# Sets, Heads and Spreading in LFG*

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comments welcome, but please do not criticize in print

LFG has traditionally proposed flat covert structures (f-structures) for a variety of constructions, such as adjectival modification and 'restructuring' complex predicates, which are analysed as having hierarchical covert structures in most other frameworks. This leads to a vareity of problems that were addressed in Andrews and Manning (1993, 1999), henceforth AM93, AM99, or AM for both, where substantial modifications to the LFG architecture were proposed, involving extensive sharing of attributes across structural levels, so that LFG could account for the evidence for more hierarchy without losing its accounts of agreement, case-marking and various other phenomena. I will here show that the analyses of AM can be formulated using a similar but different, independently motivated and more conservative innovation, the concepts of 'hybrid object' and 'distributive attribute' introduced in Kaplan and Dalrymple (2000), henceforth DK.

The notion of distributive attribute in fact goes back to the unfortunately no longer available Bresnan et al. (1985), and is taken up and further developed in Kaplan and Maxwell (1988). Distributive attributes, when attributed to a set, are attributed to all members of a set, allowing for the satisfaction of the Completeness and Coherence conditions in examples such as *John bought and read the book*. The other ingredient, hybrid objects, is due to John Maxwell: a hybrid object is an f-structure that has both nondistributive attributes and a set of members; the nondistributive attributes hold of the entire structure independently of the members, while the distributive attributes hold of the entire structure if and only if they apply to all the set members. The crucial observation here is that there is no motivated formal requirement, but merely a traditional practice, that the set component of a hybrid object have more than one member. Therefore, hybrid objects with singleton sets can provide the attribute-sharing across nested structural levels that is needed to support the analyses of AM, without substantial in-

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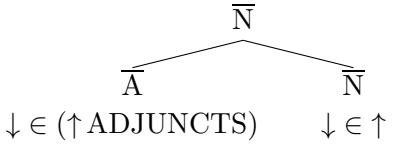
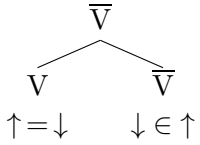
novations beyond those of DK, and within the LFG framework presented by Dalrymple (2001).

For example, the following structures are proposed for 'modal adjectives' such as *former* and *alleged* (a), and for Romance 'restructuring' predicates[1] (b), often also called 'light verbs':

(1) a.



b.



The construction of (a) is standardly analysed in LFG with 'f-structure flattening', whereby the upper and lower $\overline{\text{N}}$'s in (a) share same f-structure, and this is a popular proposal for the $\overline{\text{V}}$'s in (b) as well, but the flattening leads to a variety of difficulties discussed by AM, which amount to insufficient 'respect for the tree' (Alsina 1997). These difficulties do not appear to have been satisfactorily resolved; rather, they seem to be getting worse, as for example with some of the NP structure phenomena analyised by Pesetsky (2013) within the Minimalist Program. I will show that using singleton sets rather than f-structure equality permits a reasonably successful analysis, with only a minor innovation beyond Dalrymple (2001).

For complex/restructuring predicates, the difficulties for LFG don't appear to have multiplied, but neither have they been resolved. The present proposal fixes this, and in a way that is compatible with another recent development in LFG, the version of Lexical Mapping theory proposed in Asudeh et al. (2014)), henceforth AGT. Furthermore, in both cases, we resolve the problem that AM has with 'inside-out functional uncertainty' that is discussed in Andrews (2001). These analysis and the others we will present also depend on a greater use of glue semantics, which at least the A of AM probably understands better now than he did in the 1990s.

Before launching into the details, I will comment briefly on why this might be at least somewhat relevant to people who do not themselves work in LFG. LFG is a grammatical framework which has been stable for many decades (in effect, since 1979, with the first major publication, Bresnan (1982), appearing three years later), and has accumulated a large collection of reasonably consistent and often implementable (or not too far from implementable) analyses

[1] As first discussed in generative terms by Aissen and Perlmutter (1976) and Rizzi (1978).

of a typologically diverse collection of languages. An important value of LFG is large scale consistency across analysis, a value which this paper supports by bringing a collection of analyses previously couched within a substantially different version of LFG into the canonical version, with very little change to their substance.

Furthermore, until recently, LFG appeared to have a very serious problem in the form of being excessively stipulative, in that full LFG grammars typically involve a considerable amount of language-specific rule formulations, implying too many options in the space of possible grammars for plausible learning. But with the apparent demise of what might be called 'strong principles and parameters' — the idea that there are only principles and parameters, and not very many of either, and the rise of Bayesian and related kinds of learning theories that can make use of 'implicit negative evidence', the more relatively stipulative characteristics of LFG become less of an immediate stumbling block and more of a problem that can be addressed and progressively ameloriated. The present approach also better supports hierarchical structures that are more similar to those used in Minimalist analyses, hopefully facilitating more in the way of careful comparison of the differences between the results of the symmetrical device of attribute-sharing employed by LFG with the asymmetrical ones of probes, goals, movement, etc. employed by the Minimalist Program.

In the next section, I will present the basic theoretical ideas, and then, in the following sections, analyses of English modal and intersective adjectives, Catalan light verbs and causatives (applying generally to other Romance languages), Tariana serial verb constructions, and Misumalpan serial verbs, these being the main targets of analysis in AM. The other complex-predicate structures discussed in AM99 are Wagiman and Urdu, and a bit of Italian; Urdu fits easily into the approach we take for Romance, Italian likewise does not seem to motivate major changes (but certain of its features, such as 'Long Passives' ought to be investigated in terms of the AGT linking theory), and I won't consider Wagiman, since the discussion is brief, and the constructions rather different from the verb-combining constructions considered here. We conclude with some general theoretical discussion.

# 1 Distribution and Restriction

In this section I will discuss in greater detail some formal issues related to distribution and restriction. DK is concerned both with the representation of features and the representation of coordinate structures; here I will consider only the latter. The idea can be presented as consisting of four components:

(2) a. There are two kinds of attributes (called 'properties' in DK), distributive and nondistributive.

b. There are 'hybrid objects' consisting of both nondistributive attributes and sets (the latter as traditionally used in LFG).

c. Nondistributive attributes are specified independently for the entire hybrid object and its individual set members.

d. Distributive attributes are specified subject to the following 'distributivity scheme' (whose application is a bit subtle): For any distributive attribute $A$ and set $s$, $A(s) = V$ iff $\forall f \in s, A(f) = V$.[2]

This can be seen as a kind of attribute-spreading in the sense of AM, but with a subtlety.

Consider a structure like this, where the attribute F is distributive:

(3) $\left[\left\{\begin{bmatrix}\text{F} & Y\end{bmatrix}\right.\right.$
$\left.\left.\begin{bmatrix}\text{F} & Z\end{bmatrix}\right\}\right]$

As long as nothing ascribes any F-value to the entire structure, it is possible that $Y \neq Z$. But if anything ascribes a value $X$ for F to the entire structure, then (3) must become more highly specified as (we think of $X$ as a shared value, rather than multiple copies):

[2]This is the formulation of Dalrymple (2001:158); that of DK is slightly different, phrased in terms of 'properties' which appear to include attributes as well as values, while that of Kaplan and Maxwell (1988) is even more different, involving a concept of 'generalization' over f-structures which applies recursively to sub-attributes. Happily for us, all these proposals return identical behavior for singleton sets.

(4) $\left[\begin{array}{ll} \mathrm{F} & X \\ \left\{\left[\begin{array}{ll} \mathrm{F} & X \end{array}\right]\right. & \left.\left[\begin{array}{ll} \mathrm{F} & X \end{array}\right]\right\} \end{array}\right]$

And if this is impossible, due to $Y$ and $Z$ being contradictory, then there is no solution (in effect, 'the derivation crashes'). This is exactly the effect we want in coordinate structures, where grammatical relations are sometimes shared and sometimes not:

(5) a. Mary praised Bill and criticized John

b. $\left[\begin{array}{ll} \mathrm{SUBJ} & \left[\mathrm{PRED} \quad \text{'Mary'}\right] \\ \left\{\begin{array}{ll} \mathrm{CONJ} & \mathrm{AND} \\ \left[\begin{array}{ll} \mathrm{PRED} & \text{'Praise(SUBJ, OBJ)'} \\ \mathrm{TENSE} & \mathrm{PAST} \\ \mathrm{OBJ} & \left[\mathrm{PRED} \quad \text{'Bill'}\right] \end{array}\right] \\ \left[\begin{array}{ll} \mathrm{PRED} & \text{'Criticize(SUBJ, OBJ)'} \\ \mathrm{TENSE} & \mathrm{PAST} \\ \mathrm{OBJ} & \left[\mathrm{PRED} \quad \text{'John'}\right] \end{array}\right] \end{array}\right\} \end{array}\right]$

In this case, SUBJ is shared and OBJ is not, but other possibilities are both or neither:[3]

(6) a. Mary praised Bill and Susan praised John

b. Mary (both) praised and criticized John

The 'distributivity convention' (2d) handles this and other issues associated with coordinate structures well.

This behavior is also significantly different from attribute-sharing as conceived by AM. On this account, if F where to be shared across set-membership, both $X$ and $Z$ in (3) would have to be shared with the entire structure, resulting in (4), which would make coordinate structures difficult to analyse.

[3]But there is also the issue of 'right node raising' (Mary praised and/but Susan criticized John) which raises special issues and won't be discussed here.

However, when the set is a singleton, this difference in behavior between distribution and sharing disappears. In (7a), for example, $X$ is the value of F in every member of the hybrid object's set, so (7a) comes out identical to (7b):

(7) a. $\left[\left\{\left[\mathrm{F} \quad X\right]\right\}\right]$

b. $\left[\begin{array}{ll}\mathrm{F} & X \\ \left\{\left[\mathrm{F} \quad X\right]\right\} & \end{array}\right]$

For our present applications, this produces the behavior we want, corresponding to obligatory sharing of certain attributes across ARG in the system(s) of AM, in the event that they are defined in either the entire structure or the set-member (but allows them to be undefined at both).

