Proceedings of the LFG'20 Conference

On-Line

Miriam Butt, Ida Toivonen (Editors)

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Contents

1 Editor's Note

The 2020 Conference on Lexical Functional Grammar was held on-line. The program committee for LFG20 were John Lowe and Agnieszka Patejuk. We would like to thank them for coordinating the review process and working with the conference organizers to put together this year's on-line program. The conference was originally scheduled to take place at the University of Oslo in Norway, with Helge Lødrup and Dag Haug as organizers. Due to the pandemic, the executive committee decided to move the conference on-line. Koenraad De Smedt, George Aaron Broadwell, Stephen Jones, Joey Lovestrand, Kengatharaiyer Sarveswaran, Péter Szűcs, Fengrong Yang, John Lowe and Agnieszka Patejuk then took on the challenging task of figuring out which on-line format would best suit the LFG conference.

This committee implemented a website where extended abstracts, handouts and videos of talks were uploaded beforehand, along with an open commenting function. The synchronous part of the conference was held mainly in the form of QA sessions on the talks and posters accepted for the conference. Social gatherings were facilitated via Discord. This format worked out very well and we would like to thank the ad-hoc committee for an outstandingly well organized conference that worked well and smoothly.

As usual, we would also like to thank the executive committee and the abstract and final paper reviewers, without whose prompt and thorough work the conference and the proceedings would not have been possible in this form.

This year's conference was originally scheduled to include a workshop on Scandinavian syntax, but this was canceled when the conference as a whole moved on-line.

The table of contents lists all the papers presented at the conference. Some papers were not submitted to the proceedings. For these papers, we suggest contacting the authors directly. We note that all of the abstracts were peer-reviewed anonymously (double-blind reviewing) and that all of the papers submitted to the proceedings underwent an additional round of reviewing. We would like to express our heartfelt thanks to all of the anonymous reviewers for the donation of their expertise and effort in what is often a very short turn-around time.

Hard Copy: All of the papers submitted to the LFG20 proceedings are available in one large pdf file. The proceedings' file was created via pdflatex tools and with the help of scripts written originally by Tracy Holloway King and Stefan Müller. We thank Sarah Weaver at CSLI Publications for making sure the proceedings become accessible via the CSLI site. Finally, we thank Dikran Karagueuzian at CSLI Publications for his continuous support of our proceedings and our community.

Obligatory clitic expression, clitic omission, and the morphology-syntax interface

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Abstract

In the Romance language Catalan, some verbs and some argument-structure configurations normally require the reflexive clitic; however, in certain constructions, the expected reflexive clitic is optionally missing; and, yet in other constructions, the reflexive clitic is obligatorily left out. The main theoretical claim is that so-called clitics in Romance, a special kind of affix, are licensed by syntax-morphology (SM) mapping principles so that a clitic is used if and only if it is required by an SM mapping principle. This approach has important implications for the syntax-morphology interface: words are not inserted in their inflected form in the syntax, contrary to standard LFG assumptions, but are inserted as lexemes and their inflected forms are licensed on the basis of the f-structure information.[†]

The goal of this paper is to explain a puzzle involving the reflexive clitic in the Romance language Catalan. Some verbs and some argument-structure configurations normally require the reflexive clitic; however, in some constructions, the same verbs and a-structure configurations appear to allow the reflexive clitic to be missing; and, yet in other constructions, the reflexive clitic is obligatorily left out. We thus have an alternation between obligatory expression of the reflexive clitic, optional omission of this clitic and obligatory omission of the clitic.[1]

The main theoretical claim of the paper is that so-called "clitics"[2] in Romance, a special kind of affix, are licensed by syntax-morphology (SM) mapping principles –a type of principle proposed in Luís and Spencer (2005: 213–215)– so that a "clitic" is used if and only if it is required by an SM mapping principle. Such SM mapping principles license a "clitic," whenever a given f-structure feature combination arises, and place the "clitic" in correspondence with a specific grammatical function. The morphology assigns phonological representations to "clitics" on the basis of the f-structure features that the "clitics" are linked to. This proposal makes full use of the LFG idea that different levels of representation are co-present and constrain each other. In particular, it assumes that the interaction between syntax and morphology is not one-way (with the morphology constraining the syntax, but not vice versa), as is generally assumed in LFG, and that the syntax may constrain the morphology as well. The present analysis assumes that the

[†] I thank the audience at LFG2020, in particular Ash Asudeh and Joan Bresnan, and two anonymous reviewers, for extremely valuable comments.

[1] Andrews's 1990 Morphological Blocking Principle provides an explanation for some instances of obligatory clitic expression. But many cases remain unexplained.

[2] A terminological clarification is in order here. Given the evidence that so-called "clitics" in Romance are affixes (see footnote 3), it might be more appropriate to refer to them simply as affixes, leaving the term *clitic* in its technical sense for a phonologically dependent word that does not project a full phrase. However, since there is a long tradition in Romance linguistics of referring to the elements under investigation here as *clitics*, from now on I will use the term *"clitic"* (in quotes) for these elements, in order to make it clear that they are not clitics in the technical sense of the word and that no claims are being made about clitics in this sense.

syntax and the morphology constrain each other. This conception of the syntax-morphology interface not only provides for a simple analysis of the facts of the reflexive “clitic” in Catalan, but allows a considerable simplification of the framework.

We will first present the facts of the reflexive “clitic” in Catalan, showing the contexts in which it is obligatory, those in which it is optional, and those in which it is necessarily left out. We then present the analysis and, finally, the main conclusions are highlighted.

1 The distribution of the reflexive “clitic”

Verbal “clitics” in Catalan, as in Romance in general, are assumed here to be a special kind of affix that attaches to verb forms.[3] They are prefixed to finite verbs except for imperatives and suffixed to imperatives and non-finite forms. The following chart gives the underlying form of the personal “clitics” (leaving out the so-called neuter “clitic” *ho* /u/ and the oblique “clitics” *en/ne* /n/ and *hi* /i/) when used as the only “clitic” in the word; the third person dative plural form for the formal register (/lz/) is shown in parentheses.

(1)

<table>
<tr><th>Person</th><th>Reflexivity</th><th>Case</th><th>Gender</th><th>Singular</th><th>Plural</th></tr>
<tr><td rowspan="4">3</td><td colspan="3">Refl +</td><td colspan="2">s</td></tr>
<tr><td rowspan="3">Refl –</td><td colspan="2">Dat +</td><td>li</td><td>lzi (lz)</td></tr>
<tr><td rowspan="2">Dat–</td><td>masc</td><td>l/lu</td><td>lz/luz</td></tr>
<tr><td>fem</td><td>la</td><td>laz</td></tr>
<tr><td colspan="4">2</td><td>t</td><td>uz/buz</td></tr>
<tr><td colspan="4">1</td><td>m</td><td>nz/nuz</td></tr>
</table>

The only “clitic” forms that are exclusively reflexive are the third person “clitics.” All “clitics” consisting of a consonant underlyingly in Catalan are realized phonetically as the consonant alone, as in (2), or with an epenthetic vowel before or after the consonant, depending on the phonological context.

1.1 Obligatory expression

Some constructions require the presence of a reflexive “clitic.” The “clitic” may signal either a lexical requirement imposed by the main verb of the construction or a binding of arguments at the level of argument structure.[4] The lexical requirement is found with inherently reflexive verbs such as *adonar-se* ‘realize’ or *emportar-se* ‘take away’: the reflexive “clitic” cannot normally be left out, as in (2). The binding of arguments arises with verbs that are otherwise transitive or ditransitive, such as *veure* ‘see’, *donar* ‘give’

[3] See the evidence presented by Bonet 1991, 1995 for Catalan, by Miller 1992 and Miller and Sag 1997 for French, by Crysmann 1997, Luís and Sadler 2003, and Luís and Spencer 2005 for Portuguese, by Monachesi 1999 for Italian, among others.

[4] In addition, the third person reflexive “clitic” can also signal either passivization or impersonalization (see Yang 2019 and references cited there), which will not be considered here.

or *dutxar* ‘shower’: the reflexive “clitic” signals the binding of the logical subject and an internal argument of the predicate and cannot be left out without resulting in the loss of the binding interpretation and sometimes also in ungrammaticality, as in (3).

(2) a. Aviat *(s’) adonarà del problema.
soon CL.REFL.3 will.realize of.the problem
‘S/he will soon realize the problem.’

b. No *(m’) adono fàcilment dels meus errors.
not CL.1.SG realize.1SG easily of.the my mistakes
‘I don’t realize my mistakes easily.’

c. *(S’) haurien d’ emportar aquestes maduixes.
CL.REFL should.3PL of take.away these strawberries
‘They should take away these strawberries.’

(3) a. De sobte *(s’) ha vist reflectida en el vidre.
suddenly CL.REFL.3 has seen reflected in the glass
‘She suddenly saw herself reflected on the glass pane.’

b. Feia dies que no *(ens) vèiem.
make.IMPF days that not CL.1.PL see.IMPF.1.PL
‘We hadn’t seen each other in days.’

c. Els jugadors *(es) donen la mà.
the players CL REFL.3 give the hand
‘The players shake each other’s hand.’

d. Avui *(ens) hem dutxat amb aigua freda.
today CL.1.PL have showered with cold water
‘Today we took a cold shower.’

We refer to the “clitic” that occurs with inherently reflexive verbs, as in (2), as the inherent reflexive “clitic” and to the “clitic” that is associated with a semantically reflexive or reciprocal interpretation, as in (3), as the anaphoric reflexive “clitic.” There is no morphological difference between the two: the same forms are used and combine in the same way with other “clitics” and with the verbs. They differ in that the inherent reflexive “clitic” cannot be replaced by a non-reflexive “clitic,” whereas the anaphoric reflexive “clitic” can, losing the anaphoric interpretation.

The obligatoriness of the reflexive “clitic” that we see in (2)–(3) is satisfied even when it is not attached directly to the verb that requires it. The reflexive “clitic” may attach to an auxiliary verb or to a restructuring verb that selects a verb that requires the “clitic” and, in fact, there may be an indefinitely long sequence of auxiliaries and restructuring verbs between the reflexive “clitic” and the verb that requires it. The class of restructuring verbs includes a large number of verbs expressing meanings of modality, movement, beginning and ending, knowledge, etc. Examples are given in (4):

(4) a. S' hauria pogut tornar a adonar
CL.REFL.3 have.COND.3.SG been.able repeat.INF to realize.INF
del seu error.
of.the POSS.3 mistake
'S/he might have realized his/her mistake again.'

b. Ens vam voler començar a veure aviat.
CL.1.PL PAST.1.PL want.INF start.INF to see.INF soon
'We wanted to start seeing each other soon.'

The "clitic" that satisfies the reflexivity requirement in the most embedded verb in the sequence of verbs –*adonar* in (4a) and *veure* in (4b)– appears attached to a verb three words away from that verb (not counting the preposition *a*). This shows that the reflexive "clitic" cannot be assumed to attach at the morphological level to the verb that requires it. (4) illustrates the phenomenon of *clitic climbing*, whereby a "clitic" that satisfies a lexical requirement of a verb appears not attached to this verb, but to an auxiliary or restructuring verb in a sequence of such verbs. The reflexive "clitic" is also obligatory in cases such as (4) and could alternatively attach to any of the infinitives following the finite verb form. For (4b), for example, there are three other positions for the "clitic," with the same meaning, as in (5):

(5) a. Vam voler-*nos* començar a veure aviat

b. Vam voler començar-*nos* a veure aviat.

c. Vam voler començar a veure'*ns* aviat.

1.2 Optional "clitic" omission

The reflexive "clitic," which is obligatory in (2)–(5), appears to be optional when the verb requiring it is an infinitive dependent on one of the causative verbs *fer* 'make' or *deixar* 'let', as an instance of the inherent reflexive, as in (6), or of the anaphoric reflexive, as in (7) (the latter based on GLC: 1021):

(6) a. Això farà adonar (-se) els meus superiors
this will.make realize.INF CL REFL.3 the my superiors
de la dificultat.
of the difficulty
'This will make my superiors realize the difficulty.'

b. No li deixis emportar (-se)
not CL.DAT.3.SG let.2.SG take.away.INF CL REFL.3
aquestes maduixes.
these strawberries
'Don't let her take these strawberries away.'

(7) a. Els han fet donar (-se) la mà.
CL.DAT.3.PL have made give.INF CL.REFL.3 the hand
'They made them shake each other's hand.'

	b.	Ens	han	fet	dutxar	(-nos)	amb	aigua freda.
		CL.1.PL	have	made	shower.INF	CL.1.PL	with	cold water

‘They made us take a cold shower.’

Even though the option of omitting the reflexive “clitic” is preferred in many cases of the type shown in (6)–(7), the possibility of expressing it cannot be excluded. And, in fact, this “clitic” is required whenever any of the complements of the infinitive dependent on the causative verb is expressed as a “clitic” attached to the infinitive. The genitive complement of *adonar-se* is expressed either as a PP introduced by *de*, as in (6a), or by the oblique “clitic” *en/ne*, as in (8a); the accusative object of *emportar-se* can be expressed by means of an accusative “clitic” such as *les*. When one of these “clitics” is attached to the infinitive, it must appear together with the reflexive “clitic,” as shown in (8): omitting the reflexive “clitic” results in unacceptability. This is the case not only with the inherent use of the reflexive “clitic,” as in (8), but also with its anaphoric use, as in (9). The anaphoric interpretation requires the reflexive “clitic,” so that the version of (9a) without that “clitic” is ungrammatical with the intended anaphoric reading, although acceptable with the interpretation that there is an unspecified recipient (‘They made them give it away.’).

(8)	a.	Ell	els	farà	adonar	{-se	’n /*-ne}.
		he	CL.ACC.3.PL.M	will.make	realize.INF	CL.REFL.3	NE / NE

‘He will make them realize it.’

b.	Deixa	-li	emportar	*(-se)	-les.
	let	CL.DAT.3.SG	take.away.INF	CL.REFL.3	CL.ACC.3.PL.F

‘Let her take them away.’

(9)	a.	Els	han	fet	donar	{-se	’l
		CL.DAT.3.PL	have	made	give.INF	CL.REFL.3	CL.ACC.3.SG.M
		/*-lo}		(el	premi).		
		CL.ACC.3.SG.M		the	prize		

‘They have made them give it to each other (the prize).’

b.	Ens	han	fet	dutxar	*(-nos)	-hi.[5]
	CL.1.PL	have	made	shower.INF	CL.1.PL	HI

‘They made us shower in it.’

1.3 Obligatory “clitic” omission

When a non-reflexive “clitic” corresponding to a complement of the infinitive in a causative construction undergoes “clitic” climbing and appears attached to the causative verb (or higher up in the structure), the reflexive “clitic” that is optional in (6)–(7) and obligatory in (8)–(9) is obligatorily left out. The reflexive “clitic” in such cases is ungrammatical whether it is attached to the infinitive, as in (10a), (11a), and (12), or to the subordinating

[5] Colloquially pronounced [du'ʧanzi] for *dutxar-nos-hi* and [du'ʧaɾi] for *dutxar-hi*.

verb, as in (10b) and (11b).[6] Leaving out the reflexive "clitic" in (10)–(12) makes all of these examples grammatical. The form corresponding to (12) in which the reflexive "clitic" is attached to the matrix verb is not given, because, with first and second person "clitics," the reflexive form is identical to the non-reflexive form and that would result in a sequence of two identical first person "clitics," which is excluded for morphophonological reasons.

(10)	a.	Això	els	en	farà	adonar	(*-se).	
		this	CL.ACC.3.PL.M	NE	will.make	realize.INF	CL REFL.3	
	b.	*Això	se	'ls	en	farà	adonar.	
		this	CL REFL.3	CL.ACC.3.PL.M	NE	will.make	realize.INF	
		'This will make them realize.'						

(11)	a.	No	els	hi	deixis	emportar	(*-se).	
		not	CL.ACC.3.PL	HI	let.2.SG	take.away.INF	CL REFL.3	
	b.	*No	se	'ls	hi	deixis	emportar.	
		not	CL REFL.3	CL.ACC.3.PL	HI	let.2.SG	take.away.INF	
		'Don't let her take them away.'						

(12)	Ens	-hi	han	fet	dutxar	(*-nos).	
	CL.1.PL	HI	have	made	shower.INF	CL.1.PL	
	'They made us shower in it.'						

