for a structural approach, Sells 1985 for a concise summary of the 'traditional' LFG approach, and Levin 1993 for a summary of properties and list of references). In this section we do not do justice to all of its complexities, showing only that Dative Shift can also receive a natural treatment within our approach.

English is an asymmetric object language (Bresnan and Moshi 1990) which does not allow double-object constructions in which both objects are unrestricted ([−r]). Now consider the table of possible (ranked) linkings in (23) which result from the assumptions of intrinsic classifications for agent and theme given in (12) and for goals in English given in (23), together with our set of preference constraints.

(23) GOAL links to [−o] ∨ [−r] in English:
$(\widehat{*}_\alpha\ \text{GOAL})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{OBLgoal}) \vee$
$(\widehat{*}_\alpha\ \text{GOAL})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{SUBJ}) \vee$
$(\widehat{*}_\alpha\ \text{GOAL})_\lambda = (\widehat{*}_{\alpha\lambda}\ \text{OBJ})$

(24)

| | AGENT | GOAL | THEME | Subject preference | Total | Optimal |
|---|---|---|---|---|---|---|
| (a) | SUBJ (3) | $OBL_\Theta$ (1) | OBJ (2) | +1 | 7 | √ |
| (b) | SUBJ (3) | OBJ (2) | $OBJ_\Theta$ (1) | +1 | 7 | √ |
| (c) | SUBJ (3) | $OBL_\Theta$ (1) | $OBJ_\Theta$ (1) | +1 | 6 | |
| (d) | NULL | SUBJ (3) | OBJ (2) | +1 | 6 | |
| (e) | NULL | OBJ (2) | SUBJ (3) | | 5 | |
| (f) | NULL | SUBJ (3) | $OBJ_\Theta$ (1) | +1 | 5 | |
| (g) | NULL | $OBL_\Theta$ (1) | SUBJ (3) | | 4 | |
| etc. | | | | | | |

Note that our approach in fact allows for an argument alternation with ditransitives: the version in which the goal is linked to an oblique (PP) is ranked equally highly with the version in which the goal is the primary object of the verb. Which of the two possibilities is to be realized must again be determined by other factors in the clause, and must also be constrained by lexical considerations.

It must be noted that our approach does not provide a clean account of passives of ditransitives. Option (d) is correctly ranked as an optimal solution, but option (g), which is also a well-formed option, is not highly ranked. However, as native speaker judgements vary considerably with regard to the acceptability of passive ditransitives (McCawley 1997, personal communication), we do not feel discouraged by this result, but take the confusion in ranking to directly reflect a source of variation in the grammar.

## 6 Linking in Complex Argument Structures: Causatives

### 6.1 Alternation and Variation in Grammatical Functions

Another interesting class of examples for a theory of linking are causative constructions. In many languages, causatives form complex predicates, either morphologically, as is the case e.g. in Chicheŵa (see (26), taken from Alsina 1992a), or else syntactically, as e.g. in Romance languages (see (25)).[4] As shown by Alsina and Joshi (1991) and Alsina (1992b), the underlying a-structure compositions can be accounted for crosslinguistically with a minimal assumption of variation. However, languages display considerable variation as to the surface realization of identical underlying a-structures. This is illustrated in (25a) and (26a) by a contrast between structurally similar causative constructions in French and Chicheŵa, both involving a causative morpheme or predicate, and a transitive verb.

(25) a. Jean a fait manger des gâteaux aux enfants.
Jean has made eat the cakes to the children
'Jean made the children eat the cakes.'

b. Jean a fait manger des gâteaux par les enfants.
Jean has made eat the cakes by the children
'Jean had the cakes eaten by the children.'

(26) a. Nǔngu i-na-phík-ítsa kadzīdzi maûngu
porcupine SUBJ-PAST-cook-CAUS owl pumpkins
'The porcupine made the owl cook the pumpkins.

b. Nǔngu i-na-phík-ítsa maûngu kwá kádzīdzi
porcupine SUBJ-PAST-cook-CAUS pumpkins by owl
'The porcupine had the pumpkins cooked by the owl.

In both languages the causee is realized as an objective function. But the languages differ in the type of objective function, ([+/− r]), that the causee is linked to. In Chicheŵa the causee is realized as a direct object: it can be expressed with an object marker, and it can function as the subject of the passive. Thus, the causee is the 'unrestricted' object ([−r]) while the embedded patient/theme must be analyzed as a 'restricted' ([+o]) object (cf. Alsina 1992a, 548–549).

In the French example, on the other hand, it is the embedded theme/patient that functions as the unrestricted accusative object, while the causee is marked with dative case. Thus, the object causee in the Chicheŵa example (25a) is an OBJ, whereas its French equivalent in (26a) is a restricted object, an $\text{OBJ}_{\Theta}$. We capture these differences in linking to grammatical

[4] We confine ourselves to French for illustrative purposes — the facts cited apply to Italian and Catalan as well.