However there is a potential problem in that there can be difficulties in having the same attributes be distributive (or not) in all constructions. I therefore suggest that there can 'undersharing' specifications, corresponding to classic LFG restriction, where a normally distributive attribute is specified to behave nondistributive, and 'oversharing' specifications, where a normally nondistributive attribute is specified to behaving distributively. Obvious notations for these, derived from Kaplan and Wedekind (1993) and AM99, are illustrated below, where F (normally nondistributive) is overshared and G (normally distributive) is undershared:

(8) A $\rightarrow$ ... B ...
$\downarrow \in \uparrow$=F /G

The difference between oversharing and explicit $(\uparrow \mathrm{F}) = (\downarrow \mathrm{F})$ annotations is that the latter require F to be defined in order for an f-structure to be determined (Kaplan and Bresnan 1982:203). The extent to which these notations are necessary is unclear, but they are an obvious possible recourse to keep in mind. Observe that although they are certainly a bit of a step backwards in terms of reducing stipulation, they do not constitute a serious learnability problem as long as the evidence for them is easy to observe in plentiful data, since harder things rather clearly are learned, such as social conditions on the use of grammatical constructions.

The final issue I will consider here is the status of the 'quasi-attribute' $\in$, representing set-membership. This is not normally presented as an attribute, comparable to SUBJ or COMP, but it is often notated as one, especially in iofu statements (Dalrymple 2001:154). But if we think of it as an attribute, we need to observe that it is multi-valued, which raises the issue of whether certain other attributes are also multi-valued, such as perhaps an attribute ADJUNCT to replace the set-valued ADJUNCTS. Proceeding along these lines, we could think 'membership' as a 'head' attribute 'H', with two peculiarities:

(9) a. H can be multi-valued.

b. Certain other attributes distribute across H in accordance with the distributivity scheme.

This conception has a resemblance to the ideas of AM99,[4] but differs in at least two ways (a) the actual proposed extent of sharing is much more restrained (b) no attempt is made to think of the results of sharing as a 'projection' in the usual sense in which this word is used in LFG. Although I won't pursue it here, the idea derives some appeal from the fact that it is certainly natural to think of coordinate structures as multi-headed, with the behavior of distributive features a natural generalization of the kind of attribute-sharing that is characteristic of intuitive head in LFG (keeping in mind that headship is not really defined in a serious way in LFG, nor in most other frameworks).

# 2 Adjectives, Modal vs. Intersective

Dalrymple (2001) presents an LFG+glue analysis for intersective adjectives that works well, and can arguably be extended to at least some subsectives, such as *skillful*, by treating them as taking an unexpressed *as*-argument, which is normally supplied by the head noun when the adjective is in attributive position, but supplied from context when the adjective is predicative:

(10) a. Brett is a skillful surgeon (but totally ordinary as a pilot).

b. Wow, he's skillful! (as a surgeon) [watching Brett in the operating theater, implying nothing about his ability to land an airplane in strong and gusty crosswinds].

[4]But differs in that H takes on the roles ascribed to ARG there.

But the analysis fails to give a very satisfactory account of 'modal' adjectives such as *former* and *alleged*, because it doesn't account for the interpretational consequences of ordering as presented originally by Andrews (1983) and also a major topic of AM93. Consider for example the pair:

(11) a. He is an unscrupulous former property-developer

b. He is a former unscrupulous property-developer

The first characterizes his career as a developer as in the past, but his unscrupulousness as persisting, while the second locates both in the past, so that he could well be a comprehensively reformed character. We also note that *He is a formerly unscrupulous property developer* means that he's still a developer, but is no longer an unscrupulous one. When *former* is replaced by its adverbial variant, the attribution to past time applies only to the adjective, not the entire adj+noun combination.

An evidential issue with this kind of contrast is that many such pairs of adjectives seem to strongly prefer one order or the other, suggesting the possibility of a cartographic account using a very refined system of functional heads (e.g. Cinque 1994, 2010), but it seems to me that there are enough cases of two orderings with both adjectives retaining the same meaning to rule this out. There are of course many other issues with adjective ordering; it remains to be seen whether the present proposal can be extended to cope with them.

Theoretically, it might be possible to preserve the syntactic analysis of Dalrymple (2001) unaltered, but capture the semantic interpretational facts with restrictions involving f-precedence (Kaplan and Zaenen (1989), Dalrymple (2001:171-174)). One issue is that the concept would have to be generalized so as to involve some kind of c-structure-based command relationship, in order to deal with the concentricity effects as discussed in Andrews (1983).[5] Another is that the formulations seem to come up rather complex, and it is difficult devise a single, plausibly universal constraint that manages to deal with the full range of cases considered in AM, including both modal adjectives and complex predicates.[6] A final problem is that such an approach would probably have very limited prospects for explaining further phenomena, such

[5]There is also a very interesting discussion of concentricity effects with the Greek polydefinite construction in Velegrakis (2011).

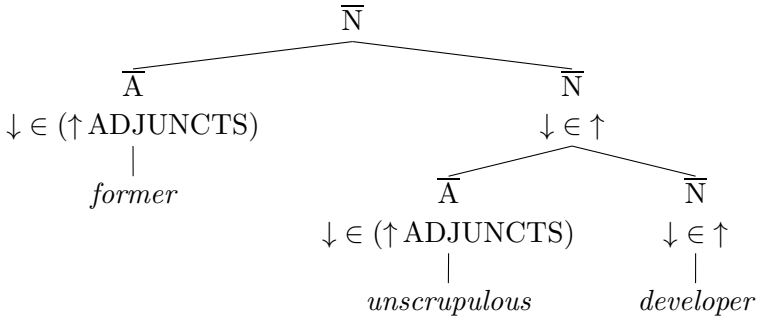
[6]Andrews (2007a) formulates a constraint for complex predicates, but doesn't attempt to extend it to modal adjectives.

as those discussed in Cinque (2010) and Pesetsky (2013). Our analysis will therefore work by using singleton sets to project more of the articulation of c-structure into the f-structure level, where it control the semantics, as well as having in principle a further range of possible effects, while using distribution to implement the phenomena that motivate the flattening that is a traditional characteristic of f-structure.

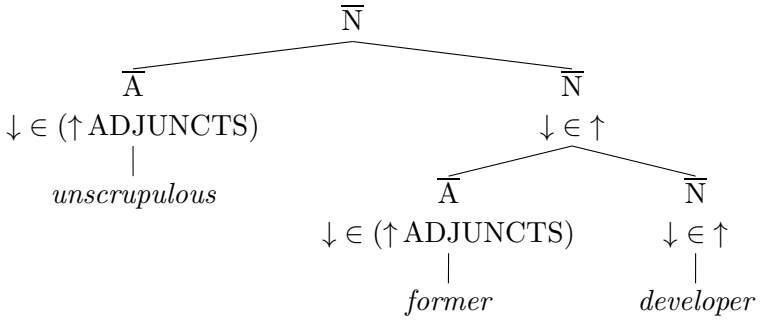
## 2.1 Nesting Structures

I propose the following annotated c-structures for 'former unscrupulous developer' and 'unscrupulous former developer' (some nonbranching nodes and their ↑=↓ annotations, omitted):

(12) a.




b.




On the assumption that ADJUNCTS and PRED are non-distributive, these produce the following f-structures:

(13) a.
$$\begin{bmatrix} \text{ADJUNCTS} & \left\{\left[\text{PRED} \quad \text{`Former'}\right]\right\} \\ \left\{\left[\begin{array}{ll} \text{ADJUNCTS} & \left\{\left[\text{PRED} \quad \text{`Unscrupulous'}\right]\right\} \\ & \left\{\left[\text{PRED} \quad \text{`Developer'}\right]\right\} \end{array}\right]\right\} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{ADJUNCTS} & \left\{\left[\text{PRED} \quad \text{`Unscrupulous'}\right]\right\} \\ \left\{\left[\begin{array}{ll} \text{ADJUNCTS} & \left\{\left[\text{PRED} \quad \text{`Former'}\right]\right\} \\ & \left\{\left[\text{PRED} \quad \text{`Developer'}\right]\right\} \end{array}\right]\right\} \end{bmatrix}$$

These structures are more complex in certain ways then they absolutely have to be; it might be possible to introduce the modal adjective PRED as an attribute of the top-level f-structure rather than as one one of a member of an ADJUNCT-value. But I will attempt here to keep the c- and f-structures of traditional adjectives as similar to each other and to previous work in LFG as possible.

For the glue semantics analysis, we can largely use the analysis proposed by Dalrymple (2001), with some minor changes due to the slightly different structures. Glue analyses normally use a 'semantic projection', and although there has not been much in the way of compelling evidence presented that this exists (Andrews 2010b), we will find a use for it in the treatment of Romance causatives later, where it plays a role in the linking theory of Asudeh et al. (2014). So we will include it here as well, although it does not appear to make a substantial contribution. By convention, the semantic projection includes an attribute VAR whose value is associated with individual variables/reference index, and a value RESTR, whose value is associated with propositions. We will also use these, noting that they render it unnecessary to include semantic types to make assembly work properly. It is furthermore awkward to notate both the semantic projection and semantic types, so we will omit the latter.

Dalrymple's analysis will require a slight modification because of the fact that the nominal input for the adjectival constructor must be taken from

the lower $\overline{\text{N}}$, with output returned to the highter one. We will also reduce clutter (and make typsetting easier) by assuming a convention that if a semantic projection (s-structure) attribute is attributed to an f-structure, then the semantic projection is automatically inserted, so that '(↑VAR)' is interpreted a '($\uparrow_\sigma$ VAR)'. With these adaptations, Dalrymple's constructors for *unscrupulous* would be (c.f. p 266):[7]

(14) a. $\lambda x.Unscrupulous(x)$ : (↑VAR)→(↑RESTR)

b. $\lambda PQx.P(x) \wedge Q(x)$ : $[(\uparrow\text{VAR})\rightarrow(\uparrow\text{RESTR})] \rightarrow$
$[(\%G \in \text{VAR})\rightarrow(\%G \in \text{RESTR}))] \rightarrow (\%G\,\text{VAR})\rightarrow(\%G\,\text{RESTR})$
$\%G = (\text{ADJUNCTS} \in \uparrow)$

The second constructor, called the 'Intersector' in Andrews (2010a), combines the meaning of the adjective with that of the noun intersectively, accessing the latter by means of inside-out functional uncertainty (iofu), as indicated by the equation '$\%G = (\text{ADJUNCTS} \in \uparrow)$' at the end of the constructor, and then supplies this to the containing f-structure (again using iofu). Thanks to the resource-sensitivity of glue semantics, the functional uncertainty that such annotations introduce does not constitute a problem. There are also decent prospects for making it more attractive by introducing in the PS rules rather than the lexical entries of adjectives, but we will retain Dalrymple's formulation here.

One might think that these constructors could be simplified a bit if we equated the semantic projections of the higher $\overline{\text{N}}$ and the adjunct AP, but this would fail once we tried to include Dalrymple's analysis of adverbial modifiers of adjectives, at least if we tried to apply the idea in a reasonably consistent way. Since we have nothing new or interesting to say about this analysis, we won't present it here.