1.4 Summary

The reflexive "clitic" is obligatory, as a general rule, in its inherent use and its anaphoric use. However, it appears to be optional when the verb that would normally require it is an infinitive dependent on a causative verb. But this optionality is only apparent, because the reflexive "clitic" is required on the infinitive when this verb form has other "clitics" attached to it, but cannot be expressed when the other "clitics" dependent on the infinitive are attached to the higher causative verb (or to a higher restructuring verb).

2 Explaining the facts

The fact that the reflexive "clitic," which is required by particular verbs or a-structure configurations, is in certain constructions necessarily overt, in others optionally expressed, and yet in others necessarily unexpressed, I take to be strong evidence for the status of the reflexive "clitic" as an affix and, further, not as an affix within a morpheme-based approach to morphology, but as an affix within a realizational approach. If we assumed it was a

[6] The "clitic" combination *els hi* (phon. [əlzi]) in (11a) corresponds in the colloquial register to one or two third person objects provided one is dative and one is plural (possibly, but not necessarily, the same one), irrespective of gender. The glossing reflects the idea that, in (11a), it corresponds to a third person plural accusative object and to a third person singular dative object, of either gender. The translation in (11) is one of many possible translations.

morpheme, with its own (sub)lexical entry, it would be very hard to explain that it could be unexpressed, even though there is a verb that requires it.

I also assume that the reflexive "clitic," unlike most other "clitics" in Romance, is not the expression of an object (or an oblique) in both of the uses studied in this paper. This idea is quite uncontroversial for the inherent use of the reflexive "clitic," as it does not alternate with a phrasal object. This idea is not so obvious when applied to the anaphoric reflexive "clitic," as it does alternate with a phrasal object, but, according to the arguments presented in Grimshaw 1982, 1990, Alsina 1996, and others, it is unlike pronominal "clitics" and is analyzed as signaling a valence-reducing operation.

In what follows, I will present the analysis of the reflexive "clitic," adopting these two assumptions (namely, that the reflexive "clitic" is an affix within a realizational approach to morphology and that it is not the expression of an object or an oblique). The analysis involves: (a) the licensing of an a-structure feature, [REF], by a specific class of verbs and by a specific a-structure configuration; (b) the licensing of a "clitic" as a verbal affix given certain f-structure features, on the assumption that a "clitic" is licensed if and only if there is a rule requiring it; and (c) the assignment of a phonological realization to a "clitic" on the basis of its f-structure features by specific rules (morphological realization rules, to use Luís and Sadler's 2003 term).

2.1. Licensing of the a-structure feature [REF]

One of the licensing conditions for the reflexive "clitic" is the feature [REF]. This feature is present on a logical subject (or a-structure subject) –the most prominent argument at a-structure– under two circumstances. On the one hand, inherently reflexive verbs like *adonar-se* or *emportar-se* lexically specify that their logical subject is marked with the feature [REF]. Thus, the lexical entry of an inherently reflexive verb includes this information:

(13) *Lexical information of inherently reflexive verbs*:

[PRED 'X < [REF]…>']

(13) indicates that the most prominent argument role at a-structure includes the feature [REF]. As in Alsina 1996 and other work, I am assuming that a-structure is part of the PRED value and is a list of arguments represented by means of features and ordered by prominence, so that the leftmost argument in the list is the logical subject.

On the other hand, the binding of two argument roles at a-structure, one of which must be the logical subject, results in this argument having the feature [REF], as shown in (14).

(14) *Anaphoric Reflexive Licensing Principle*:

[PRED 'X < $[\ ]_1$ … $[\ ]_1$…>'] → [PRED 'X < $[\text{REF}]_1$ …>']

Correspondence between elements at different levels of structure is shown by means of coindexation, which signals that the two bound arguments in (14) map onto the same GF (in the process named a-structure binding in Alsina 1996). In this way, a GF may be linked to the feature [REF] in one of two ways: either because the verb of its clause is an inherently reflexive verb and, therefore, includes the information in (13) in its lexical entry or because the predicate of its clause involves an a-structure binding configuration, which triggers the principle in (14). The GF that is linked to [REF] is, in most cases, the subject, given that it corresponds to the logical subject and, as a default, the logical subject maps onto a subject. But as we shall see, it is not always the case that the GF linked to [REF] is the subject.

2.2. Licensing of "clitics"

We assume that "clitics" are a class of affixes that are licensed by syntax-morphology (SM) mapping principles, along the lines of Luís and Spencer (2005: 213–215). A "clitic" is licensed in the morphology of a verb if there is an SM mapping principle that requires it and cannot be used unless there is such a principle. Although this paper deals with the reflexive "clitic," we will see how pronominal, or non-reflexive, "clitics" can be accounted for before turning to the reflexive "clitics." The most general form of the "clitic"-licensing principle states, as in (15), that a pronominal non-subject is expressed as a "clitic."

(15) *General "clitic"-Licensing SM Mapping Principle (CLI-LIC)*:

$$\begin{bmatrix} \text{PRED} & <\ldots\ \theta_2 \ldots> \\ \text{OBJ/OBL} & [\,\text{PRED}\ \ \text{pro}]_2 \end{bmatrix}_1 \Rightarrow [_{\text{V}}\ldots \text{cl}_2 \ldots]_1$$

According to this principle, a verb that corresponds to an f-structure containing a pronominal object or oblique argument must include a "clitic" corresponding to that argument. An SM principle is a constraint on the correspondence between c- and f-structure that should be interpreted as follows: The f-structure specified on the left of the arrow in (15) maps onto a verb (its head in the c-structure) containing a "clitic" linked to a GF in that f-structure. SM mapping principles such as (15) interact in an OT fashion with two constraints:[7] *Express GF*, (16), requiring GFs to have an overt expression, either as XPs or as affixes (i.e., penalizing pro-drop), and *Minimize Morphology*, (17), penalizing the use of affixes:

(16) *Express GF (EXP-GF)*: A GF must be overtly expressed (as an XP or as an affix).

(17) *Minimize Morphology (MIN-MOR)*: An affix obtains a violation mark.

By EXP-GF, all GFs, including those required by Completeness, should have expression, either in c-structure or in the morphology. MIN-MOR can be

[7] See Bresnan 2000, Kuhn 2003, Alsina and Vigo 2014, 2017, among others, for proposals adapting Optimality Theory (OT) to LFG.

seen as an adaptation of Bresnan et al.'s (2016: 90) principle of Economy of Expression to the morphology that assigns a cost to affixes, such as "clitics." It is clear that these two constraints are partially conflicting and the two alternative rankings give different results.

It should be noted that, in the present conception of inflectional morphology, affixes, such as "clitics," are the realization, or spell-out, of syntactic features. This means that inflectional affixes do not carry syntactic features, and the words that contain these affixes do not carry the syntactic features associated with these affixes. This implies that the traditional LFG analysis of "pro-drop," subject-verb agreement, or pronominal incorporation, cannot be maintained in the present framework: e.g., the feature [PRED 'pro'] that is assumed to be carried by an object marker in Chicheŵa in Bresnan and Mchombo 1987 would here be part of the f-structure and interpreted as a particular affix by an SM mapping principle. This also implies that "clitic" doubling (the expression of a given GF by means of an independent pronoun and a pronominal affix) does not raise the issue of PRED feature unification.

In a constraint ranking in which EXP-GF outranks MIN-MOR (EXP-GF » MIN-MOR), a "clitic" is used only if the alternative is a null expression: a "clitic" is preferred over a pro-dropped argument. If we compare a structure in which a given argument is expressed only as a "clitic" with a structure in which the same argument has no expression, both structures receive a violation mark for one of the two constraints, but the latter structure gets a fatal violation of EXP-GF, making the "clitic" expression the optimal choice.

In the reverse ranking of the two constraints (MIN-MOR » EXP-FG), if we compare a "clitic" expression with a null expression of an argument, the "clitic" expression is a worse choice than the null expression, making argument pro-drop the optimal candidate. In this way, we capture the difference between languages with incorporated pronominals, such as "clitics," and languages with argument pro-drop. (See section 3 for the status of languages like English lacking both "clitics" and pro-drop.) The former are languages with the ranking EXP-GF » MIN-MOR.

In addition, if a "clitic"-licensing principle such as CLI-LIC (15) is ranked above MIN-MOR, we obtain a language with pronominal "clitic" doubling, a language in which pronominal non-subject arguments are expressed by means of a "clitic" and possibly also by means of a pronominal XP.[8] In the reverse ranking, we have a language in which the "clitic" expression of a pronominal object or oblique is possible only when the pronominal XP is not used. That is, if the ranking is MIN-MOR » CLI-LIC, using a "clitic" to double a pronominal XP obtains a fatal violation of MIN-MOR, making "clitic" doubling ungrammatical. This is the situation we find in a language like Italian, where "clitic" doubling never arises.

[8] As noted above, there are not two expressions with the PRED feature, but only one (the full pronoun), and so no general principle prevents this situation.

In languages where "clitic" doubling is found in limited situations, such as Catalan, we can assume the ranking MIN-MOR » CLI-LIC and that there are more specific "clitic"-licensing constraints that rank above MIN-MOR. A case in point would be the obligatory "clitic" doubling with first and second person objects, but space constraints prevent us from illustrating this situation. In general, "clitic" doubling is disallowed in Catalan: for example, the so-called neuter object "clitic" *ho* can be used, as in (18a), but cannot be used if the object is expressed by an independent pronoun, as in (18b):

(18) a. *(Ho) diré.
HO say.FUT.1.SG
'I will say it.'

b. (*Ho) diré això.
HO say.FUT.1.SG that
'I will say that.'

For (18a), a structure with the object "clitic" is in competition with a structure with a null object. The latter structure obtains a fatal violation of EXP-GF, making the structure with the "clitic" the optimal choice, even if this one has a violation mark for MIN-MOR. If the object is expressed by an XP, in (18b), EXP-GF is satisfied without a "clitic"; so, including a "clitic" merely incurs a violation of MIN-MOR and has no ameliorating effect.

The tableaux in (19) show how the competition between the word *ho diré* (with the "clitic") and the word *diré* (without the "clitic") is resolved differently in (18a) and (18b). The relevant constraint ranking is EXP-GF » MIN-MOR » CLI-LIC. The two competing candidates are a V linked to the same f-structure and EVAL chooses the best morphological structure for it given that syntactic information. Crucially, the input has an OBJ with the [PRED 'pro'] feature that is provided by a general rule in (19a) (see section 3) and by the word *això* 'that' in (19b).

(19) a.

[OBJ [PRED 'pro']]	EXP-GF	MIN-MOR	CLI-LIC
a. ho diré		*!	
☞ b. diré	*!		*

b.

[OBJ [PRED 'pro']]	EXP-GF	MIN-MOR	CLI-LIC
a. ho diré això		*!	
☞ b. diré això			*

2.3. Licensing of the reflexive "clitic"

The principle that licenses a reflexive "clitic" differs from the other "clitic"-licensing principles in that the "clitic" is not licensed by being linked to an object or an oblique, but is licensed by a subject with the feature [REF]. We also need to assume that principle (20) ranks above MIN-MOR, as the reflexive "clitic" is realized even if the subject is overt.

(20) *SM mapping principle licensing reflexive "clitics"*:

$$\left[\begin{array}{ll} \text{PRED} & \text{'X} < \ldots [\text{REF}]_1 \ldots > \text{'} \\ \text{SUBJ} & [\ldots]_1 \end{array}\right]_2 \Rightarrow [_{V}\ldots \mathrm{cl}_1 \ldots]_2$$

This principle maps an f-structure whose subject corresponds to an argument role with the feature [REF] to a verb that includes a "clitic" linked to that subject. In general, logical subjects map onto the GF subject; so, in most cases, a GF linked to a [REF] argument is a SUBJ and, consequently, by the SM mapping principle (20), will license a "clitic" (a reflexive "clitic"). This is what we see in (2) and (3): the subject of the relevant clause is marked with the feature [REF] because the verb carries the information in (13), in (2), or because principle (14) applies, in (3): in both cases, the logical subject is assigned this feature and, as it maps onto the grammatical subject, principle (20) applies requiring a reflexive "clitic." In example (2a), repeated as (21), the word *adonarà*, a form of the inherently reflexive verb *adonar-se*, has a logical subject with the feature [REF], which maps onto the subject. As this subject has the feature [REF], principle (20) applies requiring the verb to include a reflexive "clitic" (a "clitic" linked to the subject).

(21)	Aviat	*(s')	adonarà	del	problema.
	soon	CL.REFL.3	will.realize	of.the	problem

'S/he will soon realize the problem.'

The information that the subject is linked to [REF] can travel a considerable distance when auxiliaries and restructuring verbs are involved. In example (4a), repeated as (22), although the auxiliary *hauria* is not a verb that requires its logical subject to be [REF], nor, for that matter, the restructuring verbs *pogut* and *tornar*, whch intervene between it and the inherently reflexive verb *adonar*, these *light* verbs have the possibility of adopting the argument structure of their dependent verb as their own. Therefore, through a chain of restructuring, the auxiliary, as well as the two intervening light verbs, has an a-structure with a [REF] argument linked to the subject, causing principle (20) to apply.

(22)	S'	hauria	pogut	tornar	a	adonar
	CL.REFL.3	have.COND.3.SG	been.able	repeat.INF	to	realize.INF

del	seu	error.
of.the	POSS.3	mistake

'S/he might have realized his/her mistake again.'

Following the analysis of Alsina 1997 (see also Rizzi 1982, Aissen and Perlmutter 1983, and Rosen 1989), we can assume that each auxiliary and restructuring verb can form a complex predicate with its complement verb, which can result in a single PRED and a-structure for the sequence of verbs in (22). And when a complex predicate is formed, the least embedded verb in the sequence of verbs taking part in the complex predicate is the one that can host "clitics." Thus, although the reflexive "clitic" in (22) morphologically attaches to *hauria*, it satisfies a lexical requirement of the verb *adonar*. With restructuring verbs there is always an alternative control construction in which the complement verb, instead of forming a complex predicate with the restructuring verb, heads a complement clause whose subject is controlled by the subject of the restructuring verb. In such cases, "clitics" attach to the least embedded verb in the complement clause. See the evidence for this claim in Aissen and Perlmutter 1983 and Rizzi 1982, where it is observed that there is no semantic difference correlating with the syntactic difference.

To illustrate the analysis, consider the alternative position of the reflexive "clitic" in (23). The simplified f-structures corresponding to these examples are given in (24). (24a) contains a complex predicate involving the two verbs *pot* 'can' and *adonar* 'realize': it is a monoclausal structure in which the logical subject of *adonar* is the subject of the clause. (24b) is the control construction, in which *pot* takes an infinitival complement[9] and its subject controls the complement's subject.

(23) a.

Es	pot	adonar	del	seu	error.
CL REFL.3	can	realize.INF	of.the	POSS.3	mistake

b.

Pot	adonar	-se	del	seu	error.
can	realize.INF	CL REFL.3	of.the	POSS.3	mistake

'S/he can realize his/her mistake.'

(24) a. $\begin{bmatrix} \text{PRED} & \text{`can} < [\ldots]_1 \ \text{realize} \ < [\text{REF}]_1 \ [\ldots] >>\text{'} \\ \text{SUBJ} & [\text{PRED `pro'}]_1 \end{bmatrix}$

b. $\begin{bmatrix} \text{PRED} & \text{`can} < [\ldots]_1 \ [\ldots] >\text{'} \\ \text{SUBJ} & \boxed{1}[\text{PRED `pro'}]_1 \\ \text{OBJ} & \begin{bmatrix} \text{SUBJ} & \boxed{1} \\ \text{PRED} & \text{`realize} \ < [\text{REF}]_1 \ [\ldots] >\text{'} \end{bmatrix} \end{bmatrix}$

Structure (24a) satisfies principle (20) at the matrix level, so that the "clitic" is licensed on the least embedded verb of the clause, namely, *pot*, as in (23a). (24b) satisfies that principle in the embedded clause, and so the reflexive "clitic" is licensed on the least embedded verb of this clause, the infinitive *adonar*. Notice that, although the subject is shared between the matrix and embedded clauses in (24b), the conditions for application of (20) are not met at the matrix level, as [REF] is in the a-structure of the lower clause.