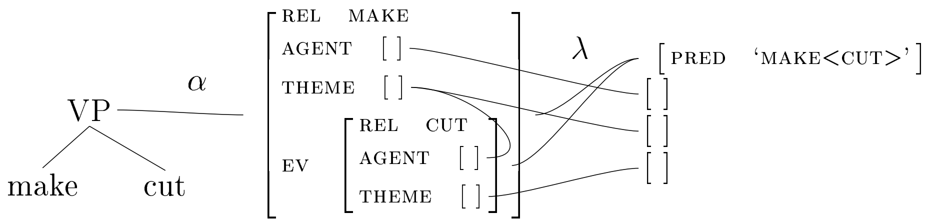
functions by postulating the existence of a language parametric preference constraint, in addition to the set of universal preference constraints we have been working with so far.

Another interesting feature of causative constructions is that in both languages we find an alternation where the causee is realized as an oblique, as in (25b) and (26b). This causative alternation, where the causee may surface as either an objective or an oblique function, results from two highly ranked linking possibilities, which must each be compatible with particular semantic constraints. That is, our approach incorporates the fact that the causative alternation is associated with a contrast in semantic interpretation, as discussed by Kayne (1975) and Hyman and Zimmer (1975) for French: in the (a) examples, the object causee must be interpreted as being directly *affected*; in the (b) examples, on the other hand, the oblique causee can only be interpreted as incidentally affected. In Alsina's (1992a, 1996) approach, this semantic difference is encoded directly within the a-structure representations. In our approach, this difference is assumed to be represented at s-structure, or in the meaning language, and from there to constrain the space of linking possibilities.

## 6.2 Argument Structure Analysis of Causatives

As argued extensively by Alsina (1992a, 1996), these causatives, irrespective of how they are formed, are an instance of complex predicates. Within the projection architecture assumed here, causative complex predicates are analyzed as in (27).

(27)




At a-structure the complex consisting of the causative predicate and the embedded predicate combine into a hierarchical structure. This complex a-structure is linked via the $\lambda$-projection to a monoclausal f-structure with a composed PRED (here given as 'make<cut>').[5] Thus, all of the roles in the complex argument structure are linked to the same f-structural nucleus, with the exception of the highest role of the embedded predicate at a-structure, which is 'bound' to the CAUSEE by the relation of 'argument control' (cf. Butt To appear).

We take the linking possibilities for the controlling and the controlled thematic roles to be the union of each one's linking possibilities. That is, in (27), the CAUSEE can realize the possible linkings for both THEME and AGENT. We further assume that the outranking relations defined by the thematic hierarchy respect the embedding relation at argument structure, so that all functions that are linked to the roles of the embedding causative relation outrank all functions that are linked to the (non-highest) embedded roles.

## 6.3 A Preference Account of Relational Variations

We will capture the language specific differences in the linking properties of the causee in French and Chicheŵa by stating a language parametric preference constraint on the realization of restricted objects. Similar to the universal constraint that sets a preference for the

[5]The exact mechanism by which such composed PREDs are instantiated at f-structure is an issue that still remains to be resolved, but something that is clearly needed for a treatment of complex predicates and related constructions.

highest thematic role being linked to a SUBJ, these language specific constraints are sensitive to the hierarchy of thematic roles, via the relation of 'outranking'. A language that adopts (28a) prefers a role being linked to an OBJ$_\Theta$ if it outranks one of the nonrestricted functions SUBJ or OBJ. This comes down to preferring, for a restricted object, the deviation from an isomorphism between the functional hierarchy and the hierarchy of roles. (28b) states a reverse constraint. Here a language adopts a preference for a role being linked to OBJ$_\Theta$ if it is outranked by an OBJ, such that the linking respects the thematic hierarchy.[6]

(28) a. Prefer a linking in which an OBJ$_\Theta$ thematically outranks (>) a SUBJ or OBJ. (set a preference for deviation from thematic hierarchy)

b. Prefer a linking in which an OBJ thematically outranks (>) an OBJ$_\Theta$. (set a preference for respecting thematic hierarchy)

The assumption of the intrinsic classifications for agent and theme given in (12), taken together with the universal and language specific preference constraints given above, yields the following ranked list of linking possibilities for French, which adopts (28a), and thus sets a preference for restricted objects to outrank nonrestricted functions.[7]

(29)

| **French** (**Italian**) | AGENT | CAUSEE | THEME | Subject preference | OBJ$_\Theta$ > OBJ<br>OBJ$_\Theta$ > SUBJ | Total | Optimal |
|---|---|---|---|---|---|---|---|
| (a) | SUBJ (3) | OBJ$_\Theta$ (1) | OBJ (2) | +1 | +2 | 9 | √ |
| (b) | SUBJ (3) | OBJ (2) | OBJ$_\Theta$ (1) | +1 | | 7 | |
| (c) | SUBJ (3) | OBL$_\Theta$ (1) | OBJ (2) | +1 | | 7 | √ |
| (d) | SUBJ (3) | OBL$_\Theta$ (1) | OBJ$_\Theta$ (1) | +1 | | 6 | |
| (e) | NULL | SUBJ (3) | OBJ (2) | +1 | | 6 | (with passive) √ |
| (f) | NULL | SUBJ (3) | OBJ$_\Theta$ (1) | +1 | | 5 | |
| (g) | NULL | OBJ (2) | SUBJ (3) | | | 5 | |
| (h) | NULL | OBJ$_\Theta$ (1) | SUBJ (3) | | +2 | 6 | (with passive) √ |
| etc. | | | | | | | |