However an issue arises when we try to extend the analysis to 'conjunctively iterated' adjectives, such as these:

(15) Max is a ruthless, dishonest, unscrupulous developer

That these are a different construction from single adjectives without a pause is shown by the fact the comma-pause is not acceptable with modal adjectives:

[7] I am also assuming here the standard 'co-descriptional' approach to glue rather than the 'description by analysis' approach advocated in for example Andrews (2010a), on the basis of wanting to introduce here only the minimum necessary changes to the standard glue framework.

(16) *Max is a former, unscrupulous developer

On the other hand the comma-separated intersective adjectives can appear either before or after a modal adjective (AM93:27-29)[8]:

(17) a. Max is a former greedy, unscrupulous developer

b. Max is a greedy, unscrupulous former developer

They are furthermore not some kind of coordinated AP because (a) they can't appear as predicate modifiers (without special intonation, or at the end of an utterance) and (b) modal adjectives can be conjoined by *and*, but not sequenced by commas:

(18) a. *Max is greedy, unscrupulous [requires a long pause and special intonation]

b. *The fact that Max is greedy, unscrupulous discourages other local business owners from having anything to do with thim.

(19) a. In 2010, Vlad was a future and former President of Russia

b. * In 2010, Vlad was a future, former President of Russia

The construction seems clearly limited to intersective semantics.

We can in fact retain the c-structure analysis of AM93:28, modulo the present proposal:

(20) $\overline{\text{N}} \quad \rightarrow \quad \underset{\downarrow \in (\uparrow \text{ADJUNCTS})}{(\text{AP})^*} \quad \underset{\downarrow \in \uparrow}{\overline{\text{N}}}$

But we do need to slightly adjust the meaning-constructors. The intersector (14b) will consume a property meaning at the semantic projection of the sister $\overline{\text{N}}$ to the adjunct, so as to produce a property meaning of the semantic projection of the mother $\overline{\text{N}}$. This works once, but If there is more than one adjective, for the following ones, the property at the sister $\overline{\text{N}}$ will already have been consumed and what will be available is one at the mother. We can deal with this by letting the '$\in$' in the second line of (14b) be optional.

Dalrymple's analysis however doesn't deliver the behavor of modal adjectives, which apply in effect as propositional operators on the predications

[8]Where the following material is taken from.

formed by applying the nominal head to the referent of the NP. There are two slightly different cases, one being adjectives such as *former* and *alleged*, which plausibly don't predicate anything of the NP referent directly, and those such as *confessed* and *self-proclaimed*, where the referent also functions as an argument (originator of a proposition concerning themselves). Under the present proposal, it seems best to use the same glue specifications for both types, with the difference between them confined to the semantic side. Since the lexical items are buried inside members of an ADJUNCTS attribute, we need to use local variables to make the constructors look reasonable:[9]

(21) In both below, $\%G = (\text{ADJUNCTS} \in \uparrow)$:

$$\lambda Px.\mathit{Former}(P(x)) \ : \ [(\%G \in \text{VAR}) \rightarrow (\%G \in \text{RESTR})] \rightarrow (\%G\ \text{VAR}) \rightarrow (\%G\ \text{RESTR})$$

$$\lambda Px.\mathit{Confess}(P(x))(x) \ : \ [(\%G \in \text{VAR}) \rightarrow (\%G \in \text{RESTR})] \rightarrow (\%G\ \text{VAR}) \rightarrow (\%G\ \text{RESTR})$$

It should be evident that the scope relationships will now be captured.

But unfortunately, we do run into a problem, which is that on the analysis so far, the modal adjectives ought to be able to intermix in various ways with the attributive ones in the iterated construction. There are various moves one could make to address this problem, but an important disideratum that most of them fail is that the non-mixing of modal and iterated adjectives be at least semi-predictable, rather than requiring a stipulation to make it happen (since we're dealing with some negative evidence in relatively complex constructions).

What I suggest then is a somewhat different approach to the intersectives, in which the Intersector is treated as a schema introduced by the PS rule (22). This is an annotation associated with the Kleene-starred AP that contains a subformula, also delimited by a Kleene star, that is naturally interpreted as a set of $n$-tuple that an associative binary operaton can apply to $n-1$ times (or the equivalent $n$-ary operaton once), where $n$ is the number of iterations. The formulation will be:

(22) $\overline{\text{N}} \quad \rightarrow \quad (\text{AP})^* \quad \overline{\text{N}}$

$\downarrow \in (\uparrow \text{ADJUNCTS}) \qquad \downarrow \in \uparrow$

$\lambda P^*x.\bigwedge(P(x))^* :$

$[(\downarrow \text{VAR}) \rightarrow (\downarrow \text{RESTR})]^* \rightarrow [(\uparrow \in \text{VAR}) \rightarrow (\uparrow \in \text{RESTR})] \rightarrow (\uparrow \text{VAR}) \rightarrow (\uparrow \text{RESTR})$

[9] The diagrammatic notation of the DBA-based analyses of Andrews (2010a) helps with the cosmetic problem here, but it is unclear to me that there are any real issues at stake.

As a proposed stipulation in a grammar, this is clearly hopeless; it needs to be a universal meaning constructor of some kind, as discussed in Andrews (2010a), or constructed in a simple way from presently unknown universal components. It should be seen as an explicit statement in a general mathematical framework of what a typologically adequate formulation should accomplish.[10] It is also important to note that it is not a logical formula as such in a notation to be interpreted semantically, but a schema that produces such formulas when supplied with a definite number of iterations (so we don't have to face the challenging task of extending our model-theoretic or deductive rules for the actual semantics). It is unclear whether iteration of intersective adjectives is universally possible, but the well known limitations on multiple adjectives in Indonesian (normally only one, occasionally two) suggest that it is not. Such typological variation can be managed by permitting the Kleene-star in the PS rule to be present or not; the 'Enhanced Intersector' will work equally well in either case.

We can now integrate the modal adjectives into the analysis by leaving their lexical entries as is, and having the enhanced intersector be optional (on the assumption that it appears with all of the APs introduced, or none of them). If the Intersector is omitted, then glue assembly will allow only a modal adjective to appear, and only one of them.

The reader may well have already noticed that for the analysis to work at all, the ADJUNCTS attribute (and also PRED) will have to be nondistributive, which does not as far as I can see cause any problems in the analysis of coordinate structures. For example, I'm aware of no motivations to apply the adjuncts to the individual conjuncts rather than the whole coordination in examples like these:

(23) a. John took a photo of a bird and made a video of a lizard on Mt. Majura yesterday.

b. Mary yelled and kicked the car door five times.

On the other hand, requiring distributivity of governable GFs such as POSS and $\text{OBL}_\theta$ seems to work out:

(24) a. Kennedy's alleged assassin was murdered before he could be tried.

[10] I also point out that although formulated here as an annotation introduced by a PS rule in a co-description treatment of glue, it could also function in a 'description by analysis' (DBA) approach as discussed in Andrews (2010a).

b. The alleged setting in final exams *(of hard problems) will be punished severely, if this is found to have actually occurred.

In (a), the possessor is arguably a Patient argument of *assassin*, but by all conventional ideas about phrase-structure, appears outside of the syntactic scope of the modal adjective. In (b), on the other hand, the *of*-PP is demonstrably an argument because the sentence becomes ungrammatical if it is omitted, and yet again appears after an adjunct.

Another interesting case is *my former mansion* from Cinque (2010:30-31), also discussed in Morrison (2014). This could be either a mansion that is no longer mine, or something that is still mine but no longer a mansion, perhaps because it has been swallowed by a sinkhole or blown to rubble by a drone-strike. The semantics of possessives is complex, little explored in LFG, and has moved substantially beyond the proposal of Williams (1982) that a grammatical possessor could be anything but a non-owner (c.f. the papers in Kim et al. (2005)), but, if we provisionally assume that all possessors bear the GF POSS, and that there is in the semantics a relation **R** covering at least ownership, we can get both readings by having the possessive marker introduce the following meaning-constructor:

$$(25)\quad \lambda Pyx.P(x) \wedge \mathbf{R}(y,x) \;:\; ((\%G\,\mathrm{VAR}){\rightarrow}(\%G\,\mathrm{RESTR})){\rightarrow}(\uparrow\mathrm{VAR}){\rightarrow}(\%G\,\mathrm{VAR}){\rightarrow}(\%G\,\mathrm{RESTR}), \%G = (\mathrm{POSS}\uparrow)$$

This works because POSS is shared across all the levels, but can only be interpreted at a single level (it doesn't matter which), yielding the required two readings.

Argument possessives, such as *my reported death* or *America's envisioned response to Ebola* can on the other hand be managed by having the lexical item of the noun specify an argument bearing the grammatical relation POSS. In classic LFG, this undermines the Completeness and Coherence conditions amd the distinction between 'governable' and 'non-governable' grammatical functions, but these are called into doubt by glue semantics anyway, and have always been rendered somewhat problematic in the light of the behavior of possessive constructions, which have never been comprehensively analysed in LFG.

## 2.2 Distributivity Issues

However we now encounter a problem, in connection with agreement. For single-headed structures of the kind we have been considering, we would

seem to want 'agreement' features such as person, number, gender and case to behave distributively, since they are usually shared between the head N and the entire NP, regardless of the presence of adjectives. However, for the analysis of coordination, DK require that these agreement features be in general nondistributive, although they discuss how noun-class in Xhosa is distributive. What I propose for this is the idea of 'stipulated undersharing' described in section 1. In general, the agreement features are distributive (or perhaps the attributes that they occur as bundled values of, such as INDEX and CONCORD, in many analyses). A simple analysis of English coordinate NPs for example might then take the form:

(26) a. NP → (NP)$^+$ (NP)$^+$
$\downarrow \in \uparrow$/PERS, NUM $\uparrow = \downarrow$

b. NP → Conj NP
$\uparrow = \downarrow$ $\downarrow \in \uparrow$/PERS, NUM

This would rely on feature-consistency of properties introduce by Conj, along with glue semantics, to produce the correct range of structures (the analysis depends on glue assembly failing if the first NP$^+$ of (a) is expanded with (b), or the second is not).

I claim that the undersharing stipulations of (26) are not a problem because (a) languages show considerable typological variation in how agreement with coordinate structures works and (b) evidence that person and number cannot be distributive is plentiful. Pursuing the phenomena of coordination further, even in only the LFG literature, is beyond the scope of what I want to do here.