When a causative verb is involved, as in examples (6)–(12), the resulting structure resembles the situation with restructuring verbs, as a complex predicate can be formed with the dependent verb and an alternative

[9] Adopting a reduced inventory of GFs, consisting only of SUBJ, OBJ, and OBL, for in-clause GFs, as in Alsina1996 and Patejuk and Przepiórkowski 2016, the infinitival complement is designated by OBJ in (24b).

structure is possible in which the dependent verb heads a complement clause whose subject is controlled. As with restructuring verbs, what signals whether a complex predicate is formed or not is “clitic” climbing. If there is no “clitic” climbing, a complex predicate has not been formed with the dependent verb, which heads its own clause. If there is “clitic” climbing, a complex predicate has been formed between the causative or restructuring verb and the dependent verb. The important difference between causative verbs and restructuring verbs is that, when a complex predicate is formed with a causative verb, the logical subject of the dependent verb is not expressed as a subject of the resulting complex predicate, but as an object, dative or accusative depending on the a-structure of the dependent verb, since the agent or causer of the causative predicate maps onto the subject. When a control construction is used with a causative verb, the subject of the complement clause is controlled by the object of the causative control verb.

The alternative behavior of the causative verbs as light verbs in a complex predicate and as control verbs explains the optional appearance of the reflexive “clitic” in (6)–(7), as we see in (25), repeated from (6b):

(25)	No	li	deixis	emportar	(-se)
	not	CL.DAT.3.SG	let.2.SG	take.away.INF	CL REFL.3
	aquestes	maduixes.			
	these	strawberries			
	‘Don’t let her take these strawberries away.’				

If we have a control construction, the dependent verb *emportar* heads a clause containing a subject and an object. The subject of the embedded clause is controlled by the dative object of the causative verb. Since there is a subject of this clause and it is linked to a [REF] role in the clause because *emportar* is inherently reflexive, the SM mapping principle (20) requires the verb of the clause to include a “clitic” linked to the subject. This explains the option of having the reflexive “clitic” in (25). But if we have a complex predicate construction, the causative verb and the dependent *emportar* form a single complex predicate and there is no complement clause headed by *emportar*. The logical subject of *emportar* is the object of the complex predicate; even though it is marked as [REF], it cannot license a reflexive “clitic” because the SM mapping principle (20) needs a subject linked to [REF] in order to license a reflexive “clitic.” This explains the option of not having the reflexive “clitic” in a sentence like (25).

The presence of another “clitic” on the infinitive dependent on a causative verb makes the reflexive “clitic” on the infinitive obligatory, as shown (8)–(9), with (8b) repeated as (26):

(26)	Deixa	-li	emportar	*(-se)	-les.
	let	CL.DAT.3.SG	take.away.INF	CL.REFL.3	CL.ACC.3.PL.F
	‘Let her take them away.’				

A “clitic” can attach to the infinitive that depends on a causative or restructuring verb when no complex predicate is formed involving the two verbs: this is the control construction, so that the infinitive heads its own clause. In this situation, any “clitic” corresponding to a dependent of the infinitive must attach to the infinitive. Since the infinitive has a subject linked to [REF], the SM mapping principle (20) requires there to be a “clitic” linked to the subject in the verb, in this case, the infinitive. In addition, the “clitic” corresponding to the accusative object also attaches to the infinitive.

“Clitic” climbing from an infinitive dependent on a causative verb signals a complex predicate construction, as in (27) (see (11)):

(27)	a.	No	els	hi	deixis	emportar	(*-se).
		not	CL.ACC.3.PL	HI	let.2.SG	take.away.INF	CL REFL.3

b.	*No	se	’ls	hi	deixis	emportar.
	not	CL REFL.3	CL.ACC.3.PL	HI	let.2.SG	take.away.INF

‘Don’t let her take them away.’

Even though the dependent infinitive requires its logical subject to be [REF], because it is an inherently reflexive verb, the reflexive “clitic” cannot appear either on the infinitive or together with the other “clitics” higher up in the structure. When a causative complex predicate is formed, the subject of the predicate is the causer or logical subject of the causative predicate and the logical subject of the dependent infinitive is encoded as an object, a dative object in (27) (see Alsina 1996, 1997). Consequently, there is no subject linked to [REF] for the SM mapping principle (20) to license a “clitic” in the morphological structure of the verb, which explains the disappearance of the reflexive “clitic” in causative constructions.

2.4. Morphological realization rules for “clitics”

The last element that we need to consider in our analysis is the actual phonological realization of “clitics.” The SM mapping principles only tell us whether a “clitic” is licensed in the morphological structure of a verb and what GF it is linked to. It is the morphological realization rules that tell us what phonological form to assign to a “clitic” on the basis of its syntactic features (i.e. of the features of the GF that it is linked to), as the following rules illustrate for three of the “clitics”:

(28) Morphological realization rules:

a. $$\begin{array}{c} \mathrm{cl}_1 \\ \begin{bmatrix} \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{bmatrix}_1 \end{array} \Rightarrow /\mathrm{m}/$$

b. $$\begin{array}{c} \mathrm{cl}_2 \\ \begin{bmatrix} \text{PERS} & 2 \\ \text{NUM} & \text{SG} \end{bmatrix}_2 \end{array} \Rightarrow /\mathrm{t}/$$

c. cl_3 $\Rightarrow$ /s/

$[\text{PERS} \quad 3]_3$
$[\text{REF}]_3$

According to (28a), a "clitic" that is linked to a GF with the features of first person and singular is assigned the phonological representation /m/; (28b) assigns the phonological form /t/ to a "clitic" linked to second person singular; and (27c) provides the shape /s/ to a "clitic" with the syntactic features of third person and reflexive. It is interesting to note that the morphological realization rules for first and second person "clitics" make no reference to the reflexivity feature: a "clitic" is realized as /m/ if it is first person and singular regardless of whether it is linked to an object and, therefore, is not reflexive or it is linked to a subject and, therefore, is reflexive. The phonological distinction between reflexive and non-reflexive "clitic" is only made with third person "clitics."

The final phonetic form of the combination of a verb with a "clitic" depends on allomorphy rules and phonological rules, such as the rules that insert epenthetic schwa before or after the underlying forms of the "clitics" given in (28), to give alternations such as [s]/[əs]/[sə], as in *s'adona*, *es pot adonar*, and *adonar-se*. (See Bonet 1991, 1995.)

3 Conclusions

The analysis of Catalan "clitics" presented here, which focuses on the reflexive "clitic," involves three elements of the grammar, specifically, of the syntax and the syntax-morphology interface. First, we have the strictly syntactic features that "clitics" are sensitive to, such as the reflexivity feature or [REF]. We have argued that this feature is assigned to the logical subject of a predicate by means of two mechanisms: on the one hand, by the lexical information of inherently reflexive verbs, and, on the other hand, by a principle that assigns that feature whenever an a-structure binding configuration arises in a clause. Second, we have the principles that license "clitics" on the basis of particular f-structure information. These are the Syntax-Morphology (or SM) mapping principles one of which is the principle licensing reflexive "clitics": this principle licenses a "clitic" linked to a subject with the reflexivity feature. On the assumption that a "clitic" must be used if licensed by an SM mapping principle and cannot be used unless licensed, we explain the fact that in many syntactic environments the reflexive "clitic" is obligatory, the fact that it appears to be optional in other environments, and the fact that it is obligatorily absent in yet other contexts. The third and final element of the analysis is the morphological realization rules, which assign phonological representation to "clitics" in the morphological structure of verbs on the basis of the syntactic features in the GFs that the "clitics" are linked to.

A distinguishing property of the present analysis is that it does not resort to morphological features (or m-features) that merely duplicate the corresponding f-structure features in order to establish the mapping between the form of affixes and their syntactic function. Proposals such as Luís and Sadler 2003, Luís and Otoguro 2004, Luís and Spencer 2005, Dalrymple 2015, Dalrymple, Lowe, and Mycock 2019, among others, assume that the syntactic features that the morphology is sensitive to have a correlate in terms of m-features and that there is a mapping between m-features and f-structure features. For example, in Luís and Sadler 2003 the third person singular accusative "clitic" in Portuguese has the correspondence between m-features and f-structure information in (29):

(29)

$$\{\text{ACC}, 3, \text{SG}, \text{M}\} \longrightarrow \begin{array}{l} (\uparrow\text{OBJ PRED})=\text{PRO} \\ (\uparrow\text{OBJ PER})=3 \\ (\uparrow\text{OBJ NUM})=\text{SG} \\ (\uparrow\text{OBJ GEN})=\text{M} \end{array}$$

Each of the m-features in (29), shown on the left of the arrow, has a perfect correlate in the f-structure, shown on the right. The m-features 3, SG, and M correspond to the f-structure features [PER 3], [NUM SG], and [GEN M], respectively. The only m-feature in (29) that does not seem to have a correlate in terms of f-structure features is the m-feature of case, which has the two values of ACC and DAT, as Luís and Sadler 2003 do not posit a corresponding f-structure feature of case; but this m-feature correlates perfectly with the GF distinction between OBJ and OBJ2, since an accusative "clitic" (with the m-feature ACC) corresponds to an OBJ and a dative "clitic" to an OBJ2. So, there is complete redundancy between f-structure features and the m-features that correspond to them.[10] The present theory achieves an important degree of formal simplification, by not positing morphological features that have a perfect correlate with f-structure features, thanks to the idea that "clitics" are linked to a specific GF. This is not to say that morphological features do not exist, but their role is restricted to features that do not have a syntactic effect, such as morphological classes (declension classes, conjugation classes, etc.).

Another feature of the present proposal is that it makes full use of the LFG idea that the different modules and levels of representation are simultaneous and constrain each other. Standard versions of LFG (e.g. Bresnan et al. 2016) impose a restriction on this idea and adopt what we may call *lexical encapsulation* for the relation between words and the syntax. According to lexical encapsulation, the information in words may constrain the syntax, but syntactic information may not have any effect on the form of a word. In contrast, the view that is not constrained by lexical encapsulation –the view adopted here– allows principles or constraints to go in either direction: the form of words constraining the syntax and the syntax constraining the form of words. We can depict the two views regarding the syntax-morphology

[10] This redundancy can be reduced by having rules that predict the m-features from the syntactic features, so that they are not all listed in lexical entries.

interface as follows, where we take the lexicon to be the module of the grammar in which morphology, or word-formation, takes place:

(30) Approaches to the syntax-morphology interface:

a. Approach with lexical encapsulation:

lexicon $\underset{\longrightarrow}{\not\longleftarrow}$ syntax

b. Approach without lexical encapsulation:

lexicon $\underset{\longrightarrow}{\longleftarrow}$ syntax

The approach without lexical encapsulation adopted here allows constraints to operate in both directions, as we have seen. To illustrate this point with the analysis proposed in this paper, the syntactic feature [REF] is licensed by a lexical item, through the information in (13), which is a constraint operating from the lexicon on the syntax, and the same feature is an essential part of the SM mapping principle licensing reflexive “clitics” (20), which is a constraint operating from the syntax on the lexicon. The feature [REF] is also assigned by principle (14), on the basis of a-structure information. This highlights the need for a multidirectional view of the correspondence between levels of representation.

The view proposed here demands changing the way the relation between words and the syntax has traditionally been seen in LFG. If we take a word consisting of a “clitic”-verb combination such as *em pentina* (CL.1.SG combs) ‘s/he combs me’, interpreting “clitics” to be affixes, the traditional assumption is that this word is inserted in the syntax carrying f-structure information about the PRED of the clause and about the OBJ. Specifically, it says that the OBJ of the f-structure corresponding to this word is a first person singular pronoun. This is usually done by assuming that the word carries a set of equations such as (↑OBJ PRED)=‘pro’, (↑OBJ PERS)=1, etc. In the view proposed here, the features of the object are not carried by the word *em pentina*, but are present in the f-structure in which this word is used (or, more precisely, in the f-structure that is linked to the X^0 node of this word in the c-structure). The word is inserted in the syntax specifying only the verb’s PRED feature. The SM mapping principles need to have access to the f-structure features of the object, such as its PRED feature, in order to license the “clitic” that is linked to it, as with principle (15), and the morphological realization rules, such as (28a), need to access the morphological structure, in which there is a “clitic,” and the f-structure to which this “clitic” is linked.

The features that the SM mapping principles and the morphological realization rules refer to cannot be assumed to be introduced by lexical items, since they are needed to generate the appropriate inflected form of verbs. Rather, they are introduced by a general principle. In the case of Catalan and other languages with “clitics” (or affixes corresponding to arguments of the clause), we can assume that there is a rule that optionally introduces the feature [PRED 'pro'] on all GFs corresponding to arguments of a verb, as well as the agreement features (person, gender, and number, taking any of the possible values of these features) of the same GFs. In this way, GFs that correspond to no lexical item in the c-structure may still have the necessary features to satisfy Completeness and to trigger the application of SM mapping principles and morphological realization rules, which provide those GFs with morphological expression in the form of "clitics" (affixes).

Languages that do not have either affixal expression of arguments or argument pro-drop, such as English, do not have the rule mentioned in the previous paragraph. Consequently, the features needed to satisfy Completeness must be introduced by lexical items. Which f-structure features are provided by rule (as opposed to provided by the lexicon) is a locus of cross-linguistic variation and we can assume that the inflectional morphology of a language (including "clitics" and other affixes) is generated by principles that are sensitive to rule-assigned f-structure features. See Alsina and Vigo 2017 for an analysis of Plains Cree morphology in line with the present proposal.

This approach to the syntax-morphology interface adheres to the *lexical integrity principle*. According to Bresnan and Mchombo (1995: 182), in LFG "the lexical integrity principle states that the morphemic structure of words differs from the c-structure of phrases both in constituents and principles of combination" and that words are the minimal, unanalyzable units of the c-structure (see also Mohanan 1995, among others). In other words, syntax is blind to morphology, as in Zwicky's Principle of Morphology-Free Syntax, (Zwicky 1987: 650; see also O'Neill 2016: 244). On the other hand and counter to mainstream LFG, morphology is not blind to syntax, but, in the case of inflection, is generated by principles that are sensitive to the f-structure features of the syntactic structures in which a word is used.

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“Verbal case” in Ashti Dargwa

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Abstract

A few peripheral verbal forms in Ashti Dargwa (East Caucasian), which has hierarchical person agreement, use the markers *-i-* or *-u-* before the person agreement suffix. At first glance, these markers seem to indicate the grammatical function of the controller of person agreement: *-i-* is used when it is a transitive subject (ergative, $\mathcal{A}$), while *-u-* is used when it is a transitive object or an intransitive subject (absolutive, $\mathcal{S}/\mathcal{P}$). The actual distribution, however, is more complex and cannot be easily described by a single rule: *-i-* is also used with subjects of unergative intransitives, reflexives, and, most puzzlingly, absolutive arguments of verbs with dative experiencer subjects. I show that this distribution cannot be described in terms of morphosyntactic features or GF configurations, and argue that, while an analysis in terms of argument structure is possible, a semantic analysis that connects the use of *-i-* and *-u-* with semantic role specifications of the arguments captures the data in the most straightforward manner. The analysis is formalized in Glue Semantics.

1 Introduction

Ashti is a variety of Dargwa,[1] a branch of East Caucasian notable, among other things, for its rich verbal morphology and the coexistence of gender and person agreement. While gender agreement is virtually always with the absolutive argument of the clause ($\mathcal{S}/\mathcal{P}$), person agreement follows a hierarchical pattern: in transitive clauses, agreement is with either $\mathcal{A}$ or $\mathcal{P}$ depending on which argument ranks higher on the person hierarchy 1, 2 > 3. That is, if one of the core arguments is a speech act participant (SAP) while the other is 3rd person, the verb agrees with the SAP argument. If both arguments are speech act participants, the verbs agrees in person with the absolutive. 3rd person agreement is only possible when both arguments are SAPs.

A few verb TAM paradigms (Generic Present and modal forms morphologically derived from it) include synthetic person markers which are preceded by one of the vowels *-i-* and *-u-*. The functions of these vowels are mysterious; while they are traditionally described as marking transitivity (cf. e.g. Magometov 1963 for Kubachi), Sumbatova and Mutalov (2003) show that in Itsari Dargwa, their distribution is closer to a kind of direct-inverse morphology, but the exact functions vary widely across different Dargwa languages. In this paper, I will show that the functions of *-i-* and *-u-* defy simple characterization in terms of syntax or argument structure, and propose a semantic account that captures their distribution.

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Person agreement rules for various Dargwa varieties have been extensively described in the works of Nina Sumbatova, in particular Sumbatova (2011a) and Sumbatova (2011b). An OT-LFG analysis of Dargwa person agreement has been proposed in Belyaev (2013); in this paper, I will use a later version of this analysis in Belyaev (2017), which abandons the idea of m-structure features in favour of an agreement sharing approach. For the purposes of this paper, I will assume an accusative GF mapping for Dargwa ($\mathcal{A} \longrightarrow$ SUBJ, $\mathcal{P} \longrightarrow$ OBJ); if a version of Falk's (2006) approach is adopted, as in Belyaev (2013) and Belyaev (2017), $\widehat{\text{GF}}$ can be used instead of SUBJ, and PIV identified with one of the core arguments; all the key parts of the analysis will be unaffected.