Now, recall that the causative alternation is in fact associated with differing semantics, depending on whether the causee is realized as an objective or an oblique function. So, as with locative inversion and the passive, we assume that the semantic structure imposes further constraints on the available linking possibilities. In this case, an interpretation in which the causee is directly affected is only compatible with options (a–b), while an interpretation in which the causee is not directly affected can only be realized by linking the causee to an oblique function, hence is restricted to options (c–d). So, within the architecture we are proposing, all parts of the grammar are taken to 'conspire' to determine the most 'optimal' linking possibility that satisfies constraints of the various levels of representation.

Within these semantically restricted linking possibilities, and due to the language specific constraint (28a), we correctly predict options (a) and (c) as the respective optimal linkings for the active causative alternations in French (and Italian). As we had seen before, the passive – which is not available in French, but is in Italian – is only compatible with options (e–h). Again, in virtue of the preference constraint (28a) we end up with two equally highly ranked linking possibilities, (e) and (h), which in fact correspond to the two passive constructions we find in Italian, which allows a 'long' passive (h).

[6]Note that there is an asymmetry between (28a) and (28b) in that we do not include the unrestricted SUBJ function in (28b). This is in fact not surprising, given that the SUBJ outranking an OBJ$_\Theta$ is already highly ranked in virtue of the preference for the highest unsuppressed role to be linked to SUBJ.

[7]Again, for sake of concreteness, we adopt a numerical weight, +2, for the preference constraints in (28), which gives them a higher weight as compared to, e.g., the linking preference for subjects.

The Chicheŵa facts now follow straightforwardly, assuming as we do that Chicheŵa adopts preference rule (26b), which encourages restricted objects to respect the thematic hierarchy.

(30)

| **Chicheŵa** | AGENT | CAUSEE | THEME | Subject preference | OBJ > OBJ$_\Theta$ | Total | Optimal |
|---|---|---|---|---|---|---|---|
| (a) | SUBJ (3) | OBJ$_\Theta$ (1) | OBJ (2) | +1 | | 7 | |
| (b) | SUBJ (3) | OBJ (2) | OBJ$_\Theta$ (1) | +1 | +2 | 9 | √ |
| (c) | SUBJ (3) | OBL$_\Theta$ (1) | OBJ (2) | +1 | | 7 | √ |
| (d) | SUBJ (3) | OBL$_\Theta$ (1) | OBJ$_\Theta$ (1) | +1 | | 6 | |
| (e) | NULL | SUBJ (3) | OBJ (2) | +1 | | 6 | (with passive) √ |
| (f) | NULL | SUBJ (3) | OBJ$_\Theta$ (1) | +1 | | 5 | |
| (g) | NULL | OBJ (2) | SUBJ (3) | | | 5 | |
| (h) | NULL | OBJ$_\Theta$ (1) | SUBJ (3) | | | 4 | |
| etc. | | | | | | | |

Again, as in French, the different semantics associated with the causative alternation constrain the space of appropriate linking possibilities. In the active, the most optimal linking possibility in the semantic class of options (a–b) is that in (b), the opposite of what we found in French, whereas in the semantic class of options (c–d) we again pick (c) as the most optimal linking. Finally, the passive is straightforward in that (e), the most optimal linking possibility, in fact corresponds to the actual realization in Chicheŵa.

## 7 Conclusion

Our view of linking in terms of preference constraints follows directly from our proposals for an integration of argument structure into LFG's projection architecture. We hope to have shown that our view of linking provides an attractive alternative to the fully deterministic linking principles of 'standard' LMT, in that we allow for more flexibility in the treatment of argument alternations, and provide for a more natural representation of the influence of extra-thematic information such as discourse structure (topic, focus) on the realization of grammatical functions. Future work includes the further exploration and formulation of both language particular and crosslinguistic preference constraints and an investigation of the precise interaction of semantic/pragmatic information with argument structure and linking.

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Miriam Butt <Miriam.Butt@uni-konstanz.de>
Universität Konstanz
FG Sprachwissenschaft
Postfach 5560 <D186>
78434 Konstanz, Germany

Mary Dalrymple <dalrymple@parc.xerox.com>
Information Sciences and Technologies Laboratory
Xerox PARC
3333 Coyote Hill Road
Palo Alto, CA 94304 USA

Anette Frank <Anette.Frank@xrce.xerox.com>
Xerox Research Centre Europe
Le Quartz
6, chemin de Maupertuis
38240 Meylan, France