A similar set of issues arise with respect to Australian NP structure as discussed by Nordlinger and Sadler (2008). They argue that numerous Australian NP constructions, which present overtly as juxtaposition, should be represented f-structuraly as sets. But issues arise as to what features should distribute, and when. For example, in (a) below, the juxtposed NP elicits plural agreement, the sum of dual and singular markings of its components, while in (b), it elicits singular (rather than dual, the result of adding two singulars):

(27) a. Mima-nikinyi-yi puluku kujarra kangkuru-jirri waraja
wait.for-IMPF-3PL.SUB 3DU.DAT two kangaroo-DU one
yalapara
goanna
The two kangaroos and one goanna waited for those two (simplified from example 38, DS:428; Nyangumarta, from Sharp (2004:315)).

b. Garid-ni bungmanyi-ni gin-amany yanybi
husband-ERG old.man-ERG 3SG.M.A-P.TWD get
(Her) old man husband came and got (her) (example 44, DS:433; Wambaya from Nordlinger (1998:133)).

Their solution is to follow Wechsler and Zlatić (2003) in locating the gender, number and person attributes in an INDEX substructure, which can then be shared, or not, as specified by the annotated PS rules (as a first approximation, subject to handling numerous complexities surveyed in footnote 24 (pg 435)). But given what we have said so far, sharing of INDEX could be the default, stipulatively suppressed in the case of the constructions that are interpreted as coordination. The widespread suppression of number distribution in coordinate structures can be plausibly explained in functional terms: if number distribution in them was not suppressed, it would be impossible to have coordinating NPs with different numbers would be impossible in positions where agreement rules would impose number on the whole NP.

## 2.3 Conclusion

This concludes our discussion of set representations for NPs. It is clear that there are many details left to sort out in terms of how agreement works (the status of 'semantic agreement' for example, with coordinate NPs), but these are closely involved with the organization of features, a different topic from the use of singleton sets in syntax, which is the focus here. It seems evident and is presumably true that the present proposal does not make these issues more difficult than they already are, so there is no requirement to address them here.

# 3 Complex Predicates in Romance

The classic problem posed by Romance Complex ('restructuring') Predicates is how to reconcile their apparent uniclausal nature, as evidenced by clitic climbing and other phenomena, with their 'respect for the tree' (Alsina 1997) as evidenced by the dependence of interpretation on the linear arrangement, and also the distribution of verbal markers. These points are illustrated by these examples (Alsina p.c.), repeated from Andrews (2007b):

(28) a. L' acabo de fer llegir al nen
It I.finish of make read to the boy
'I just made/I finish making the boy read it.'

b. La faig acabar de llegir al nen
It.F I.make finish of read to the boy
'I make the boy finish reading it (say, a map ([GND FEM])).'

The appearance of the direct object clitics *L'* and *La* associated with the semantically most deeply embedded verbs illustrates the monoclausal nature of the construction; if it is monoclausal, then, for the clitic to be OBJ of the first verb will render it the OBJ of the last verb as well. On the other hand, both the semantics and the determination of the form of each verb by the one before it militate against a monoclausal analysis. This tension has led to considerable debate in LFG, as discussed in AM99.

## 3.1 F-structure

Our proposed analysis provides a straighforward account of the semantics using glue and f-structure. As previously with modal adjectives, PRED is nondistributive, so that each level has its own PRED. Then. given the c-structure suggested in (1), example (28b) will for example get an f-structure like (29), where SUBJ and OBJ are taken to be distributive, but, to control clutter in the diagram, we do not attempt to explicitly represent this. We also don't try to represent the lexical specifications of the predicates for their arguments, which involves issues of linking theory that we take up below:

(29)
$$\begin{bmatrix} \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`Pro'} \\ \text{PERS} & \text{I} \end{bmatrix} \\ \text{PRED} & \text{`Fer'} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`Pro'} \\ \text{PERS} & \text{III} \\ \text{GEND} & \text{FEM} \end{bmatrix} \\ \text{OBJ}_{Rec} & \begin{bmatrix} \text{PRED} & \text{`Nen'} \end{bmatrix} \\ \left\{ \begin{bmatrix} \text{PRED} & \text{`Acabar'} \\ \text{VFORM} & \text{INF} \\ \left\{ \begin{bmatrix} \text{PRED} & \text{`Llegir'} \\ \text{VMARK} & \text{DE} \\ \text{VFORM} & \text{INF} \end{bmatrix} \right\} \end{bmatrix} \right\} \end{bmatrix}$$

The lexical items for the light verbs then specify their semantic complements as values of $\in$. A sample constructor would be:

(30) $\lambda Px.Finish(P(x))(x) \ : \ ((\uparrow\text{SUBJ})_e \rightarrow (\uparrow\in)_p) \rightarrow (\uparrow\text{SUBJ})_e \rightarrow \uparrow_p$

Note that the outside-in functional uncertainty associated with the $\in$ path does not cause an assembly problem for glue, since all that is required for assembly is that the required parts be found somewhere in the specified area; a fully specified location is not needed.

A potential alternative analysis might be to have each light verb introduce a member of some kind of set of 'auxiliary' f-structures, with f-precedence determining their relative scope, roughly as proposed for auxiliaries in Bahasa Indonesia by Andrews, Mistica and Arka.[11] using perhaps a PS rule like this (note that this would accommodate the arguments of Manning (1996) for a right-branching structure):

(31)
$$\begin{array}{lccc} \text{VP} & \rightarrow & \text{V} & \text{VP} \\ & & \downarrow \in (\uparrow\text{AUX}) & \uparrow = \downarrow \end{array}$$

However there is a factor present in the Romance languages that is absent from Indonesian, which is verb-marking.

[11] At a Pargram meeting, perhaps in 2008.

In Catalan (and Spanish), most light verbs select either infinitive or gerund as the verb form of their nonfinite semantic complement, and in many cases also specify a verb-marker, homophonous with a preposition, such as *a* or *de*. Some auxilaries also take a past participle. We could use the 'm-projection' proposed by (Butt et al. 1996), which is an additional level of structure, projected off c-structure, where certain morphologically relevant features reside. In these complex predicate structures, each VP would have an m-projection, shared with its V, the the m-projection of each semantic complement being in the m-structure the DEP-value of its mother. But this requires setting up an entire projection to deal with a rather limited phenomenon that does not appear to exist in most languages (since it was proposed, the m-projection has not found many additional uses, although some have been suggested). But similar to AM's proposals, the present one doesn't require further elaboration to provide a suitable locus for these morphological features: if they don't distribute in these constructions, they will sit where they are deployed by the lexical entries of the light verbs.

## 3.2 Distributive Issues

However, although they do not distribute in our proposed structure for Romance complex predciates, they do distribute in coordinate structures, the infinitive VFORM feature obligatorily, and the VMARK features optionally:

(32) a. acabà de riure i (de) plorar
finish.PAST.3SG VM laugh.INF and (VM) weep.INF
He/she stopped laughing and crying

b. Quan acabis de llegir l'article i (de) fer-ne
When finish.2SG VM read.gfINF the-article and (VM) make-of it
el resum, avisa'm.
the summary, advise-me.
When you finish reading the article and summarizing it, let me know.

Alex Alsina (pc; Dec 2 2014)

Although both versions are acceptable, the one with with the second *de* included is more formal, so that, if omitted, it might be supplied by a copy-editor.

Distribution of infinitive, gerund and past participle VFORM is illustrated here:

(33) a. La Maria fa riure i plorar el nen
the Mary makes laugh and cry the boy
Mary makes the boy laugh and cry
Alsina (1997:222)

b. La Maria està rient i plorant
the Mary is laughing and crying
(Alsina p.c.)

c. La Maria ha rigut i plorat
the Mary has laughed and cried
(Alsina p.c.)

Unfortunately, with these other verb forms, nobody has produced layering constrasts as clear as those of (28), but one can nevertheless produce examples that show that the verb forms aren't shared uniformly through a collection of light verbs:

(34) a. La vol anar acabant
It.F wants.3sg do-gradually.INF finish.GER
He wants to be gradually finishing it (e.g., a thesis)

b. ??La va volent acabar
It.F go.3sg want.GER finish.INF
He is wanting to finish it

(Alsina p.c., based on Espunya i Prat (1996:179), modified to include clitic-climbing)

(b) is marginal, presumably for semantic reasons, but I think good enough to make the case that infinitive and gerund marking can appear in either order.

The most plausible analysis either:

(35) a. The VMARK and VFORM attributes are distributive, but stipulatively undershared in complex predicate constructions.

b. They are nondistributive, but stipulatively overshared in coordinate structures

These alternatives are difficult to distinguish, because in either event, the required stipulation is evident from basic data about the constructions. But I suggest that (a) should be mildly preferred, since the stipulated nondistribution in complex predicate constructions can be explained from the conservativity of overt marking, together with the fact that the constructions derive from multiclausal complement structures, where distribution is not expected and did not occur.

For VMARK, distribution is observationally optional; a plausible analysis of this is that these are two-level constructions in which an outer '$\overline{\text{VP}}$' sits on top of the verb-marker and the VP. If the $\overline{\text{VP}}$s are conjoined, VMARK is distributed in order to get expressed, whereas if the VPs are conjoined, distribution does not happen. Evidently, formal style favors conjunction of $\overline{\text{VP}}$s rather than VPs (presumably an arbitrary cultural fact with no real explanation).

Although coordinate structures do require a bit of fiddling, note that they require even more work if we use the m-projection, since some kind of reflection of coordination has to be imported into m-structure, whose appeal was partly based on the idea that it was very simple. So I thnk the present proposal pulls ahead here.

An area where some substantive revision of the analyses proposed in AM99 is required is adverb placement. The previous section and the discussion of frequency adverbs in Andrews (1983) indicate that the ADJUNCTS attribute is not distributive, while AM99:55 argue in effect that it is (given the present proposal), on the basis of these examples:

(36) a. He fet beure el vi a contracor a la Maria.
I have made drink the wine against $x$'s will to the Mary
'I have made Mary drink the wine against her/my will.'

b. Volia tastar amb molt d'interès la cuina tailandesa
I wanted to taste with much interest the cuisine Thai
'I wanted to taste Thai food with much interest.'
(with *with much interest* most naturally modifying *want*)

However (36a) is I now think irrelevant to this issue because *a contracor* could be generated in either the upper or the lower $\overline{\text{V}}$ so as to produce either of the required readings without issue, and (36b) could presumably be produced by generating the OBJ (c-structurally a PP, as discussed by Alsina (1996)) in

the upper level, and supplied by distribution to the lower verb, allowing the adverb to appear at its semantically appropriate level.