2 The distribution of *-i-* and *-u-*

2.1 Morphology

The synthetic TAM series whose endings are derived from the Generic Present set (Generic Present, Realis and Irrealis Conditional, Prohibitive) include one of the vowels *-i-* or *-u-* before the 1st and 2nd person markers:

	SG	PL
1	*-u/i-d*	*-u/i-d-a*
2	*-u/i-t*	*-u/i-t:-a*
3	tr: *-u*, *-an*; intr: *a*, *-an*	

Table 1: Generic Present endings

The main function of these markers seems to be to indicate the controller of person agreement ($\mathcal{A}$, $\mathcal{P}$), but upon closer scrutiny, the actual distribution is more complex. In what follows, I will describe the main contexts in which *-i-* and *-u-* tend to be used.

2.2 Core functions

With transitive verbs, *-i-* and *-u-* behave as a kind of "verbal case" affixes: *-i-* is used if the controller is ergative, *-u-*, if it is absolutive:

(1) a. $\mathcal{A}$ agreement: *-i-*

u-dil *čitu* *b-u:s-**i**-t*
thou-ERG cat N-catch.IPFV-I-HAB.2[SG]
'**You** (sg.) catch the cat.'

b. $\mathcal{P}$ agreement: *-u-*

čitu.l-dil *u* *u:s-**u**-t*
cat-ERG thou [M]catch.IPFV-U-HAB.2[SG]
'The cat catches **you**.'

In accordance with the ergative case marking pattern, intransitives generally use *-u-*:

(2) $\boxed{\textit{nus:a}}$ *d-ax-**u**-d-a-l* ...
we 1PL-go.IPFV-U-1-PL-COND
'If **we** go...'

Thus, the initial generalization is that the two vowels indicate which of the core arguments is the controller of person agreement: *-i-* is used when the controller is the transitive subject (that is, the ergative, or $\mathcal{A}$), while *-u-* is used with objects and intransitive subjects ($\mathcal{P}$). This is an unusual morphological feature that does not have a common typological name; functionally, the closest equivalent is case. Another counterpart is the category of direct/inverse, which marks the relative position of arguments on a prominence hierarchy; since in Ashti, the choice of agreement controller is determined by the person hierarchy, in transitive clauses *-i-* may be said to be a direct marking, while *-u-* is the inverse. However, this generalization does not apply to intransitive verbs; this is why Sumbatova and Mutalov (2003), while describing a similar pattern in Itsari Dargwa, apply the "inverse" name to *-u-* with reservations.[2]

This general pattern, however, is violated in three contexts: with agent-like intransitives, with affective (dative experiencer subject) verbs, and with reflexives.

2.3 Split intransitivity

While the normal form of the "verbal case" affix with intransitive verbs is *-u-*, *-i-* can also be used with most intransitive verbs (and with some of them, preferably so). In this case, the subject is interpreted as somehow being more agent-like, or at least more in control of the situation. Thus, in (3a), with the "intransitive" *-u-*, the imperative is interpreted in a kind of admonitive sense: "be careful lest you fall". In (3b), with *-i-*, the interpretation is rather that the subject should make an effort, perform specific actions so as not to fall.

(3) a. *-u-* with intransitives: lack of control
*ka-mma-w-i:k-**u**-t*
DOWN-PROH-M-fall.IPFV-U-2[SG]
'[be careful,] do not fall [by accident]'

[2]The distribution of *-i-* vs. *-u-* in Itsari is different: *-i-* is used whenever $\mathcal{A}$ is higher than $\mathcal{P}$ on the prominence hierarchy 1,2 > 3, while *-u-* is used when $\mathcal{P}$ is lower than or equal to $\mathcal{A}$ on the same hierarchy. The hierarchy for person agreement in Itsari, in contrast, is 2 > 1 > 3. Thus, the pattern of *-i-*/*-u-* marking in Itsari, unlike in Ashti, is detached from person agreement and cannot be described in the same terms.

b. *-i-* with intransitives: agentivity

*ka-mma-w-i:č-**i**-t*
DOWN-PROH-fall.IPFV-I-2[SG]
'do not fall [, make an effort]'

It is even possible to use *-i-* with verbs that clearly do not involve any agentivity in the direct sense of the word, such as 'die' in (4). In this case a control interpretation is "coerced", in a way: The agent is interpreted as somehow potentially being responsible for their death via the actions that they are about to perform; e.g., (4) could be uttered when the speaker embarks on a dangerous journey. This example also illustrates the fact that the change in *-i-*/*-u-* marking does not influence case marking on the subject, unlike fluid-S languages (Dixon, 1979) where similar semantic effects correlate with ergative/absolutive marking of $\mathcal{S}$.

(4) ***du*** *w-ibč'-**i**-lli,* *qal* *gal.li-j* *d-ik:-a*
I M-die.PFV-A-COND.1SG house son-DAT NPL-give.PFV-IMP.SG
'If **I** die, give the house to (my) son.'

The distribution of *-i-* and *-u-* with intransitives is also reminiscent of the unergative/unaccusative distinction (Perlmutter, 1978; Hout, 2004), although in Ashti it is less lexically conditioned than in more prototypical cases. Interestingly, the effect of using *-i-* and *-u-* with movement verbs (5) is exactly the same as the effect of the choice between 'be' and 'have' in Romance, cf. (6) from Italian: the former enforces a telic interpretation (while mainly occuring with unaccusatives), while the latter, atelic (while occuring with unergatives). In general, the use of *-u-* vs. *-i-* with intransitives in Ashti agrees with the Auxiliary Selection Hierarchy proposed in Sorace (2000) based on Romance data.

(5) a. *-u-* with intransitives: telicity

pat'imat.li-š:u *w-ax~max-**u**-t*
P.-APUD[LAT] M-go.IPFV~PROH-U-2[SG]
'do not go to Patimat'

b. *-i-* with intransitives: atelicity

*w-aš~maš-**i**-t*
M-go~PROH-I-2[SG]
'do not go [anywhere]'

(6) Italian

a. 'be' with intransitives: telicity

sono *corso* *a* *casa*
am run to house
'I **have** run home.'

b. ‘have’ with intransitives: atelicity

__ho__ *corso* *ore* *e* *ore*
I.have run hours and hours
‘I **have** run for hours and hours.’

2.4 Affective verbs

Ashti, like most other East Caucasian languages, has verbs with dative-marked experiencer subjects and absolutive stimuli; verbs with such valency frames are traditionally called “affective verbs”. The specific range of affective verbs varies across East Caucasian languages and even within the Dargwa branch; in Ashti, it includes perception verbs like ‘see’, ‘hear’; volitional and emotional predicates like ‘want’ or ‘like’ (the latter two are actually the same verb); cognition verbs such as ‘think’, ‘understand’, and ‘know’.

For the purposes of most syntactic phenomena (person agreement, control, binding etc.), these dative-marked subjects behave just as ordinary $\mathcal{A}$s:

(7) $\boxed{\textit{dam}}$ *murad* *ʔulħ-i*[4]*-__d__*
I.DAT M. [M]see.PFV-PRET-1[SG]
‘**I** saw Murad.’

(8) *dam* $\boxed{\textit{u}}$ *ʔulħ-i-__t:i__*
I.DAT thou [M]see.PFV-PRET-2[SG]
‘I saw **you**.’

But with these verbs, *-i-* has to be used regardless of the grammatical function of the controller:[5]

(9) a. $\boxed{\textit{dam}}$ *pat’imat* *j-ulħ-__i__-d* / **j-ulħ-__u__-d*
I.DAT P. F-see.IPFV-A-1[SG]
‘**I** see Patimat.’

b. *pat’imat.li-j* $\boxed{\textit{du}}$ *ʔulħ-__i__-d* / **ʔulħ-__u__-d*
P.-DAT I [M]see.IPFV-A-1[SG]
‘Patimat sees **me**.’

This is unexpected, because, if anything, affective verbs are expected to be closer to intransitives, with the dative phrase lacking some of the subject properties. But the dative subject behaves just like the ergative subject, controlling agreement and

[4]The morpheme *-i-* in this example is one of the markers of the Preterite paradigm (*-a-* in other conjugation classes) which is a different morpheme than the *-i-* used in the habitual and modal paradigms. It does not change depending on the agreement controller.

[5]The verb ‘to see’ belongs to the *-un*-conjugation class, where the invariable marker *-a-* can optionally be used instead of both *-i-* and *-u-*. However, *-i-* is also invariably used with “affective” verbs of other conjugations, which do not have this morphological trait.

selecting *-i-* in the suffix. The absolutive, however, gets *-i-* as well, even though it has nothing agentlike about it — there is no direct parallel to unergatives, where this distribution is expected.

2.5 Reflexives

Another challenge to the $\mathcal{A}/\mathcal{P}$ generalization comes from reflexives. These can only use *-i-*:

(10) *di-l* *du* *w-a̰qˤ-a̰qˤ-**i**-lli* …
I-ERG I M-wound.PFV-CAUS-A-COND.1[SG]
'If I wound myself…'

The general principles of Ashti agreement suggest that $\mathcal{P}$ "wins" if both have the same rank. Otherwise, reflexives clauses could be expected to be detransitivized in some sense. In both cases, the expected affix choice is *-u-*,[6] or at least free variation between *-i-* and *-u-*. Yet the verb here behaves as if the agreement controller is always $\mathcal{A}$ (selecting *-i-*).

2.6 Summary

To summarize the data of this section, the distribution of *-i-* and *-u-* with transitive verbs and intransitives is given in Table 2.

	$\mathcal{P}$		
$\mathcal{A}$	1	2	3
1	-i-d	-u-t	-i-d
2	-u-d	-i-t	-i-t
3	-u-d	-u-t	(-u/-an)
S_{unacc}	-u-d	-u-t	(-a/-an)
S_{unerg}	-i-d	-i-t	(-a/-an)

Table 2: *-i-* and *-u-* with transitives and intransitives

With affective verbs, the distribution is different in that *-i-* is used throughout, see Table 3.

	$\mathcal{P}$		
$\mathcal{A}$	1	2	3
1	-i-d	-i-t	-i-d
2	-i-d	-i-t	-i-t

[6] This is apparently the case in Itsari (Sumbatova and Mutalov, 2003), although the data are only given in a table, with no examples.

3	-i-d	-i-t	(-u/-an)

Table 3: *-i-* and *-u-* with "affective" verbs

3 Analysis

The distribution of Ashti *-i-* vs. *-u-* is problematic because it cannot be easily tied to any one specific parameter, and different mismatches work in different directions. The initial data on transitive and intransitive verbs indicate that *-i-* is associated with $\mathcal{A}$ (ergative subjects), while *-u-* is associated with absolutive arguments (direct objects and intransitive subjects). The split in intransitive verbs can be described within the same logic: *-i-* marks "agentive" arguments, while *-u-* marks arguments that are more patient-like. However, the opposite logic seems to work in affective verbs: *-i-* is used for both experiencer and stimulus, although the absolutive argument of affective verbs is not agent-like in any way. Finally, the use of *-i-* in reflexive contexts is difficult to explain in the general logic of ergative vs. absolutive agreement.

In what follows, I will evaluate several possible solutions to this problem in the LFG architecture. I will not provide a definitive conclusion, because the phenomenon requires further study, but the discussion herein can serve as the basis for a more developed approach.

3.1 Case

One option is to follow through with the analogy between *-i-* vs. *-u-* and case, treating the distribution of *-i-* and *-u-* as largely idiosyncratic and not directly connected to any semantic or syntactic features. The feature CASE has to be introduced to generalize over the mapping between grammatical functions and nominal "flags" (in the terminology of Haspelmath, 2019); if a "flag" directly reflects grammatical function, the syntactic feature CASE is not needed, but this is rarely the case (Spencer and Otoguro, 2005; Spencer, 2009). In a similar fashion, one could introduce a separate feature VCASE (for "verbal case") to indicate whether an NP, when indexed by person agreement, should be marked as *-i-* or *-u-*. As seen from (4), dependent case marking in Ashti is independent from *-i-* vs. *-u-* marking on the verb: the intransitive subject stays absolutive even if verbal marking changes. Thus, VCASE, if it is introduced, should be kept distinct from CASE.

If such a feature is used, *-i-* and *-u-* form a typologically common two-term system (Arkadiev, 2006; Arkadiev, 2009): *-u-* is the direct/nominative "case", specialized in marking direct objects and non-agentive intransitive subjects, while *-i-* is a typical polyfunctional oblique, used in all other contexts, that do not form a natural class. Such a solution allows us to avoid trying to capture the distribution of *-i-* in a homogeneous way: affective verbs are "double oblique" verbs simply because they are lexically defined as such. Like in many other languages with reduced case systems, VCASE would then be restricted to 1st and 2nd person pronouns.

Even though such an analysis may well represent the diachronic origin of *-i-* and *-u-* marking (if the person suffixes go back to incorporated pronouns),[7] it is hardly adequate synchronically, as it stipulates a feature for which all verbal arguments (or at least all verb subcategorization frames) have to be marked, but which only surfaces in very forms in the verbal paradigm.[8] Another problem with this approach is that it fails to account for the behaviour of reflexives: If “ergative” pronouns are assumed to have the “oblique” feature (*-i-*) and “absolutive” pronouns are assumed to be “direct” (*-u-*), there is no motivation for *-i-* marking in (10), since competition between two speech argument participants normally results in agreement with the absolutive. One would then have to assume that verbs with reflexive objects are also double obliques, or behave in the same way as agentive intransitives; neither assumption has any basis, because reflexives occupy normal argumental positions and there is no detransitivizing morphology on the verb (the 3rd person marker of some paradigms distinguishes transitive and intransitive verbs).

3.2 Syntax

A purely syntactic account would require finding something in common between $\mathcal{A}$, unergative $\mathcal{S}$, and both arguments of affective verbs. It is clear that in the standard LFG view of GFs and their distribution, no such common features can be found. If this idea is taken seriously, one would have to assume that unaccusatives, where the verb is marked with *-u-*, are underlyingly transitive; they would then have an OBJ thematic argument and a non-thematic SUBJ argument structure shared with the object, like in (11). This allows us to uniformly describe *-u-* as marking the OBJ controller, and *-i-* as marking the SUBJ controller.

(11)
$$\begin{bmatrix} \text{PRED} & \text{‘die‹OBJ›SUBJ’} \\ \text{SUBJ} & \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{‘pro’} \\ \text{AGR} & \begin{bmatrix} \text{NUM} & \text{SG} \\ \text{PERS} & 1 \\ \text{GEND} & \text{M} \end{bmatrix} \end{bmatrix} \\ \text{AGR} & \end{bmatrix}$$

[7]Based on the similarity with auxiliary selection in Romance, one could speculate that verbal endings go back to different auxiliaries instead. Split auxiliary selection is not attested in East Caucasian, but neither is “verbal case” of this kind in general, or hierarchical person agreement outside Dargwa, for that matter. The origin of Dargwa person agreement morphology remains obscure, see Sumbatova (2011a) for an overview.

[8]An anonymous reviewer wonders whether a single stipulation for a subset of grammar could be better than a grammar-wide generalization if it only accounts for a relatively obscure phenomenon. This is true in principle, but in this case, the stipulation would not be minor: it has to cover all clauses.

This solution is clearly less-than-adequate, primarily because there is no independent motivation for such structures; significant changes to the f-structure of numerous verbs have to be introduced purely on the basis of *-i-* vs. *-u-* marking. Capturing the behaviour of affective verbs requires even more complicated solutions: the stimulus would have to be promoted to SUBJ status if it controls verbal person agreement, but not in other contexts. Finally, this analysis does not solve the problem of reflexives, because these would have to be assumed to involve structure sharing between SUBJ and OBJ, which has no syntactic motivation as the reflexive is expressed by a separate NP. To conclude, *-i-* and *-u-* cannot be tied to specific grammatical functions, although it is interesting that an attempt to do this ends up recreating the core assumptions of the Unaccusative Hypothesis.

3.3 Argument structure

3.3.1 Core proposal

Another option is to characterize the distinction between *-i-* and *-u-* in terms of differences in argument structure, i.e. in the module of grammar that determines the mapping between semantic roles and grammatical functions. Lexical Mapping Theory, or LMT (Bresnan and Kanerva, 1989) in LFG typically operates with the decomposition of the core grammatical functions according to two features, [+/−o] and [+/−r], in the way shown in 4.

	−r	**+r**
−o	SUBJ	OBL_θ
+o	OBJ	OBJ_θ

Table 4: Cross-classification of grammatical functions in LFG

Thematic roles have inherent (under)specifications such as [−o] for agents, [−r] for patients; these are then sequentially mapped to the lowest compatible position on the markedness hierarchy:

- SUBJ $\succ$ OBJ,OBL_θ $\succ$ OBJ_θ

Unaccusativity has been explained in LMT (Bresnan and Zaenen, 1990) in terms of different underspecification patterns for different kind of intransitive subjects: unergative ones are [-o] (akin to transitive subjects) while unaccusative ones are [-r] (akin to direct objects). The standard specifications of transitive verbs and two kind of intransitives are given in (12).

(12) a. agentive transitive catch ⟨ *ag* *pt* ⟩
[-o] [-r]

b. unergative run ⟨ *ag* ⟩
[-o]

c. unaccusative fall ⟨ *th* ⟩
[-r]

Thus, the distribution of *-u-*, at least, is easily described as marking controllers that are specified as [-r]. The marker *-i-* would then describe arguments that are specified as [-o]. However, there are several problems with this solution: affective verbs, reflexives, and the question of whether one can refer to entities such as [-o] in the LFG metalanguage.

3.3.2 Affective verbs

Affective verbs differ from transitive verbs mainly in the dative marking of their subject — but when this subject is a controller of person agreement, the verb uses *-i-*, just as in transitive subjects; there is no need to view the dative argument as anything else but [-o]. It is the absolutive argument that is exceptional in receiving *-i-* marking, even though syntactically it seems to behave just like any other direct object. Thus, in order to describe the distribution of *-i-*/*-u-* in terms of argument structure specifications, objects of transitive verbs (patients) should be specified differently than objects of affective verbs (stimuli), while both mapping to OBJ.

The only option available seems to be to stipulate that stimuli are mapped to [+o], as in (13). This specification is the same as that of secondary objects, but in the absence of other arguments competing for object status, these get mapped to OBJ.

(13) "affective"
see ⟨ *exp* *stim* ⟩
[-o] [+o]

We could then describe the distribution of *-i-* and *-u-* as in (14)

(14) a. *-u-*: the AGR controller is **[-r]**;
b. *-i-*: the AGR controller is **not [-r]**.

It is unclear, however, whether there is enough evidence to introduce such language-specific mappings. One piece of independent evidence that could motivate this mapping comes from antipassivization. In Ashti, most imperfective verbs can be used in the antipassive construction:

(15) a. *pat'imat-li dig b-uk-aj*
P.-ERG meat N-eat.IPFV-PRET.3

b. *pat'imat (dig-li) j-uk-aj*
P. meat-ERG F-eat.IPFV-PRET.3
'Patimat used to eat meat.'

But this is not available for affective verbs:

(16) a. *pat'imat.li-j b-u̯lħ-i̯n*
P.-DAT N-see.IPFV-PRET.3
'Patimat used to see.'

b. *#pat'imat j-u̯lħ-i̯n*
P. F-see.IPFV-PRET.3
*'Patimat used to see.', #'Someone used to see P.'

Antipassivization in Ashti is basically an instance of Unspecified Object Deletion, as in (17): The [-r] argument is suppressed, and the [-o] becomes the sole argument of an intransitive verb, which, in an ergative language, gets absolutive marking. The "ergative" patient that can be optionally expressed can either be treated as an adjunct or as an oblique.

(17) $$\text{eat} \left\langle \begin{array}{cc} \textit{ag} & \textit{pt} \\ \text{[-o]} & \text{[-r]} \\ & \downarrow \\ & \emptyset \end{array} \right\rangle$$

If the stimulus of affective verbs is treated as [+o], it cannot be deleted due to the generalization that only unmarked arguments can be suppressed (Alsina, 1990; Bresnan, Asudeh, et al., 2016, p. 333).

3.3.3 Reflexives

In clauses with reflexive direct objects, both arguments, of course, have the same rank; therefore, according to the general rules, the agreement controller should be the patient, not the agent — thus, *-u-* is expected. But *-i-* is used instead. The only way to solve this contradiction in an argument-structure-based approach is to assume that reflexive clauses are actually intransitive: that is, the reflexive acts as a detransitivizer of sorts. Such an analysis would be very artificial, however, since I am aware of no data that points to reflexive clauses actually being intransitive.

3.3.4 Referring to a-structure features

The final remaining problem is that there is no mechanism in classic LMT for morphosyntactic elements to refer directly to a-structure underspecifications. The analysis of Bresnan and Zaenen (1990) only applies to argument structure derivation (resultatives); it was not meant to capture purely f-structure / syntactic phenomena. Kibort (2014) further develops LMT by dispensing with semantic roles, only leaving positions arg_1, arg_2, etc., which are associated with feature underspecifications. Findlay (2016) further reduces the role of a-structure, by treating arg_n as s-structure features inherently associated with certain feature specifications ([-o], etc.); but these feature specifications themselves are nothing more than disjunctions of GFs that correspond to this specification in classic LMT, e.g. [+o] is the disjunction $\textsc{pluso} \equiv \{\textsc{obj} \mid \textsc{obj}_\theta\}$. This leaves us with no way to refer to features like [+o], neither in classic LMT nor in its more recent versions.

A possible way of "saving" such an analysis, at least technically, is to replace feature specifications with $\textsc{arg}_\textsc{n}$ positions. In these terms, transitive verbs in Ashti operate with arg_1 and arg_2 (just like standard transitive verbs in other languages), while affective verbs have only arg_1 and arg_3:

(18) a. agentive transitive

$$\begin{array}{llll} \text{catch} & \langle \; arg_1 & arg_2 & \rangle \\ & \;\;\;\text{[-o]} & \text{[-r]} & \end{array}$$

b. "affective"

$$\begin{array}{llll} \text{see} & \langle \; arg_1 & arg_3 & \rangle \\ & \;\;\;\text{[-o]} & \text{[+o]} & \end{array}$$

In this system, the definition of the 1st person agreement marker with *-u-* can be as in (19). Agreement markers with *-i-* would then be described as the negative version of *-u-*, i.e. describing the negation of the conjunction of the last two equations in (19), or the disjunction of two negative equations. For a more generalizing analysis, these two equations could be put into a template; the definition of *-i-* would then negate this template.

(19) *-u-d*

$$\begin{array}{l} \%\mathrm{GF} = \{(\uparrow \textsc{subj}) \vee (\uparrow \textsc{obj})\} \\ (\%\mathrm{GF}\ \textsc{agr}\ \textsc{pers}) =_c 1 \\ (\%\mathrm{GF}\ \textsc{agr}\ \textsc{num}) =_c \textsc{sg} \\ (\uparrow \textsc{agr}) = (\%\mathrm{GF}\ \textsc{agr}) \\ \%\mathrm{GF}_\sigma =_c (\uparrow_\sigma \textsc{arg}_2) \end{array}$$

That predicates can be freely associated with different argument slots, and that these may be non-contiguous, is explicitly acknowledged in Findlay (2016): "These argument positions are ordered, and a predicate can select any combination of them – that is, not necessarily a contiguous subsection: a predicate could select an arg_1 and an arg_4, for example" (p. 301). At least formally, then, an analysis along these lines is possible. However, the deeper question — *why* stimuli get assigned to arg_4 is left unresolved. Latest versions of LMT explicitly avoid an association between arg_n positions and semantic roles, so trying to explain it in this way would be at odds with the general logic of the theory. This analysis would find stronger support if several pieces of evidence conspired to motivate it, but at present, the only evidence is *-i-* vs. *-u-* and the impossibility of antipassive mappings.

The issue of reflexives having *-i-* is also still difficult to resolve in terms of LMT, and it is not clear if stipulating that verbs with reflexive direct objects are intransitive would solve more problems than it would introduce.

3.4 Semantics

3.4.1 Core proposal

A final possibility is to analyze the distribution of *-i-* and *-u-* in semantic terms, i.e. in terms of the semantic roles that the corresponding agreement controller maps to. The following generalization could be proposed:

(20) *-u-*: the agreement controller is the Patient or Theme;
-i-: used elsewhere.

However, it is problematic for morphology to distinguish between Patients / Themes and Stimuli (despite both being mapped to Absolutive OBJ), because stimuli are not usually viewed as a separate theta-role (although they are indeed often discussed when considering more fine-grained issues); of course, semantic roles can be viewed as language-specific, but then this analysis would not be much different from the argument structure analysis, which refers to language-specific, highly idiosyncratic argument structure assignments. A semantic analysis would only have an advantage if it could make use of some intrinsic semantic property of "affective" predicates, but it is clear that traditional conceptions of theta-roles do not involve such subtle distinctions. In particular, stimuli are still Proto-Patients in terms of Dowty (1991), and certainly they are not any more agent-like than patients proper. Furthermore, this analysis requires that all subjects of intransitive verbs that trigger *-i-* are treated as agents. For verbs like 'die', this is implausible: with *-i-*, the subject is indeed interpreted as causing the situation in some way, but in the end, it still remains primarily a patient.

Another problem is the way one could refer to semantic roles in the syntax. In some approaches to argument structure, this is simple enough. For example, if the a-structure projection of Butt et al. (1997) is adopted, we can use definitions like the following:

(21) *-u-d* $\%\mathrm{GF} = \{(\uparrow \textsc{subj}) \vee (\uparrow \textsc{obj})\}$
$(\%\mathrm{GF}\ \textsc{agr pers}) =_c 1$
$(\%\mathrm{GF}\ \textsc{agr num}) =_c \textsc{sg}$
$(\uparrow \textsc{agr}) = (\%\mathrm{GF}\ \textsc{agr})$
$(\textsc{patient}\ \lambda^{-1}(\%\mathrm{GF}))$

However, with the advent of Glue Semantics, there is a growing consensus in LFG that there are good reasons to treat semantic roles as belonging to meaning representation and not to a- or s-structure (Asudeh and Giorgolo, 2012). In the system of Asudeh & Giorgolo, further developed in Asudeh, Giorgolo, and Toivonen (2014) (and which Findlay, 2016 builds upon), s-structure only has abstract argument slots, not direct representations of thematic roles; the latter are only represented in the meaning languages using Neo-Davidsonian predicates like patient$(e) = x$.

I believe that both of these problems can be overcome, and a generally coherent semantic analysis of *-i-* and *-u-* can be provided, if one adopts a different system of semantic roles and introduces constraints on them in the meaning language itself via the appropriate meaning constructors.

3.4.2 Additional semantic distinctions

In order to explain the unusual behaviour of "affective" verbs, it is instructive to compare the analysis of a rather similar phenomenon — dative experiencer subjects in Icelandic — in Schätzle (2018). Schätzle provides a compelling account of the syntactic behaviour and case-marking of various types of arguments in Icelandic by combining insights from several different areas of grammar and research traditions. One way in which this work is of significance to the analysis of Ashti is that Schaetzle essentially adapts the theory of Ramchand (2008) to LFG. Ramchand's approach crucially depends on the positions of the arguments in the syntactic structure that she postulates: Initiators, in her system, are the specifiers of initP (i.e. "subjects" of the initiating subevent); Undergoers are specifiers of procP ("subjects" of the process subevent), Rhemes and Paths are complements of procP, and so on. Schätzle instead reinterprets notions like INITIATOR and UNDERGOER as semantic roles in an approach that combines the main ideas of Butt et al. (1997) with the newer developments in LMT described above: semantic roles map to arg_n positions, which, in their turn, are associated with feature specifications that map them to GFs. This leads to a system where semantic roles, arguments structure, and grammatical functions are neatly separated.

What is crucial for this paper is that Schätzle's approach allows us to incorporate the core insight of Ramchand's analysis of argument structure. Instead of the traditional — diverse and often confusing — inventory of semantic roles, Ramchand operates with a restricted set of primitive roles (Initiator, Undergoer, Result, Rheme, etc.) that can be combined — i.e. mapped to one argument — in various ways to yield different verb classes. Ramchand's specifications for each of the verb classes discussed in this paper (in Schätzle's representation) are as follows:

(22) a. agentive transitive

$$\begin{array}{llllc} & & \textsc{init} & \textsc{und} & \\ & & | & | & \\ \text{catch} & \langle & arg_1 & arg_2 & \rangle \\ & & \text{-}i\text{-} & \text{-}u\text{-} & \end{array}$$

b. "affective"

$$\begin{array}{llllc} & & \textsc{init}\ \textsc{und} & \textsc{rh} & \\ & & |\ / & | & \\ \text{see} & \langle & arg_1 & arg_2 & \rangle \\ & & \text{-}i\text{-} & \text{-}i\text{-} & \end{array}$$

c. unaccusative

$$\begin{array}{lllc} & & \textsc{und} & \\ & & | & \\ \text{run} & \langle & arg_1 & \rangle \\ & & \text{-}u\text{-} & \end{array}$$

d. unergative

$$\text{run} \quad \langle \quad \begin{array}{c} \text{INIT UND} \\ \textit{arg}_1 \\ \textit{-i-} \end{array} \quad \rangle$$

Thus, in agentive transitive verbs, the subject is the Initiator and the object is the Undergoer. In "affective" verbs with experiencer subjects, the subject is simultaneously the Initiator and the Undergoer, while the object is a Rheme;[9] in unaccusatives, the subject is the Undergoer, while in unergatives, the subject is both the Initiator and the Undergoer, like in "affective" verbs. The latter specification is significant, as it naturally captures the use of *-i-* with verbs like 'die': using *-i-* interprets the verb as having an initiating subevent, but keeps the subject an Undergoer of the process subevent.

It can be readily seen from (22) how the distribution of *-i-* and *-u-* can be described: *-u-* marks **"exclusive" Undergoers that are not shared with any other semantic role**, while *-i-* is the "default" option that marks **all other argument types**, including Undergoers that simultaneously act as Initiators. Thus, Ramchand's theory, in the interpretation of Schätzle (2018), allows capturing the relevant generalizations without any additional stipulation, which is a significant advantage over the argument structure approach.

3.4.3 Semantic interpretation

Without going into the details of the system of Asudeh, Giorgolo, and Toivonen (2014), its core ideas can be described as follows. Verbal lexical entries do not directly encode their valency, like in standard Glue analyses, but have a generic meaning constructor like $\lambda e.\,\text{laugh}(e) : (\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma$. Arguments are then introduced via calling additional templates like AGENT, which do two things: first, define the mapping from GFs to ARG_N positions at s-structure via templates such as ARG1, etc. (following standard LMT principles, discussed in detail in Findlay 2016); second, introduce the specific semantic roles via separate meaning constructors such as $\lambda P \lambda x \lambda e P(e) \wedge \text{agent}(e) = x : [(\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma] \multimap (\uparrow_\sigma \text{ARG}_1) \multimap (\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma$. Ramchand's system can be adopted to this approach by replacing predicates like agent(x) with predicates corresponding to Ramchand's roles (traditional theta-roles are effectively redundant in this system); the meaning constructors can be formulated in such a way that one argument carries more than one role. For example, agentive transitive verbs might have meaning constructors as in (23a), while unergatives, where the same argument is the Initiator and the Undergoer, as in (23b).

[9]Another option for stative verbs with experiencer subjects is to have the subject as the Initiator and the object as a Rheme; Ramchand analyses 'fear' in this way, while 'see' is treated akin to verbs with incremental themes. For my purposes, this distinction is not important; crucially, in both classes of verbs stimuli are Rhemes, not Undergoers, which described the Ashti distribution.

(23) a. $\lambda P \lambda x \lambda e.P(e) \wedge \text{initiator}(e) = x : [(\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma] \multimap (\uparrow_\sigma \text{ ARG}_1) \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma$

$\lambda P \lambda x \lambda e.P(e) \wedge \text{undergoer}(e) = x : [(\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma] \multimap (\uparrow_\sigma \text{ ARG}_2) \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma$

b. $\lambda P \lambda x \lambda e.P(e) \wedge \text{initiator}(e) = x \wedge \text{undergoer}(e) = x : [(\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma] \multimap (\uparrow_\sigma \text{ ARG}_1) \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma$

The behaviour of *-i-* and *-u-* can then be described by making person agreement markers “modify” the semantic specification of the agreement controller by adding additional semantic role predicates. Consider the proposed contribution of the 1st person singular marker *-ud* in (24).