## 3.3 Linking Theory

Finally, to make this analysis and the following one of Tariana work, we need a linking theory. The problem is caused by the causatives, wherein the 'causee Agent' of the lower verb is realized as a syntactic object of the causative verb. Furthermore, as shown by Alsina (1996:216), the causee Agent cannot be a SUBJ(ect) of the caused verb.[12] This object is an ordinary direct object if the caused verb is intransitive, an 'indirect object' marked by *a* and expressed by dative clitics if the caused verb is transitive. A further problem is that we can't use classic Lexical Mapping Theory in its original form, since the linking theory needs to apply to syntactically formed combinations of causative light verbs and 'caused' normal ('heavy') ones.

What I propose to do here is to use the 'Kibort-Findlay' mapping theory (Findlay 2014) as adapted and presented in Asudeh, Giorgolo and Toivonen (2014), henceforth AGT. Not only does this seem able to handle the phenomena adequately, but is also consistent with a wide range of further phenomena of optional valence and valence change. The presentation makes use of the semantic projection; perhaps this is not essential, but it seems better to use the theory as is, for now at least, without trying to make unnecessary changes.

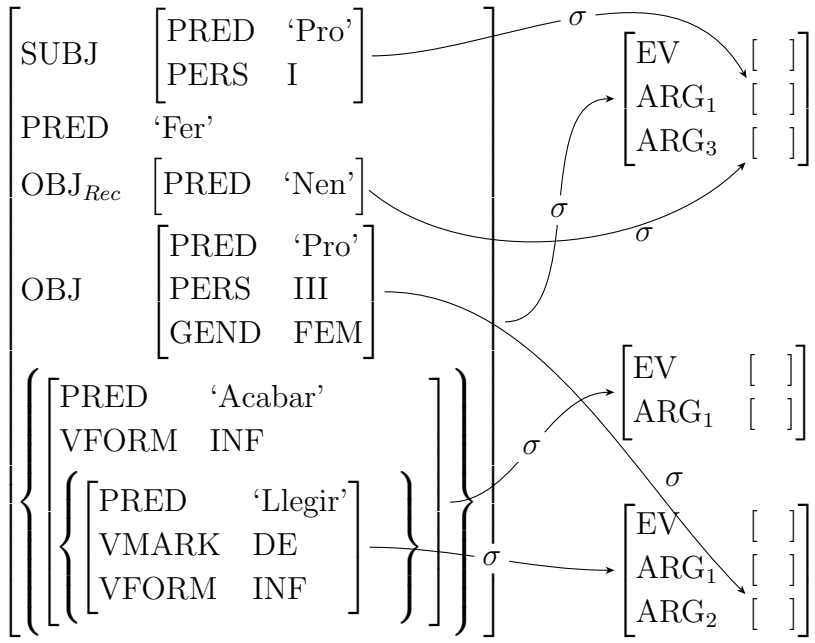
The semantic projection as proposed by AGT (and previous work on which AGT builds) has considerably more structure than the traditional semantic projection. In particular, for verbs, there are $\text{ARG}_i$ attributes for the semantic values of the arguments, and an EV attribute for a Davidsonian 'event' variable.[13] The Linking theory then equates the $\text{ARG}_i$-values with the semantic projections of grammatical relation values. Although the argument structure/semantic projection is richer than the traditional semantic projection in LFG, it doesn't have to be a recursive projection of f-structure, since glue semantics can assemble the meanings together by combining references to f-structure and s-structure. With the proposed semantic projection

[12] Andrews (2007b) adapts Alsina's argument to show that a bizarre artifice which might be used to make a version of such an analysis work in glue will not deliver the correct results.

[13] Although presented as a 'replacement' for argument structure, the proposal could also I think be seen as one of using argument structure as a replacement for the semantic projection.

added, (29b) becomes:[14]

(37)




The argument structures and the $\sigma$-links between f-structures and outer-level semantic structures are produced by the lexical entries themselves (in AGT, via extensive use of templates), while the links between f-structures and the $\text{ARG}_i$ values are produced by linking theory, as to be discussed later. Note that there are no $\sigma$-links to the EV-values, although these do play a role in the formulation of the meaning-constructors.

Glue assembly will work over the s-structures and their attributes. We won't consider how the s-structures are produced in the first place; Kibort and Findlay derive them from the standard LMT feature-specifictions $[\pm r]$ and $[\pm o]$ ('restricted' and 'object', respectively). The constructors we will assume are as below, where we're assuming an 'Agentive' sense of *acabar* 'finish', where it takes an Agentive argument and an event. We also won't concern ourself with the innards of the event-semantics structures assumed by Asudeh *et al.*, since these play no essential role here. To reduce clutter, we continue to follow the convention that if an $\sigma$-structure attribute is notationally accessed from an f-structure, then the $\sigma$-projection is automatically inserted. But there is an issue of event semantics we need to deal with,

[14]Asudeh *et al.* also have a REL argument in the semantic projection, which I omit, due to not seeing any function for it here.

which is the relation between the semantically subordinate and superordinate events, and the nature of the former. Here I take the position that if John finishes writing a paper, there are two events involved, writing the paper (subordinate), and finishing the paper (superordinate), and that the former is existentially quantified. Likewise for causatives. These decisions can be challenged, but hopefully not in ways that vitiate the syntactic analysis and the main features of its relationhip to the semantics:

(38)
$$\begin{aligned}
\lambda yxe.\mathit{LLegir}(e,x,y) &: (\uparrow\text{ARG}_2)\rightarrow(\uparrow\text{ARG}_1)\rightarrow(\uparrow\text{EV})\rightarrow\uparrow_\sigma \\
\lambda Pxe.(\exists e_2)\mathit{Finish}(e,x,P(e_2,x)) &: [(\uparrow\in \text{ARG}_1)\rightarrow(\uparrow\in \text{EV})\rightarrow(\uparrow\in)_\sigma]\rightarrow \\
&\quad (\uparrow\text{ARG}_1)\rightarrow(\uparrow\text{EV})\rightarrow\uparrow_\sigma \\
\lambda Pyxe.(\exists e_2)\mathit{Cause}(e,x,y,P(e_2,y)) &: [(\uparrow\in \text{ARG}_1)\rightarrow(\uparrow\in \text{EV})\rightarrow(\uparrow\in)_\sigma]\rightarrow \\
&\quad (\uparrow\text{ARG}_3)\rightarrow(\uparrow\text{ARG}_1)\rightarrow(\uparrow\text{EV})\rightarrow\uparrow_\sigma
\end{aligned}$$

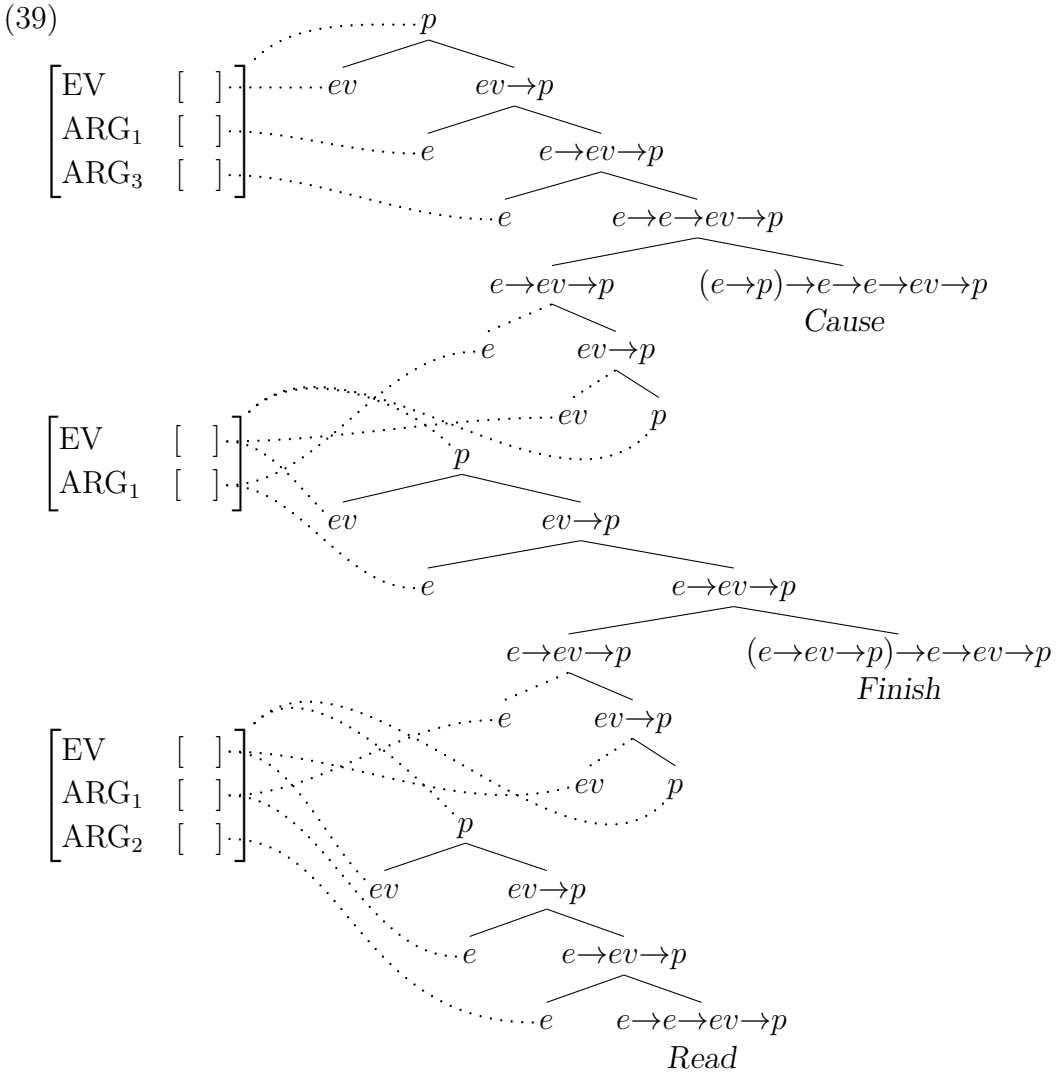
Note that we could remove the $\sigma$ subscripts by adopting a further convention that all literals on the glue side designate s-structure locations, but haven't chosen to do this (as a reminder that we really are using the semantic projection).