(24) *-u-d* $\%\text{AGR} = \{(\uparrow \text{SUBJ}) | (\uparrow \text{OBJ})\}$

$(\uparrow \text{AGR}) = (\%\text{AGR AGR})$

$(\%\text{AGR AGR PERS}) = 1$

$(\%\text{AGR AGR NUM}) = \text{SG}$

$\lambda P \lambda x \lambda e.P(x)(e) \wedge \text{undergoer}(e) = x \wedge \text{initiator}(e) \neq x :$
$(\%\text{AGR}_\sigma \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma) \multimap (\%\text{AGR}_\sigma \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma)$

In this f-description, %AGR is the local name for the agreement controller, which is freely identified with either SUBJ or OBJ, to be later filtered by OT constraints according to the person hierarchy: only higher-ranking controllers, or patients in transitive clauses with two SAPs, are licensed (see Belyaev, 2017 for more detail). The AGR feature of this argument is shared with the AGR feature of the clause. The meaning constructor adds two more statements via conjunction to the entailments introduced by meaning constructors as in (23). Consider the f- and s-structures for (4) in (25): SUBJ maps to ARG1 at s-structure and is associated with the semantic role Undergoer (in the unaccusative interpretation). Instantiating the meaning constructors in (23) and (24) gives us the proof in (26). The resulting meaning constructor must then be combined with a tense or mood operator (in this case, conditional) to yield the resource f, but this last step is not important for this paper.

(25) $\begin{bmatrix} \text{PRED} & \text{‘die’} \\ \text{MOOD} & \text{COND} \\ \text{AGR} & \rule{8em}{0.4pt} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{‘pro’} \\ \text{AGR} & \begin{bmatrix} \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix} \end{bmatrix} \xrightarrow{\sigma} f \begin{bmatrix} \text{REL} & \text{die} \\ \text{EVENT} & ev[\;] \\ \text{ARG}_1 & s[\;] \end{bmatrix}_\sigma$

(26)

$$\dfrac{\dfrac{\begin{array}{c}\lambda P \lambda x \lambda e. P(x)(e) \wedge \text{und}(e) = x \wedge \text{init}(e) \neq x : \\ (s \multimap ev \multimap f) \multimap (s \multimap ev \multimap f)\end{array} \quad \dfrac{\begin{array}{c}\lambda P \lambda x \lambda e. P(e) \wedge \text{und}(e) = x : \\ (ev \multimap f) \multimap s \multimap ev \multimap f\end{array} \quad \begin{array}{c}\lambda e.\, \text{die}(e) : \\ ev \multimap f\end{array}}{\begin{array}{c}\lambda x \lambda e.\, \text{die}(e) \wedge \text{und}(e) = x : \\ s \multimap ev \multimap f\end{array}}}{\begin{array}{c}\lambda x \lambda e.\, \text{die}(e) \wedge \text{und}(e) = x \wedge \text{und}(e) = x \wedge \text{init}(e) \neq x : \\ s \multimap ev \multimap f\end{array}} \quad \begin{array}{c}me : \\ s\end{array}}{\begin{array}{c}\lambda e.\, \text{die}(e) \wedge \text{und}(e) = me \wedge \text{und}(e) = me \wedge \text{init}(e) \neq me : \\ ev \multimap f\end{array}}$$

Using *-u-* here makes the sentence grammatical, but it is clearly incompatible with examples where the agreement controller is also the initiator, because these would contain a logical contradiction.

The definition of *-i-d* is semantically essentially the negation of *-u-d* (being logically equivalent to ¬[undergoer$(e) = x \wedge$ initiator$(e) \neq x$]):

(27) *-i-d* $\quad$ $\%\text{AGR} = \{(\uparrow \textsc{subj}) | (\uparrow \textsc{obj})\}$
$(\uparrow \textsc{agr}) = (\%\text{AGR}\ \textsc{agr})$
$(\%\text{AGR}\ \textsc{agr pers}) =_c 1$
$(\%\text{AGR}\ \textsc{agr num}) =_c \textsc{sg}$
$\lambda P \lambda x \lambda e. P(x)(e) \wedge [\text{undergoer}(e) \neq x \vee \text{initiator}(e) = x] :$
$(\%\text{AGR}_\sigma \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma) \multimap (\%\text{AGR}_\sigma \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma)$

If this is applied to a verb where the first disjunct is always false, such as 'die', the second disjunct must necessarily be true. This causes the "coercion" effect which we observed above: Even verbs which are not lexically agentive are interpreted as having some kind of an initiating subevent, precisely because the Initiator semantic role is in fact introduced by the suffix *-i-*.

Another advantage of this approach is that it explains why verbs with reflexive objects use *-i-*. Indeed, reflexives involve bound variable anaphora (Reinhart, 1983), thus the equations [initiator$(e) = x$] and [undergoer$(e) = x$] will necessarily hold for the same x. This precludes the use of *-u-*, because this requires the agreement controller to be an Undergoer while not being an Initiator. Hence the only option is to use *-i-*, which is consistent with the empirical data.

4 Conclusions

In this paper, I have described an interesting phenomenon in Ashti Dargwa where in certain verbal forms, one of the two suffixes, *-i-* or *-u-*, appears before the person agreement marker. These suffixes, which, at first glance, seem to indicate the grammatical function of the agreement controller ($\mathcal{A}$ vs. $\mathcal{P}$), actually have a more complex distribution. While *-u* seems to be restricted to patient-like arguments, the distribution of *-i-* is less clear in that it is licensed with a seemingly heterogeneous class of arguments: transitive subject, unergative subjects of intransitive verbs, reflexives and, most puzzlingly, both experiencers and stimuli of "affective" verbs (transitive with dative experiencer subjects). I sketch four possible analyses of this phenomena: in terms of a special "verbal case" feature, syntax, argument structure, and semantics. The "verbal case" analysis and the syntactic analysis can be immediately rejected, as they introduce too many stipulations that have no independent empirical confirmation. An argument-structure analysis is technically possible, but requires introducing a language-specific mapping of stimuli, which, again, has little empirical motivation. Finally, I propose a semantic analysis which uses Ramchand's (2008) analysis of argument structure, inspired by the analysis of Icelandic dative subjects in Schätzle (2018). I show that Ramchand's approach, combined with the theory of valency in Asudeh, Giorgolo, and Toivonen (2014), allows for an elegant and natural analysis of *-i-* and *-u-* in semantic terms: *-u-* is licensed by Undergoers that do not share the semantic role of Initiator, while *-i-* is licensed with all other roles (i.e. in contexts that constitute the negation of the definition of *-u-*). This analyses captures the relevant data and allows for a natural treatment of an "agentivity coercion" effect that arises from using *-i-* with seemingly purely patient-like arguments like the subject of the verb 'die'. Unlike all other analyses, it also correctly predicts the behaviour of reflexives.

There are still several open questions to be resolved. First, the unavailability of antipassive argument mapping with "affective" verbs is predicted by the argument structure analysis, but is as of yet unexplained in the semantic approach. Second, the use of *-i-* and *-u-* in Ashti should be systematically investigated for all the major classes of predicates identified in Ramchand (2008) and elsewhere. Third, the theory of Ramchand (2008) itself should be more fully adapted for LFG and Glue: I currently use notions like Initiator and Undergoer as primitive labels for semantic roles, whereas Ramchand's concept of subevents might be more directly incorporated into the semantic component. Finally, the distribution of *-i-* and *-u-* should be compared with corresponding markers in other Dargwa varieties, both for hypothesizing their origin and for achieving a better understanding of their synchronic functions.

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Swabian ed and edda: Negation at the interfaces

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Abstract

This paper discusses the interplay of linear word order, negation, and prosody, and its implication for the scope of negation expressed by two Swabian negation particles *ed* and *edda* which correspond to the Standard German negation particle *nicht* ('not'). By means of a corpus study of spoken Swabian from the 60s, the paper offers an insight into the analysis of negation from the perspective of several grammar modules, and into the distribution of Standard German *nicht* via the comparison to the use of two different Swabian negation participles.

1 Introduction

Swabian, a Southern German dialect with approximately 820.000 speakers, has two negation particles, *ed* and *edda* (variations: *ned/id* and *nedda/idda*), where *edda* only occurs at the end of sentences, while *ed* occurs in all possible positions.[1] The two forms corresponds to the single negation particle *nicht* ('not') in Standard German and, taken together, show a similar distribution to the Standard German negation particle. However, the two negation particles seem to have a complementary distribution at the end of a clause, which might offer insights into hitherto undiscussed aspects of negation.

Negation in Standard German has been widely discussed from a syntactic and a semantic perspective (see, for example, Penka and Zeijlstra (2010) and references therein) but less so with respect to prosody. Although several authors note that prosodic structure seems to play a role when it comes to determining the scope of negation (Blühdorn, 2012; Jacobs, 1991), a larger prosodic corpus analysis of spoken data has not been conducted at this point and a formal analysis of the interplay between negation, linear word order, and prosody in German has to date not been provided. A second aim of this paper is thus to establish patterns, where prosody can guide the semantic analysis of the scope of negation and can thus contribute valuable information to the overall linguistic analysis of a clause.

As Swabian negation roughly follows the same distributional patterns as Standard German negation, the following overview of the negation particle *nicht* will be taken as a starting point.[2] By means of corpus data of spoken Swabian from the 60s, the paper will proceed to a discussion of negation in the context of linear

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[1]Similar distinctions can also be found in other dialects, for example, in Austrian, which distinguishes between *niet* and *nöt*. An exact understanding of whether these distinctions are similar to the one found in Swabian is left to further research.

[2]Further possibilities of negation, for example, negative indefinites like *kein* 'not a/no', other more implicit negations like *jemals* 'ever', morphemes implying negation like un*geschickt* 'in-/un-', connectors like *weder ... noch* 'neither ... nor', or any interaction of the particle with other elements like *nicht mehr* 'no more' or *nicht einmal* 'not even' are excluded from the discussion.

word order and prosody on the one hand, and the insights offered by the use of two negation particles in Swabian on the other hand. The paper concludes with a sketched analysis of the Swabian data across the LFG modules.

2 Negation in Standard German

From a diachronic perspective, the negation particle *nicht* underwent the Jespersen Cycle (Jespersen (1917), see also Jäger and Penka (2012)). In Old High German, sentential marking was indicated by the preverbal clitic *ni*, but Old High German also featured a second, verb-independent particle: *niowiht* ('nothing'), which had a relatively free distribution. In Middle High German, both of these particles could be used for sentential negation. In Modern German, finally, the preverbal clitic was completely replaced by the particle *niowiht* (today's *nicht*).

2.1 Distribution

A consequence of this process seems to be that the modern negation particle has a fairly free distribution in the German clause structure. As German linguistics traditionally divides sentences into fields, which organise the linear order of elements in a German clause, we will briefly review this structure as it helps to keep track of the negation particle.

Vorfeld (pre-field)	linke Satzklammer (left bracket)	Mittelfeld (middle field)	rechte Satzklammer (right bracket)	Nachfeld (post-field)
subject topicalised objects ...	**finite verb**	subject objects Adjuncts ...	**participles** infinitives verb particles ...	sub. clauses Adjuncts ...

Table 1: An overview of the field structure of a German sentence

While the occupants of the fields can differ greatly depending on the clause structure, it is important to note that in a non-subordinate clause, the left bracket contains the finite verb and the right bracket the non-finite verbal complex (if present).

- **Pre-field**: everything before the finite verb
- **Post-field**: everything after the non-finite verbal complex
- **Middle field**: everything between the finite verb and the non-finite verbal complex.

In the following example, the left and the right sentence bracket (LB/RB) are occupied by a finite auxiliary verb and a participle verb, respectively. All possible positions for the negation particle are indicated by an underscore and each position corresponds to a specific scope of negation.

(1)

__	Amra	**hat**$_{lb}$	__	dem	Lehrer
(NEG)	Amra	have.3.SG	(NEG)	the	teacher
__	die	Aufgaben	__	**gegeben**$_{rb}$	
(NEG)	the	exercises	(NEG)	give.PTCP	

‘Amra has(n’t) given the teacher the exercises.’

This placement variability leads to a number of different possibilities for the scope of the negation particle.

2.2 The scope of negation

Blühdorn (2012), following Helbig and Buscha (2000), notes that the negation particle is usually placed directly preceding the element it negates. If the particle occurs directly before the verb, it tends to scope over the verb and causes ‘sentential negation’. If *nicht* occurs before another element apart from the verb, it is more likely to scope over that element and cause ‘special negation’ or ‘constituent negation’, although it might, in principle, also scope over all following material.[3]

In example (1), there are several possibilities for the scope of negation if the negation is placed in the position right after the left sentence bracket (the finite verb). In the following, scope of negation is indicated by the bold form.

(2) *Amra hat*$_{LB}$ <u>*nicht*</u> *dem Lehrer die Aufgaben gegeben*

a. Amra did not give the exercises **to the teacher** (but to the principal)
$\rightarrow$ ‘most likely’ given linear word order

b. Amra did not give **the exercises** to the teacher (but gave him an apple)

c. Amra did not **give** the exercises to the teacher (but threw them at him)

d. Amra did not **give the exercises to the teacher** (but went for a walk)

e. Amra did not give **the exercises to the teacher** (but gave an apple to the principal)

f. ... and any other combinations

Jacobs (1982, 1991) also discusses the correlation with word order, but furthermore notes that this correlation is most likely in the Middle field, and that the correlation between scope and linear order is not necessarily true in all cases.

To find the scope of a negation, previous research (e.g., Jacobs, 1991; Jäger, 2008) applied the *sondern*-phrase. *Sondern* can be translated with *but/instead/but*

[3]This distinction between sentential and constituent negation has been discussed frequently; Blühdorn notes that sentential negation can in principle be viewed as just another type of constituent negation, see also Jäger (2008).

rather in sentences like: *It was not the boy who rolled down the hill, but the girl*, where *sondern* explicitly replaces the proposition that the negation operated on (see also Jäger, 2008). *Sondern* is often contrasted with *aber*, which can be translated with 'but', meaning 'however'. While *sondern* is applied in situations with a contrast between possible alternatives and is often used to correct a previous statement which includes a negated element, *aber* can be used as a continuation of positive or negative statements and is often used to add additional information.

(3) a. I am not tall, *sondern* short

b. I am not tall, *aber* happy

Example (3a) has a corrective context; somebody assumed that the speaker was tall. The second statement in (3b) is not corrective in that it does not imply that somebody claimed that the speaker was tall. At most it is contrastive of some previous proposition that only tall people can be happy. As the paper discusses in Section 3.1, both conjunctions play a role when determining the scope of negation, and the difference between the two conjunctions might be essential for understanding the difference between *ed* and *edda*.

2.3 The scope of negation and prosody

Jacobs also notes that prosodic 'focus' can disrupt the preference of the negative particle to scope over the element it precedes. Consider the following examples from Jäger (2008, 22, caps indicate prosodic emphasis).

(4) a. Karl ist nicht nach Berlin geflogen
Karl is not to Berlin flown
'Karl didn't fly to Berlin.'
$\rightarrow$ He did not fly to Berlin (but might have flown to Frankfurt)

b. Karl ist nicht nach BERLIN geflogen
$\rightarrow$ but to Frankfurt

c. Karl ist nicht nach Berlin GEFLOGEN
$\rightarrow$ but went by train

c. KARL ist nicht nach Berlin geflogen
$\rightarrow$ but Peter did

Note that the prosodic focus indicates that there is an alternative possibility for the element under focus which would render the proposition true. This is especially interesting in the comparison of (4a) and (4b), where the former unmarked construction can either mean that only the constituent directly following the negation is replaced, or that the whole proposition is false. Example (4b) on the other hand indicates that the negation only operates on the prosodically focussed element immediately following.

Going back to example (2), it becomes clear that prosody will most likely also play a role in determining the scope of the negation. For the individual continuations to become possible, a particular part of the sentence has to have prosodic prominence (roughly: the parts in bold form).

2.4 Negation and questions under discussion

As negation particles are very similar to focus particles, we would like to propose that negation can be modelled in terms of *Questions under Discussion* (Stalnaker, 1978; Roberts, 1996). Under this view, every discourse between two participants is viewed in terms of a shared common ground which is often modelled as a set of propositions, that is, a set of sets of possible worlds. Assertions can then be viewed as updates of the common ground, with the ultimate goal of reducing the context set (the possible worlds) to the actual world. Questions under discussions (actually 'topics' under discussion, QUD, Roberts 1996) are open questions in the discourse which the discourse participants are mutually committed to resolving.