## 3.4 Linking and Glue Assembly

Given these structures and meaning-constructors, it is clear that glue assembly will work, but then the two questions are a) how do the grammatical relations get assigned b) how is the alternation between OBJ and $\text{OBJ}_\theta$ handled for the causative verb, the former used when the caused verb is transitive, the latter when it is intransitive? For linking, there is also the subsidiary issue of suppressing linking for the $\text{ARG}_1$'s of the subordinate verbs.

Considering linking first, we can benefit for the feature of AGT that all linking is optional. The specifications in (38) will then in fact effectively suppress linking of the subordinate $\text{ARG}_1$'s, because they participate in a kind of functional control by an argument, and linking to a grammatical relation would produce a situation of resource surplus, as discussed by Asudeh (2005). This can be made visually clear by using the modified proof net notation from Andrews (2010b). The semantic types *e*ntity, *ev*ent and *p*roposition might not actually be necessary in this framework, due to the way in which s-structure attributes can be used to keep different kinds of arguments apart, but are included anyway:

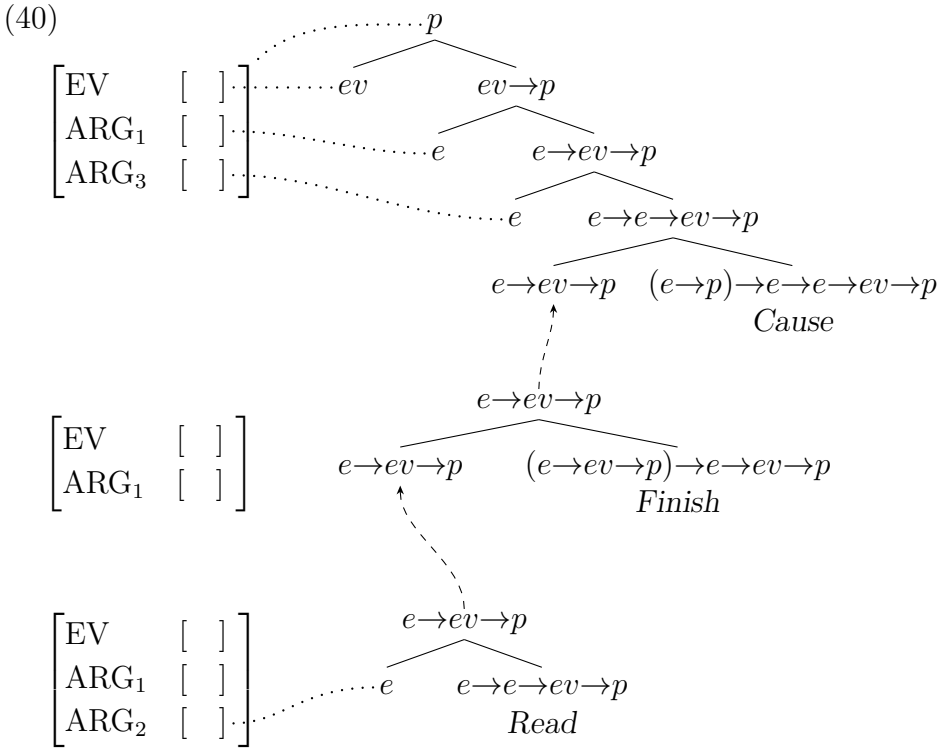
(39)




The connections (dotted lines) between glue literals of types $ev$ and $p$ and s-structure objects completely determine the possible assemblies for these items (literals can only be axiom-linked if they are connected to the same s-structure object)

We can represent the so-far required linkings more compactly by connecting with axiom-links identical complex formulas (of opposite polarity), rather than only literals, as is conventional with proof-nets. This corresponds more closely to the way implication eliminaton steps would usually be done in natural deduction proofs:

(40)




The connections (dotted lines from glue literal to s-structure object) that force an axiom-link are no longer represented in (40).

Now we see the three type $e$ literals that remain to be dealt with, each connected to a different $\text{ARG}_i$-value. These comprise a $\text{ARG}_1$, a $\text{ARG}_3$ and a $\text{ARG}_2$. By the provisions in AGT (in the absence of the resources needed for a Passive to be formed), the $\text{ARG}_1$ will have to link with SUBJ, thereby forcing the $\text{ARG}_2$ to link to OBJ, leaving $\text{OBJ}_\theta$ as the only option for the $\text{ARG}_3$. It's important that each works with each lexical entry introducing its own linking specifications into the structure, as in AGT, with no interaction between the levels of the f-structure other than those created by the fact that the grammatical functions are distributive.

## 3.5 $\text{ARG}_3$ alternations

So the final problem is to explain why the Causee object is expressed as an $\text{OBJ}_\theta$ only when the caused verb is transitive:

(41) L'/*Li he fet cantar
Him(ACC/*DAT) I-made sing

Findlay accepts the idea that the highest available grammatical function on Kibort's hierarchy must be used (the ranking is based ultimately on the number of marked feature values in the feature decomposition of the grammatical functions):

(42) SUBJ > OBJ, $\text{OBL}_\theta$ > $\text{gfOBJ}_\theta$

Unfortunately, neither Findlay nor AGT make a specific proposal as to how this is to be formalized in LFG, and, since we need to apply the principle in the syntax rather than just the lexicon, this is not a problem that can be safely overlooked.

I propose to implement the hierarchy by means of nonconstructive conditionals introduced by verbs. For the causative verbs, the relevant conditional is:

(43) $(\uparrow\text{OBJ}_\theta) \rightarrow(\uparrow\text{OBJ})$
If an f-structure has an $\text{OBJ}_\theta$, it must also have an OBJ

This will force the OBJ function to be used to express the causee agent if the caused verb is intransitive, while if it is transitive, then the the use of $(\uparrow\text{OBJ}_\theta)$ is forced by single-valuedness of the GR's.

A complexity is that Romance languages all seem to have 'semitransitive' verbs taking what appears to be an $\text{ARG}_1$ and an $\text{ARG}_3$, the latter realized as a PP with the preposition *a* that seems to act like a 'core' argument in at least some ways rather than an oblique. These would violate the constraint (43) if this constraint applied to all verbs. As a provisional fix, I propose that such verbs are lexically specified as linking $\text{ARG}_3$ to $\text{OBJ}_\theta$, and that (43) is not added to the lexical entry of a verb if doing so would render that verb's f-structure specifications contradictory. There is an unresolved puzzle in that giving the linking theory with the hierarchy constraint, we expect such verbs to be impossible because they violate it, but without the constraint we expect verbs with free alternation between OBJ and $\text{OBJ}_{theta}$, which doesn't seem to happen (without changes in semantic role). I think there is more work to be done here, but an immediate fix is to suppose that (43) is introduce as a stipulation with the causative verb, and that the semitransitive verbs lack it, but instead have their $\text{ARG}_3$ pre-linked to $\text{OBJ}_\theta$.

The issue of subject-object alternation with 'unaccusatives' in some languages but not others suggests that the other constraint needed to implement the hierarchy may or may not be present, depending on the language:

(44) (↑OBJ) →(↑SUBJ)

However, syntactically free alternation here (subject to discourse constraints) is very common, an unexplained difference between (43) and (44). There are a variety of further phenomena involving causatives that one would have to look at, such as those with the Causee Agent is omitted or expressed as a passive *by*-phrase, but investigating these would require further development of the linking theory than would be appropriate here. Instead, we push on to consider Tariana.

# 4 Tariana

Tariana is an Arawak language described by Aikhenvald (2003), henceforth Aikh2003, whose serial verb constructions (SVCs) were a major topic of AM99 (on the basis of a number of papers and personal communications; the grammar does not change the relevant parts of the landscape in any significant way). Aikhenvald distinguishes on mostly semantic grounds a rather large number of SVC types, of which AM99 and here will be concerned with only a few: certain 'asymmetric' SVCs including 'modal' and 'causatives', and 'symmetric'.

## 4.1 Types of Serialization

Symmetrical serialization is defined by Aikh2003:424 as consisting of two or more open class verbs, where none of the components is uniquely responsible for determining the semantic or syntactic properties of the construction, but rather all are on an equal footing. A typical example is:

(45) ma [wa-wa wa-dana] wa-yarupe=nuku
let's 1PL-read/play 1PL-write 1PL-thing=TOPIC
'Let's read and write up our language!'
(Aikhenvald p.c.)

AM99 treat these as in effect generating coordinate structures, and applying the syntactic LFG analysis of Dalrymple and Kaplan (2000) to them as coordinated verbs doesn't appear to create any problems. One thing that should be noted however is that they tend to pick up lexicalized, idiomatic interpretations. But this is generally rather common for coordinated lexical

items; *Susan dragged John kicking and screaming to the phone to make the call* does not imply that John was literally doing these things, only demonstrating some kind of reluctance.

More unusual are the 'asymmetric' SVCs, many with the semantics of (VP) complement constructions, whose striking feature is that all of the verbs show person and number agreement with the syntactic subject of the clause, regardless of the semantic role that that argument bears to them (this phenomenon is called 'concordant dependant inflection' (Durie 1997)):

(46) ka:ru-ka nuha [nu-a=mahka nu-hyã=niki]
fear-DECL I 1SG-give=RECPAST:NONVIS 1SG-eat=COMPLT
piri=nuku di-a=pidana
2SG.son=TOPIC 3SGNF-say-REMPAST:INFR
'Being afraid, I let (the fish) eat your son, he said.'
(asymmetrical SVC, causative semantics, Aikh2003:425)

Another example, revealing at least some capacity for recursive combination, is:

(47) nu-na=tha nu-ra nu-sata dineiru
1SG-want=FRUSTR 1SG-order 1SG-ask money
'I want to order (him) to ask for money.'
(Modal on Causative; elicited, Aikhenvald p.c.)

These two types seem to need somewhat different treatment, but building the f-structures with set-membership will cause the grammatical relations to share/distribute fully, accounting for the agreement pattern.

## 4.2 C- and F-structure

For the asymmetric constructions, following the grain of AM99, the obvious thing to do would be to characterize the semantically subordinate member of an asymmetric SVC as a member, and the other as a top-level head. On the one hand, there is no real evidence for this treatment of the semantic head. In particular, there doesn't appear to be any general structural fact about the relative positions of the semantic head and complement (putative set member), which instead seems to be determined by the individual verbs, mostly in accordance with semantic groupings. So for some verbs, such as the ones we've seen so far, the semantically head comes first, the other second; for others, the order is reversed:

(48) tuiRi-kere na-hwa nema
bird-island 3PL-stay 3PL.stand
'They stayed at Bird Island for a long time.'
(Aspectual; Aikhenvald 1999:480)

Aikhenvald argues very plausibly that the ordering restrictions are based on iconicity of the historical word orders of the constructions, and introducing one of them as a member doesn't seem to add anything to this explanation; what it does do is provide formal underpinnings for an analysis. On the other hand, this structure does not cause any problems and allows the meaning-constructors to be slightly simpler than if both are members. Therefore we will start by adopting it, and also introduce the other later for symmetric SVCs.

Suppose that the annotated c-structure rule for SVCs is:

(49) V → (V)*
<↓ ∈ ↑>

In the first place, we interpret this as an alternative to lexical insertion, which produces simple verbs. A constraint against unfilled nodes will then block an empty expansion of the (V)*, and Offline Parseability Constraint will then require that at least two V's are produced.

These can then appear with various combinations of the $\uparrow = \downarrow$, annotation, which we take to be present by default if nothing else is specified, and $\downarrow \in \uparrow$. This analysis will extend to symmetric serialization, which we can assume have all their members introduced with the set-meber annotation. The rule (49) overgenerates substantially, which then has to be constrained by glue.

## 4.3 Glue Analysis

The symmetric constructions can be treated essentially as coordinate structures, in one of two ways, either by a schema along lines similar to the one proposed above for iterative adjectives, or with a 'seed constructor' and coordinate-adders (my terminology) as proposed for English coordinate VPs by Asudeh and Crouch (2002). I'll present the schema approach here. What we need to do is convert a collection of 1-/2-ary predicates into a 1-/2-ary predicate. A term such as '$[< (\downarrow \text{OBJ})_\sigma \rightarrow > (\downarrow \text{SUBJ})_\sigma \rightarrow (\downarrow \text{EV}) \rightarrow \downarrow_\sigma]$' can consume a transitive or intransitive verb meaning, depending on whether the optional material in the angle brackets is included or not (there doesn't

appear to be any clear reason to worry about grammatical relations other than subject and object, in this case). So we want one of these for each verb. The meanings for the subject and object will be supplied by the NP arguments of the entire SVC, while each verb will get its own existentially quantitified event variable. The format of meaning side I suggest for this is:

(50) $\lambda P^{*}{<}y{>}x.\bigwedge((\exists e_2)P(e_2, x{<}, t{>})^{*}$

Keep in mind that this rather informally defined thing is not supposed to function as a logical formula in a meaning language, but as a schema for producing one when a specific number of verbs is specified. So $P^{*}$ in the lambda-variable declaration represents a sequence of predicate variables $P_1, \ldots, P_n$, then we iterate the material in the starred parentheses in the body of the lambda abstract $n$ times to produce something that the $\bigwedge$ conjunction operator can act on, replacing $P$ with the appropriate $P_i$ in each iteration. Each one gets its own existentially quantified event variable, the subject variable, and the object variable if there is one, in accordance with the <> notation (as defined in Chomsky and Halle (1968)).

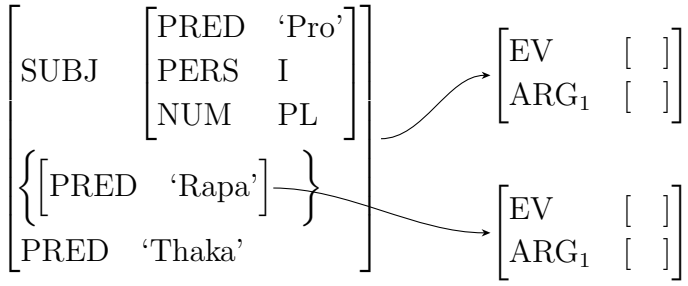
The glue-side will then look like this:

(51) $[< (\downarrow \mathrm{OBJ})_\sigma \rightarrow > (\downarrow \mathrm{SUBJ})_\sigma \rightarrow (\downarrow \mathrm{EV}) \rightarrow \downarrow_\sigma]^{*} \rightarrow$
$< (\uparrow \mathrm{OBJ})_\sigma \rightarrow > (\uparrow \mathrm{SUBJ})_\sigma \rightarrow (\uparrow \mathrm{EV}) \rightarrow \uparrow_\sigma$

Putting (50) and (51) together give us the constructor we want. Like the treatment of interated intersective adjectives in section 2, it constitutes a problem for learnability, which we will not attempt to resolve here.

Moving on to the asymmetric constructors, we find that the meaning-constructors can be exactly as they are in Romance (except for the issue of specifying the linear order), since the 'semantic complement' is specified as a member, and the NP arguments are associated with s-structure ARG-attributes. We illustrate with a simple example with an intransitive light verb, effects of linking theory not yet represented:

(52) a. [wa-Rapa wa-thaka] wha
1PL-dance 1PL-stop we
We stopped dancing for a while
(Aspectual; Aikhenvald 2003:433)

b. 


The relevant constructors will be as below, closely following those of (38)

(53) $\lambda yxe.Rapa(e,x,y)$ : $(\uparrow \text{ARG}_1) \rightarrow (\uparrow \text{EV}) \rightarrow \uparrow_\sigma$

$\lambda Pxe.(\exists e_2)Thaka(e,x,P(e_2,x))$ : $[(\uparrow \in \text{ARG}_1) \rightarrow (\uparrow \in \text{EV}) \rightarrow (\uparrow \in)_\sigma] \rightarrow$
$(\downarrow \text{ARG}_1) \rightarrow (\uparrow \text{EV}) \rightarrow \uparrow_\sigma$

These will assemble the same way, and linking can work in the same way, as it does in Romance.

For causatives, however, although the glue is the same, there is an apparent, but not, I claim, an actual difference in the linking. In Tariana, there is no overt difference in the case-marking of the two objects of a ditransitive verb; both are 'accusative' (Aikh2003:236-238, 143-148):

(54) na-na kuphe-nuku di-walita
3pl-OBJ fish-TOPIC.NON.A/S 3sg-offer
He offered them fish

*-na* here marks pronominal non-subjects, while *-nuku* marks non-subject topics, both applying to both the theme and recipient of a ditransitive verb. But only the theme can be passivized (Aikh2003:236, 259), indicating that the Recipient is $\text{ARG}_3$ (or, possibly, an unmarked oblique of some kind, but I am aware of no reason to suspect this). So we conclude that unlike in Romance, in Tariana $\text{OBJ}_\theta$ and OBJ have identical case-marking properties

But the linking theory and the present analysis says that, since the caused verb's $\text{ARG}_2$ will have to link to the OBJ function, therefore the Causee Agent can only be an $\text{ARG}_3$ or an oblique, the former again being preferable. So we account smoothly for the overt form of the causatives, but also get a prediction, which is that if passivization can apply at all to the causatives, only the caused object, not the causee agent, will be able to be passivized. Aikhenvald's grammar does not indicate whether causatives can be passivized, so this is a genuine prediction rather than a retrodiction of previously known

facts from theoretical ideas devised later (note that it wouldn't matter if the causee agent were an oblique rather than an $ARG_3$: the prediction would be the same).

There is a further prediction we can make that does not follow from the treatment of AM99, which is that Causee Agents cannot be treated as distinctively direct objects (e.g., OBJ distinguishable from $OBJ_\theta$) in a syntactic rather than morphological construction, when the caused verb is transitive. This happens in certain morphological causatives, such as those of Chichewa, where there are two possible forms of the causative construction (Alsina 1993). In one, the Causee Agent is an optional oblique marked with *kwa*, in the other, it appears as a 'first object', subject to object pronoun incorporiation and passivization distinctively from the caused object, which is subject to neither (Alsina 1993:124):

(55) a. Kadzizi a-na-phík-a maûngu
1a.owl 1-S-PS-cook-FV 6.pumpkins
The owl cooked the pumpkins

b. Nŭngu i-na-phík-íts-a kadzidzi maûngu
9.porcupline 9S-PS-cook-CAUS-FV 1a.owl 6.pumpkins
The porcupine made the owl cook the pumpkins

c. Nŭngu i-na-phík-íts-a maûngu (kwá kádzīdzi)
9.porcupline 9S-PS-cook-CAUS-FV 6.pumpkins to 1a.owl
The porcupine had the pumpkins cooked (by the owl)

In the (b) construction, the Causee Agent but not the caused object shows typical 'object properties' such as the ability to be expressed by an incorporated object pronoun, while with the (c) contruction, it's the caused object that can be expressed as an incorporated object pronoun (Alsina 1993:500):

(56) a. Nŭngu i-na-mú-phík-its-á maûngu
9.porcupine 9S-PS-cause-CAUS-FV 6.pumpkins
The porcupine made it cook the pumpkins [the owl]

b. *Nŭngu i-na-wá-phík-its-á kádzīdzi
9.porcupine 9S-PL-6O-cook-CAUS-FV 1a.owl
The pumpkins were made to be cooked by the owl

c. Nŭngu i-na-wá-phík-its-á (kwá kádzīdzi)
9.porcupine 9S-PL-6O-cook-CAUS-FV by 1a.owl
The porcupine had them [the pumpkins] cooked (by the owl)

Assuming the AGT mapping theory, the behavior of the (b) construction cannot be produced by a syntactic complex, cause-union causative construction, but only by one that is produced by derivational morphology (so that single argument-structure is assigned to the base-verb+causative complex), or one that is biclausal, as in English, so that both the causative and caused verb can have their own $\text{ARG}_2$, each linked to the OBJ of a different clause. Different versions of linking theory, such as what is envisioned in Andrews (2007b), do not deliver this conclusion; it remains to be seen if it is correct.

A further consequence of this analysis that 'concordant dependent inflection' is actually what is expected if the caused verb in a clause union construction is of the same morphological type, e.g. 'finite', as a main verb. That is, the only reason that the subordinate verbs in Romance don't show person-number agreement with the grammatical subject of the whole construction is that they are 'non-finite' rather than 'finite'. Since concordant dependent inflection does not seem to be especially common, this is something that needs closer investigation. Although this is expected in a clause union analysis, there are possible ways around it, such as with an undersharing specification for SUBJ. If such specifications occur, because they are essentially stipulative in terms of the formal theory, we should expect them to have some other explanation, such as a historical origin from a nonfinite structure.