The use of a negation can then be seen as rejecting a proffered assertion and as a signal that a QUD is 're-opened', that is, the QUD is unresolved. By means of either linear order or by marked prosodic prominence it is made clear which part needs to be replaced for the rejected assertion to be accepted as part of the common ground. Effectively, prosodic prominence thus allows the speaker to constrain the possible sets of propositions for the QUD that was re-opened by the negation.

3 Corpus Work

The data for this paper was taken from the Zwirner corpus (*Zwirner Corpus*, 1950s-1960s) conducted in 1966 and 1968 in smaller villages in the Swabian area. This corpus was chosen because there are no other resources for unscripted spoken Swabian; that is, while the speakers are recorded, they are not prompted to use a particular expression, but speak freely in their native dialect. Furthermore, these recordings reflect the dialect without the now common influence through exposure to other dialects (including standard German).

A random sample of 13 speakers was chosen by the authors. The speakers were between 31 and 75 years old and had spent most of their life in their villages. The interviewed speakers talked about life in the villages while they were growing up and during their adulthood. This included childhood memories (e.g., pranks, friendships) as well as descriptions of, for example, the correct treatment of a vinyard. The interviewer is the same in all interviews and a native speaker of Swabian. He only engages with the interviewed person if the speaker stops speaking, prompting them to comment on a particular topic.

The total length of the spoken data was 4 hours and 6 minutes. In a first step, the authors listened to the recordings and noted down every sentence that included the negation particles *ed/edda*. For every sentence a decision was made as to which element was in the scope of the negation. All sentences containing a negation particle were extracted for a more compact prosodic analysis at a later stage via the annotation software Praat (Boersma and Weenink, 2013). The total number of sentences containing at least one negation was 254.

3.1 Negation, linear word order, and prosodic prominence

For our analysis we only chose those sentences which had a clear left and right sentence bracket (as explained above in section 2.1). As spoken data is often fractured, this step was taken to allow for a relatively uniform data set. The resulting 94 instances were further divided according to which (if any) elements intervened between the negation particle and the final verb. The material preceding the particle in the Mittelfeld was not taken into consideration with respect to the group division as the negation only scopes over the following material in an unmarked structure. The division based on the material between the negation and the final verb resulted in the following groups:

1.	(...)	Neg	A(dv)P	NP/PP(+)	V	⇒ 10 cases
2.	(...)	Neg	A(dv)P		V	⇒ 24 cases
3.	(...)	Neg		NP/PP(+)	V	⇒ 8 cases
4.	(...)	Neg			V	⇒ 53 cases

Table 2: Possible sequences between negation and final verb in the middle field

With respect to the prosodic analysis, the previous accounts did not clearly specify their methodology. Blühdorn (2012), who focusses on work by Buering (2006) and on the relationship between prosody and notions of information structure like ‘topic’ and ‘focus’, simply refers to ‘rising’ and ‘falling’ accents. He unfortunately does not provide a detailed overview of the data or the method he used, and in particular rejects the idea of a prosodic reflection of different focus types (e.g., a prosodic distinction between broad vs. narrow focus).

In this paper, we use the acoustic indications established in Baumann et al. (2007) who show clear differences between different types of focus structures (broad, narrow, contrastive). As Baumann et al. (2007) note, prosodically marked focus can be expressed on a number of levels. Two that will be taken into consideration in this paper as well are 1) tonal considerations, where a sentence with a late contrastive focus will have fewer prenuclear accents, and higher/steeper nuclear accents, as well as 2) durational measurements, where an increased duration is expected to occur on the syllable that carries the main accent. Baumann et al. also observe that with broad focus structures, the different pitch accents in a clause are subject to a general downstep pattern; that is, a H* pitch accent following another

H* pitch accent will most likely be lower than the first accent. In contrastive focus constructions, however, the pitch accent on the contrastive element is most likely to be at the same level or higher in comparison to a previous accent. Baumann et al. conclude that this strategy emphasises the prominence of a particular element and supports the marking of a semantic contrast.

In the following, the four sentence types listed in Table 2 will be discussed with respect to linear word order, the scope of negation, and prosody.

3.1.1 ed A(dv)P XP(+) V

The first set consisted of 10 sentences where the negative marker *ed* was placed before an AdvP followed by an NP or PP (and in some cases a second NP/PP). In 7 sentences, the negation directly referred to the following adverbial. In 5 of these cases, the adverbial received main stress. However, in 2 cases it was the following noun which received main stress. Although this would suggest that the noun is in the scope of the negation, there are other factors at play. One of the examples ((6b)) is discussed below; the other example contained the particle *gar*, which can be translated as 'at all' and which cannot be applied to nouns, but refers to an adjective. The combination of *gar* with the negation particle in (5) thus forces the adjective to be in the scope of the negation, otherwise the clause would be ungrammatical.

(5)	...	gar	ed	schee	**Wetter**	gwea
	...	at all	NEG	nice	weather	be.PTC

(It) wasn't nice weather at all.
Continuation: sondern schlechtes (but bad (weather)).

(Sp 166, 154 s)[4]

There are only three occurrences where the negation referred to the following noun which in all cases carry a prosodically marked contrastive focus. In these sentences, the linear word order does not indicate a differing scope of negation; scope of negation can only be determined by means of a prosodic analysis.

In the following, one of the examples with contrastive focus is compared to a similar example, where the prosodic pattern is unmarked. Both sentences have been reduced to the relevant parts. Example (6a) is a sentence, where the contrastive prosodic marking of the noun (*Trollinger* = a type of wine) places this noun within the scope of negation. In (6b), on the other hand, the negation refers to the material directly following, the quantifier construction *so viel* ('so much').

[4] In the corpus, each speaker (Sp) is assigned a number to ensure anonymity (here: 166). 's' stands for 'second' and refers to the position of this specific utterance in the overall recording of this speaker.

(6) a. ... ed so viel **Trollinger** ghet
... NEG so much Trollinger have.PTC
(They) didn't have so much Trollinger.
Continuation: sondern Lemberger (but 'Lemberger');
*sondern weniger (but less)
(Sp 95, 380 s)

b. ... ed **so** **viel** Arbeit gmacht
... NEG so much work make.PTC
(They) didn't create so much work.
Continuation: sondern weniger (but less);
*sondern Freizeit (but free time)
(Sp 169, 1475 s)

Figure 1 shows the respective speech signals for examples (6a) and (6b).[5] In the prosodically contrastive example on the left, *ed so viel* does not carry an accent and is prosodically phrased with the previous material. *Trollinger*, on the other hand includes a very large rising pitch span, and a strong L*+H focus accent.[6] In the speech signal on the right, on the other hand, *ed so viel* carries an accent and seems to form a prosodic unit for itself. The following noun *Arbeit* also has an accent, but it is downstepped from all previous accents in the sentence and thus does not indicate a contrastive element.

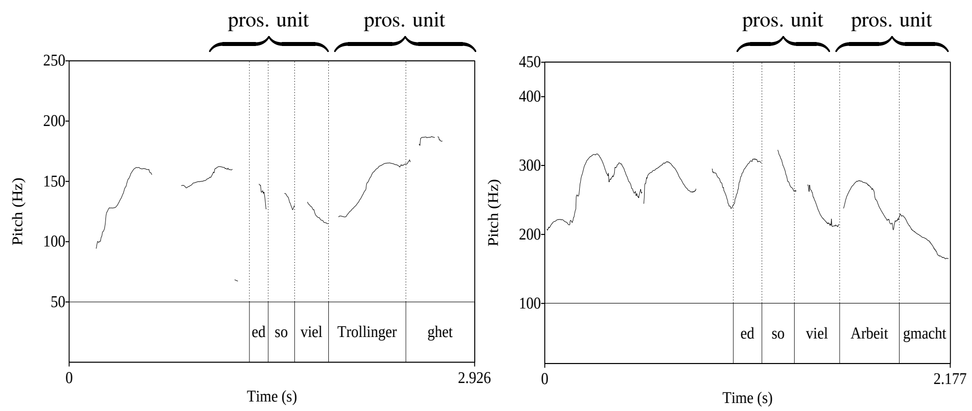

Figure 1: Speech signals for contrastive noun (6a) on the left, non-contrastive noun (6b) on the right.

Another indication for a contrastive context can be seen in the analysis of syllable duration.

[5]As the speakers had different genders, the pitch scale was adjusted to make the examples comparable.

[6]The further rise on *ghet* is a continuation rise to the following clause (where the speaker indeed replaces 'Trollinger').

	ed	*so*	*viel*	noun (1st syll)
(6a) **contrastive**	0.14	0.19	0.24	**0.21**
(6b) **non-contrastive**	0.15	0.17	0.24	**0.15**

Table 3: syllable duration in seconds in examples (6a) and (6b)

While there is no significant difference between the two versions of *ed so viel*, the difference in duration on the first (lexically stressed) syllable of the noun is very distinct: the first syllable of the contrastively stressed *Trollinger* is significantly longer than the first syllable of the noun *Arbeit* in the non-contrastive context.

3.1.2 ed A(dv)P V

The second set contained sentences, where the ed+A(dv)P combination was placed directly before the verb without an intervening noun. There are 23 cases, where the negation scopes over the following A(dv)P. In each case, the head of the A(dv)P was stressed. The negation itself was stressed in about 50% of the cases.

There was only one case where the negation did not refer to the following material, but to a topicalised element in the pre-field, which carried prosodically contrastive stress. The negation particle *ed* also carried stress, but not so the following material.

(7) **Onda** ka mr's **ed** so gut lagra
Downstairs can one.it ED so well store.PRTC
'One cannot store it so well downstairs.'
(Sp 164, 226 s)

In standard linear word order, *onda* would be placed after *gut*: .... *ed so gut onda lagre*. Its topicalisation in the pre-field and the additional prosodic prominence enforce the negation to scope over it.

3.1.3 ed NP/PP V

The third group consisted of the negation particle followed by an NP or PP and the verb. In 8 of 8 cases, the head noun received main stress and was in the scope of the negation.

3.1.4 ed V

The situation is more diverse with the last, large group of 53 sentences, where the negation operator directly precedes the verb. In 26 cases, the negation particle directly refers to the following verb. In all of these cases, the verb carries main stress; in some of them, the negation particle carries stress as well. Only one case shows a slightly different pattern: the verb is unstressed and the noun preceding the negation carries main stress. However, the following negation particle has a 'semantically meaningful' contrastive stress with an upstep in the pitch, similar to the one discussed in Section 3.1.1.

(8) Des hat mr sich als **rechter** Bauer **ed** nemma lau
that has one himself as proper farmer NEG take let
'A proper farmer would not let that be taken away from him.'

(Sp 170, 809 s)

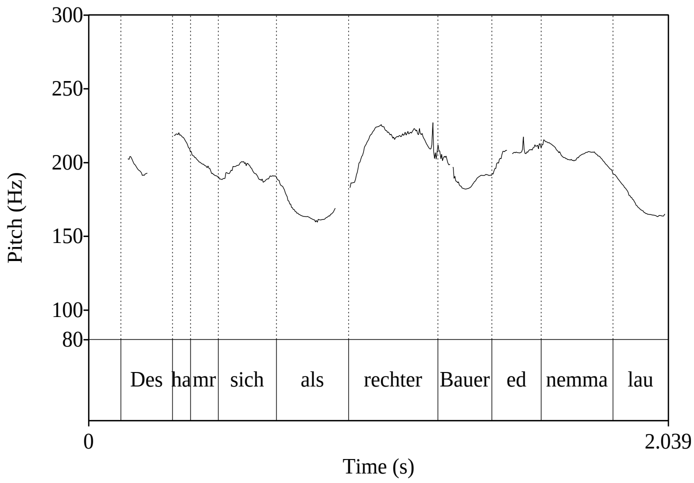

Figure 2: Speech signal for example (8)

In (8), *rechter* 'proper' carries a contrastive accent. However, instead of a following deaccentuation, there is a second prosodic prominence on *ed* which shifts the focus to the prosodic unit of the negation particle and with it to the following verb.

The second group consists of 27 sentences where the negation particle does not scope over the verb. Approximately one third of the sentences contain a topicalised, prosodically stressed item in the pre-field that would otherwise be positioned to the right of the negation particle in an unmarked sentence (similar to example (7)). The topicalised items found in the corpus comprise nouns, adjectives, and infinitives.

(9) ... en **Apfel** häbet mir ed **ghet**
... an apple have we NEG had
'An apple, we didn't have'

(Sp 175, 158 s)

Another third of the sentences contains a topicalized, stressed demonstrative pronoun ('des'), which would be placed before the negation in an unmarked sentence. It seems to be difficult to stress an object demonstrative pronoun in the middle field, so placing it in the pre-field might be a strategy to mark a pronoun as contrastive.

There are five cases where the linear word order might suggest that the negation scopes over the verb, but where the prosodic marking clearly suggests otherwise. In (10), the natural continuation given linear order would be something like ‘but I knitted’. However, the prosodic focus on the subject pronoun opens up this proposition for alternatives, that is, there is somebody else who could spin. And indeed, in the following clause, the speaker talks about a woman in the village who used to spin wool.

(10)	Ja	**i**	han	ned	gschponna
	Yes,	I	have	NEG	spin.PRTC
	‘Yes, I didn’t spin.’				

(Sp 174, 476 s)

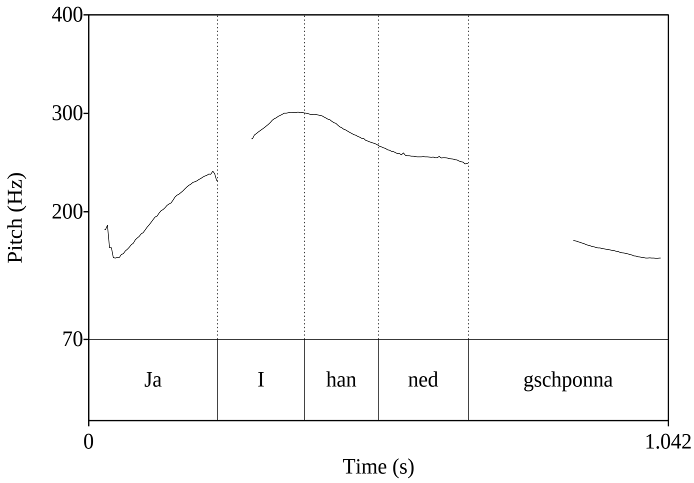

Figure 3: Speech signal for example (10)

In the speech signal in Figure 3, the contrastive focus on the subject pronoun is marked very distinctly: the pitch span as well as the duration of the pronoun mark this as relevant for meaning. The rest of the clause shows a very clear deaccentuation, typical for postfocal material.

An interesting insight when looking at these examples is the preference for the ‘continuation’, that is, whether a continuation with *sondern* or *aber* is preferred. All the examples discussed under section 3.1. prefer a continuation with the *sondern*-phrase, except for this very last group where *ed* is placed directly preceding the verb, but does not refer to the verb in that position. All of these 27 examples would be more natural with a continuation starting with *aber* (although *sondern* is an alternative option in some of these examples).

3.2 *ed* and *edda*

So far, only *ed* was discussed. *Edda* only occurs at the end of sentences and is thus never part of a typical middle field between two sentence brackets. If a sentence contains a right sentence bracket in form of a participle, a negation particle (*edda/ed*) cannot occur following that bracket, so *edda* never appears in sentences that have both brackets. It can, however, occur in sentences where the participle/infinite is topicalized, that is, where the typical occupant of the right sentence bracket is placed in the pre-field. This raises the question whether the negation particle in these structures actually occupies the right sentence bracket.

The form *ed* also occurs at the end of sentences, but less often than *edda*: *ed* was found nine times at the end of a sentence, while *edda* was found 19 times. Of these, several were interjection statements, a version of 'I don't know' placed in the middle of another utterance. These were excluded from the analysis, leaving 8 examples with *ed*, and 15 with *edda*. As these are relatively small numbers with regard to sentence-final negation, the following observations can only be cautious speculations. Example (11) shows a typical sentence with *ed*:

(11)	Oine	den	scho no	ebbes	raus,	aber	**viel**	grad	**ed**
	Some	do	still	something	out	but	much	really	NEG

'Some still get something out (of the ground), but it's not really much.'