## 4.4 Linear Order

But, beyond the differences in c-structure and verb marking, there is a further difference between Romance and Tariana, which is the need for some way to express the verb-order restrictions in Tariana. If we had chosen to embed the light verbs as set-members, we could use f-precedence to achieve this, which might in fact be a good reason for doing that, at the cost of making the meaning-constructors a bit different than those for Romance. But because we didn't, we have to something a little bit different, referring to both the c-structure node that the light verb is introduced under, and the c-structure correspondent of its semantic complement. The meaning-constuctor for *Thaka*, elaborated to express the ordering restriction, can be stated as follows:

(57) $\%F \in \uparrow$
$\lambda Pxe.(\exists e_2)\mathit{Thaka}(e_2, x, P(x))$ : $[(\%F\,\mathrm{ARG}_1)\rightarrow(\%F\,\mathrm{EV})\rightarrow\%F_\sigma]\rightarrow$
$(\uparrow\mathrm{ARG}_1)\rightarrow(\uparrow\mathrm{EV})\rightarrow\uparrow_\sigma$
$\phi^{-1}(\%F) << \hat{*}$

In the constraint, on the second line, $\hat{*}$ designates the c-structure node of the V itself, while $\phi^{-1}(\%F)$ refers to all of the c-stucture nodes corresponding under $\phi$ to the f-structure that is identified (non-deterministically) by the local name $\%F$ in the top line. This is just the V that introduces the semantic complement verb (the fact that it might have grammatical function values in various other linear positions is irrelevant), so the ordering restriction is thereby stated. Other asymmetric serial verbs submit to the same treatment, with variation in what the ordering constraint says.

An explanatory question that is raised by this account is why these constraints should tend to be preserved, given their stipulative nature. In conventional generative thinking, this is a mystery, but I suspect that there might be an explanation available in the more information theoretic view of language that is being developed in many quarters, presented for example in Chater et al. (2015). The effect of imposing the restriction is to reduce the amount of data needed to specify the corpus, or at least roughly equivalently, increase the extent to which the learner can predict what happens around them from what has gone before, a plausible and empirically supported motivation for learning, including of grammatical constraints (Ramscar et al. 2013).

# 5 Misumalpan

For Romance and Tariana, we have essentially implemented the substance of AM99 in a more conservative framework using the same ideas, but our treatment of Misumplan(Miskitu and Sumu) will quite different: AM99 analysed these languages with a rather extreme use of projections, which glue can effectively eliminate.

Relevant examples from Miskitu are:[15]

[15] AM99:83, based on work by Ken Hale and Danilo Salamanca.

(58) a. [Yang yul ba ra yab-ri] wîna pi-n
I dog the ACC give-OBV:ACT.1 meat eat-PAST.3
'I made the dog eat meat.' (MCD:29)

b. [Yang yul ba ra yab-ri] wîna pi-ras
I dog the ACC give-OBV:ACT.1 meat eat-NEG
'I didn't make the dog eat meat.' (MCD:29)

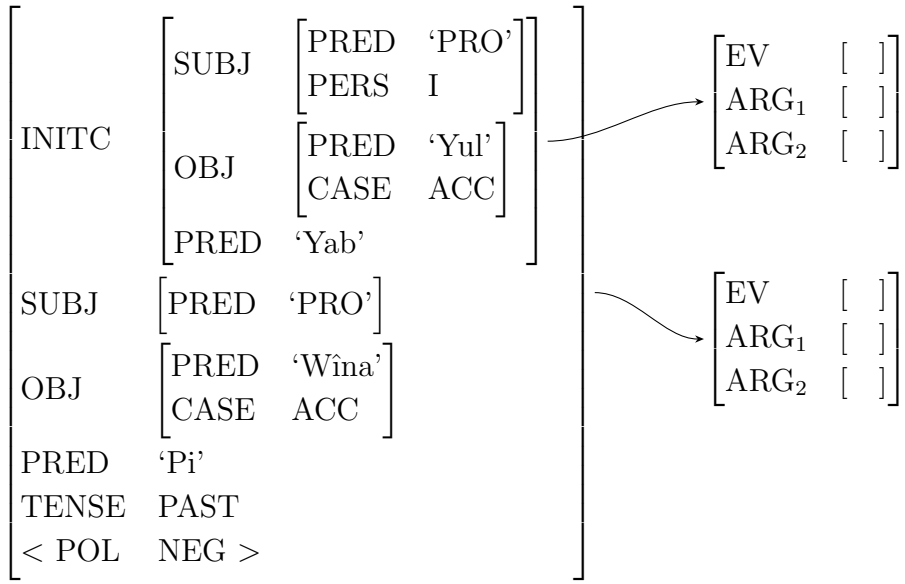
In these examples, the superficial form is that of a 'consecutive' structure, where the bracketted material is a morphosynactically subordinate clause indicating what happens first, and the remaining material looks like a main clause, saying what happens next.

But the semantics of these constructions are different, and essentially causative. In particular, the negative applies not to the final result ((b) does not mean that I caused the dog to not eat meat), but rather to the entire proposition that I made the dog eat meat. The substantive semantics can be plausibly described in with the Wierzbickian DO (TO), BECAUSE OF and AFTER semantic primes, roughly and schematically, as follows:

(59) X did something to Y (I did something to the dog)
because of this, after this, something happened (the dog ate meat).

In formal terms, we can use the usual three-place causative predicate, but the connection to the syntactic structure will have to be unusual.

For the morphology to work, we would appear to want the first clause to be the value of some grammatical function, which we'll call INITC (Initial Clause), with the second the main clause:

(60)



From a traditional perspective, this seems like a rather poor prospect for semantic interpretation, but glue can manage it far more deftly than AM99 realized.

In the first place, there does not appear to be 'semantic functional control' between the arguments. In particular, we don't seem to want anything to enforce identity or coreference between the object of the Cause verb and the subject of the Effect verb (AM99:99-100). For example Bittner (1998:64-65) shows that there can be a variety of relationships between the causee object or its possessor, and some argument in the caused clause:

(61) a. Upla kumi sin mai mun-an yul mai
person one 'also' you(OBJ) cause-OBJ:ACT.3 dog you(OBJ)
sam-ras kan
bite-NEG PAST.3
Noone will cause you to be bitten by the dog
(Causee object = caused object)

b. Witin upla kumi sin yula (ra) pruk-an law-ras
he person one his dog (ACC) hit-OBV:3 get.angry-NEG
kan
PAST.3
He didn't get anyone angry by hitting his$_i$ dog (Possessor of causee object = caused subject)

In these the fact that the subject of the first clause is within the scope of the negative marker indicates that this is a causative rather than a consecutive structure. Furthermore, AM99:100 note an example from Sumu where there is no coreference at all:[16]

(62) Kârak âraysyang dai, yang alas âranayang
he.laugh.OBV.3 laugh.NEG.1 PAST I self laugh.PAST.1
He didn't laugh me into laughing; I laughed by myself

Note that the obviatively marked verb is intransitive in the Sumu original, in spite of being rendered transitively in the free English translation. So AM99 conclude that there is no formal coreference requirement, but only tendency, based on a requirement for a causal relationship.

Therefore the arguments can all be realized independently as NPs, with the further consequence that the Causee Agent does not have to be an $\mathrm{ARG}_3$, but can be an $\mathrm{ARG}_2$, and that is what it in fact appears to be.[17] A rather simple meaning-constructor suffices:

(63) $\lambda Pyz.Cause(P)(y)(x)$ : $(\mathrm{INITC}\uparrow)_\sigma \rightarrow (\uparrow\mathrm{ARG}_2) \rightarrow (\uparrow\mathrm{ARG}_1) \rightarrow (\mathrm{INITC}\uparrow)_\sigma$

Its mode of application is similar to that of a sentence-adverbial such as *apparently*, although it manages arguments that appear in its own clause. For both of the clauses, virtually any contemporary linking theory will suffice.

There is one interesting issue which the present literature does not entirely settle, as far as I am aware, which concerns the scope of negation. If we assume that the causative verb takes an argument of type $p$, which the caused verb provides, we predict an ambiguity in examples such as (62) and (58b), which apparently does not occur. This is a *prima facie* problem for the glue analysis, for which a possible solution would be to use more types. For example if the causatives complements were of an 'Event' type, and the negation only applied to 'Propositions', the scopes would be restricted as stated in the literature. On the other hand, there are some potential examples that could use further investigation. Causation of a negative might be semantically suspicious and therefore rejected, but permissive verbs also occur in the causative construction:

[16]From an undated 'miscelleneous causative data' handout compiled by various people including especially Danilo Salamanca, and distributed by Ken Hale.

[17]Note that because the Miskitu accusative case-marker *ra* is highly multifunctional, also marking various kinds of obliques, it is the possibility of object agreement with the verb that indicates $\mathrm{ARG}_2$ status of the Causee Agent.

(64) Witin yang ra ai swi-n skul ra wa-ri
he me ACC me let-OBV:ACT.3 school ACC go-PAST.1
He let me go to school

Nobody appears to have investigated whether negation of the caused verb here could produce the meaning 'he let me not go to school'. So there is a margin of doubt about the nature of the facts here, and whether a distinction between $p$ and $ev$ types is truly required (although, this is very useful elsewhere, and, I would guess, probably correct here).

# 6 Conclusion

We have seen that a considerably more restrained use of attribute-sharing, independently motivated for the analysis of coordinate structures, can be combined with a more intensive use of glue semantics to capture the major analysis of AM. The basic ideas are essentially the same as those of AM, but the required net changes to the LFG framework from the presentation of Dalrymple (2001) are far less, essentially nothing more than the addition of oversharing and undersharing to the concept of distributivity. Classic LFG analyses would furthermore require less revision, although more than is required for the framework itself. We also find a high degree of compatibility with the recent linking theory of AGT, which supports LFG analysis of a very wide range of phenomena beyond the complex predicate structures we have examined here, and, furthermore, generates a typological prediction about grammatical relation change in complex predicates.

However there is another issue, the status of classic (negative) restriction as proposed by Kaplan and Wedekind (1993). Should this be abandoned or delimited? I think abandonment would be premature, but I suggest that restriction be limited to situations where the two partially identified f-structures do not have any containment relation in c-structure. This would rule it out for all the constructions discussed here, with the result that iofu will work for them without issue, but it might still be used for situations where there is extensive property-sharing between constituents that are not related by a containment relationship, such as pronouns and their antecedents.

The exclusion of this kind of restriction from phrase-structure rules such as those involved with our complex predicate constructions could be achieved with a constraint requiring that if there is a downward c-structure path from a

node $A$ to a node $B$, there must also also a downward f-structure path. This is a very natural condition to impose, and excludes some rather odd configurations such as daughters who take their mothers as f-structure attribute-values but not vice versa.

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