(Speaker 164, 136 s)

In the clause *aber viel grad ed*, *viel* and *ed* are both stressed; *viel* is in contrastive focus to which the negation refers. Of the eight sentences used for final *ed*, seven were similar to (11) in that they scoped over a particular element (mostly adjectives, one noun). Only in one case did *ed* scope over a clause that was uttered in the previous context and was deleted in the clause with *ed*: 'Did they have to work'? – *überhaupt ed* ('not at all'). Elliptic constructions (of different types) were found in four cases, three sentences were 'complete'. In the elliptic examples, the negation seems to be used to replace a context that was previously stated, often occurring together with the element which is under discussion and whose replacement would render the proposition true.

Of the 15 sentences with *edda*, there are 11 with elliptic constructions. None of the negation particles scope over an adjective; rather, the scope seems to be broader. Most negation particles in this group seem to scope over the verb and larger parts of the sentence as in (12).

(12)	da	hat	mr	no	koi	Sämaschine	ghet
	at.that.time	has	one	yet	no	seeder	have.PTC
	...	ond	schpäter	au	no	edda	
	...	and	later	also	yet	NEG	

'One didn't have seeders at the time ... and later (one) also not (have them).'

(Speaker 175, 428 s, shortened)

With respect to stress, in the four 'complete' sentences, *edda* does not carry any stress. While most examples where in some type of contrast to some previous context, this was more pronounced in the elliptic examples. In four of them, there was an explicit corrective construction in response to something the interviewer had asked, introduced by a preceding 'No'. In these cases, the complete sentence was deleted except for the negation particle (which negated the proposition) and the element, which needed to be replaced for the proposition to be accepted ((13)).

(13) (Interviewer: 'Is there a bus to Geislingen?')

Noi,	von	**uns**	aus	**edda**
No	from	us	off	NEG

'No, not from us (our village to Geislingen)'

(Speaker 169, 894 s)

In all of these examples, the item-to-be-corrected and *edda* were stressed. In the only corrective focus example found with *ed*, the negation particle was not stressed.

Another interesting observation is the fact that for the sentences with *edda*, it feels more natural to continue with 'aber'. With the sentences ending in *ed*, this is only the case for the two sentences where the negation particle does not refer to an adjective. All others have a strong preference for a continuation with *sondern*. It is not quite clear what exactly distinguishes these two groups, especially as these seem to go beyond the distinction between *ed* and *edda* (as discussed in Section 3.1.4). As stated above, the data is too sparse to make a final conclusion. We can at this point only leave these author observations for future research.

3.3 A note on *ned* and *ed*

During the analysis, it became clear that six speakers used two versions of the negation particle: *ed/edda* and *ned/nedda*. One speaker and the interviewer constantly used *ned/nedda*, 6 speakers used only *ed/edda*. As these forms are usually attributed to regional variation and should thus only occur rarely with one speaker, we wanted to see whether there is a constant pattern with the speakers that used both versions.

For this investigation, we looked at the material preceding the negation particle. Among the six speakers, there were 50 occurrences of *ned*, and 66 occurrences of *ed* (with a fairly proportional distribution within each speaker). From a phonological perspective, no consistent pattern was found: neither the preceding segmental material, nor stress at the word level, nor stress at the sentence level seemed to have an effect. So far we can only conclude that the use of *ned* and *ed* is free variation.

4 Negation and prosody: an LFG analysis

The German XLE grammar uses the concept of fields to organize sentence structure (Dipper, 2003; Butt et al., 1999). Each field is assigned a metacategory with the finite verb as the left bracket, and the non-finite verbal complex as the right bracket (see also Table 1).

(14) S $\longrightarrow$ VORFELD
V2 "finite verb"
MITTELFELD
VC "non-finite verbal complex"
NACHFELD

The middle field has a fairly free word order; and as demonstrated in example (1) that is also true for the distribution of *nicht* in the middle field. The (shortened) metacategory MITTELFELD can include NPs, PPs, and Adverbs in any order. The free word order is made possible by the shuffle operator (,) which allows for all categories to appear in any order.[7]

(15) MITTELFELD $\equiv$ NP*, PP*, ADV*, (NEG)

The negation particle *ed* can be optionally realized in the middle field, where it can be freely placed between the constituents, similarly to adverbs, but not with a completely identical distribution (see Jäger, 2008). *Edda*, on the other hand, should optionally be allowed to replace the VC in the main S rule in (14) together with a constraint that the NACHFELD cannot be realized.

(16) ... { VC NACHFELD | NEG$_{edda}$}

Przepiórkowski and Patejuk (2015) propose two negation attributes: ENEG (appr. sentential) and CNEG (for constituent negation). Such a fine-grained distinction is not necessary for the data presented above. Syntactically, the negation is not part of the other constituents in the metacategory, for example, it is not a daughter of the NP. Its scope is determined either by linear order, which can be regulated via f-precedence and 'right sister', or by prosodic prominence.[8] A standard adjunct notation would thus suffice (ParGram, see also Laczkó (2014)).

(17) $$\begin{bmatrix} \text{...} & \\ \text{ADJ} & \left\{ \begin{bmatrix} \text{PRED} & \text{`ed'} \\ \text{ADJUNCT-TYPE} & \text{neg} \end{bmatrix} \right\} \end{bmatrix}$$

[7] Existing constraints concerning the linear order of the German Mittelfeld go far beyond this paper and are not relevant to the point made here.

[8] F-precedence could be combined with the rule in (15) via intersection, for example, & NEG $<_f$ [NP | PP | ADV]. How this constraint can be formulated in combination with a shuffle operator is left for further research.

In order to capture the prosodic patterns, we follow the proposal made by Bögel (2015) for the prosody-syntax interface and extend it to include the exchange with information structure. In this approach, the interface between c-structure and p-structure is mediated via two transfer processes: the *transfer of vocabulary*, which exchanges phonological and morphosyntactic information of lexical elements via the multidimensional lexicon, and the *transfer of structure* (♮), which exchanges information on syntactic and prosodic phrasing, and on intonation.

The model distinguishes between *comprehension* (from form to meaning, parsing) and *production* (from meaning to form, generation). During *production*, the information from different modules, for example on c-structure constituency and i-structure values, is encoded in p-structure. During *comprehension*, information from the speech signal feeds into p-structure in form of acoustic cues (fundamental frequency, length, intensity, ...). This information is translated into more categorical terms, for example, prosodic units and pitch accents, that allow for a meaningful interpretation of the speech signal by other modules of grammar.[9]

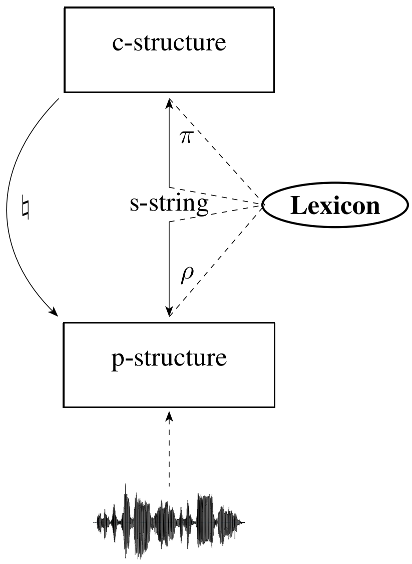

Figure 4: Abstract overview of the prosody-syntax interface during comprehension

Consider the following example, where the scope of negation is determined via prosody.

[9]This approach follows the hypothesis that any grammar framework should follow a 'directional' perspective; in the work on the interface to prosody, but also in the computational implementations of the ParGram effort, this distinction betwen comprehension and production is essential. A thorough debate, however, goes far beyond the scope of this paper.

(18) Ravi hat ed im Bett gschlafa
Ravi has NEG in.the bed slept
'Ravi didn't sleep in the bed.'

a. **'Unmarked' prosody**: negation scopes over *im Bett*
→ *... but he slept on the sofa*

b. **Contrastive stress on *Ravi***: negation scopes over *Ravi*
→ *... but Amra slept in the bed*

Analysing the written data in terms of linear word order does not necessarily yield the right results. The only way to unambiguously interpret the meaning of this sentence is by considering prosody, that is, p-structure in LFG. P-structure in Bögel (2015) is represented via the p-diagram, a linear syllablewise representation of the speech signal over time. The following representation shows the p-diagram for example (18b) during *comprehension*.

PROS. PHRAS.	$(_\iota$	...	...	...	...	...	...	$)_\iota$	**interpretation**
GToBI	**H**	...		...	...	...	...	...	↓
PROMINENCE	**3**	..	...	...	...	...	...	...	
DURATION	0.27	0.19	0.14	0.16	0.14	0.12	0.36	0.23	**signal**
FUND. FREQ.	208	209	169	157	162	165	160	155?	↓
SEGMENTS	[ʁa]	[vɪ]	[hat]	**ed**	[ɪm]	[bɛt]	[gʃla]	[fə]	
VECTORINDEX	$\mathbf{S_1}$	$\mathbf{S_2}$	$\mathbf{S_3}$	$\mathbf{S_4}$	$\mathbf{S_5}$	$\mathbf{S_6}$	$\mathbf{S_7}$	$\mathbf{S_8}$	

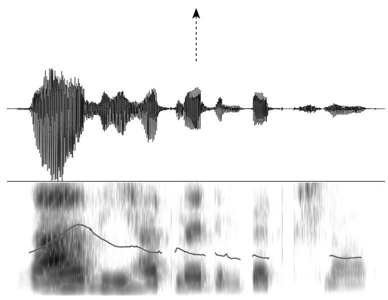

Figure 5: P-diagram and speech signal for example (18b).

The signal information in form of duration and mean fundamental frequency (f_0) can be expressed in the corresponding categorical terms in form of prosodic units and accents (the 'prosodic vocabulary') at the interpretation level. P-structure, in a sense, thus also includes the phonetics (='signal') - prosody (='interpretation') interface. The high levels of f_0 with a following fall in frequency (post-focal deaccentuation), and the long duration of the first syllable clearly indicate a strong pitch accent on *Ravi*.

The strong, early peak in the intonation phrase (ι) points towards a contrastive accent. As the annotation conventions in GToBI (Grice and Baumann, 2002) only allow for the indication of pitch accents (H/L), this paper adopts the new DIMA annotation set (Kügler et al., 2019), which allows for a much more fine-grained annotation of the speech signal. Besides the annotation of tones, DIMA also proposes the independent marking of prominence levels, ranging from ‘none’ to level 3. While a typical pitch accented syllable corresponds to level 2, level 3 in combination with a H* accent is very likely to indicate superior prominence (e.g., with a contrastive or corrective meaning). The addition of prominence levels to the representation thus allows to distinguish between different types of pitch accents. There might be several accents labelled with H in one sentence, but it is only the one with a prominence level of 3 that is of importance for the estimation of the scope of negation.

During the transfer of structure ($\natural$), which exchanges information on syntactic and prosodic constituency (Bögel, 2015), and on intonation (Butt et al., 2017), the contrastive pitch accent becomes available to syntax. The following annotation, which can in principle be combined with any node, checks whether the associated material carries prosodic prominence in p-structure.[10] If this is the case, an attribute [PROM = +] is included in the f-structure of the prosodically prominent element.[11] In principle, this could also be extended to include different types of prominence as discussed in Baumann et al. (2007).

NP

$$(\natural(T(*))\mathrm{S}_{any}\ \text{GTOBI}) =_c \text{H}$$
$$(\natural(T(*))\mathrm{S}_{any}\ \text{PROMINENCE}) =_c 3$$
$$(\uparrow \text{PROM}) = +$$

GToBI	...	...	H	...	...	...	...		
PROMINENCE	...	...	3	...	...	...	...		

Figure 6: The annotation for a contrastive focus at the prosody-syntax interface

The reference to p-structure can be rewritten as a meta-category which routinely checks the prosodic status of every terminal node in c-structure. If, for example, *Bett* in example (18) had a prominent accent, the following f-structure would be generated.

[10]The annotation can be read as: For all terminal nodes T of the current node *, there must be a (any) syllable S for which the attribute GToBI has the value H*, and a syllable for which the attribute PROMINENCE has the value 3.

[11]The answer to the question, whether this should be a non-binary PROM feature or whether [PROM = –] is a useful addition to the feature system has to be left to further research in prosody.

(19)
$$
\left[\begin{array}{ll}
\text{...} & \\
\text{OBL-DIR} & \left[\begin{array}{ll} \text{PRED} & \text{‘im’}\langle\text{OBJ}\rangle \\ \text{OBJ} & \left[\begin{array}{ll}\text{PRED} & \text{‘Bett’}\\ \text{PROM} & + \end{array}\right]\end{array}\right] \\
\text{ADJ} & \left\{\left[\begin{array}{ll}\text{PRED} & \text{‘ed’}\\ \text{ADJUNCT-TYPE} & \text{neg}\end{array}\right]\right\}
\end{array}\right]
$$

where neg $<_f$ OBL-DIR

Prosodic prominence can ultimately only be interpreted through the combination of the information from all modules. With the semantically neutral PROM feature, a premature interpretation in terms of semantics/pragmatics is avoided; it is only in combination with the negation operator and linear scope that meaning can be constructed, for example, along the lines proposed in Zymla et al. (2015) and in terms of possible worlds for the QUD.

5 Conclusion

This paper discussed the topic of negation in German and the Swabian dialect. By means of a large corpus study of spoken language, the paper looked at how negation interacts with linear word order and prosody on the one hand, and compared the distribution of the two distinct negation particles in Swabian, *ed* and *edda*, with the Standard German negation particle *nicht*. With respect to the distribution, it was shown that *edda* only occurs at the end of the clause, while *ed* can occur in every position. However, at the end of the clause, *ed* only seems to allow for a very narrow scope, while the scope of the negation particle *edda* seems to be broader.

With respect to the scope of negation in prosodically unmarked sentences, negation usually scopes over the following element/constituent. However, this pattern can be overwritten via prosodic prominence, which can shift the scope of the negation particle to the prosodically prominent element. Prosodic prominence can be captured easily via the syntax-prosodic interface proposed in Bögel (2015). In the presence of a contrastive accent, a PROM feature is projected to the element's f-structure. C-structure thus serves as a pivot between p-structure and semantics/pragmatics, enabling the grammar to detect meaningful prosodic patterns; essential for any language which signals information-structure via prosody. With its modular architecture, LFG provides the perfect environment for an analysis of negation on multiple levels, while simultaneously, complex phenomena like negation prove to be valuable test cases for the research at the interfaces.

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Mixed Categories in Tamil via Complex Categories

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Abstract

This paper discusses nominalized complements in Tamil, analyzing them as a type of mixed category. We unpack the complex morphological marking found on the nominalized complements and analyze their morphosyntactic properties. The embedded clauses function as verbally headed complements internally, but display nominal properties with respect to the matrix clause. We tie our analysis to a diachronic perspective on mixed categories and propose that the concept of complex categories developed within ParGram allows for: 1) an elegant account of the mixed categorical properties of Tamil nominalized complements; 2) factoring in the gradual effects of historical reanalysis.

1 Introduction

In this paper we discuss Tamil constructions as illustrated in (1) and (2), where the nature of the embedded complement is interesting. In (1) the embedded clause functions as COMP, but is morphologically a nominalized version of a relative clause. In (2) we have a nominalized version of a relative clause formed on top of a complementizer which is historically derived from the verb *en* 'say'. The examples show two seemingly contradictory features.[1]

(1) [avan pizhai sey-t-a-athu-ai] ram
[he mistake do-PAST-REL-PRON.3SN-ACC] Ram.NOM
nirupi-tt-aan
prove-PAST-3SM
'Ram proved (it) that he made mistakes.'

(2) [avan pizhai sey-tt-aan enp-a-athu-ai] ram
[he mistake do-PAST-3SM COMP-REL-PRON.3SN-ACC] Ram.NOM
nirupi-tt-aan
prove-PAST-3SM
'Ram proved (the fact) that he made mistakes.'

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[1]Abbreviations are as follows: COMP=complementizer, NOM=nominative, ACC=accusative, GEN=genitive, PRON=pronoun, REL=relativizer, 1S=first person singular, 3SM=third person singular masculine, 3SN=third person singular neuter, 3PL=third person plural, FUT=future, COND=conditional, NEG=negation, PTCP=participle, PASS=passive, NOMZ=nominalizer, PERF=perfective, QUOT=quotative.

For one, as Amritavalli and Jayaseelan point out, “we have the embarrassment of tense inside gerunds” (Amritavalli and Jayaseelan 2008, §3.2). For another, the embedded subject within this nominalized embedded clause is nominative (verbally licensed), rather than genitive (nominally licensed) as we would expect from Stowell’s (1981) Case Resistance Principle. Finally, in both examples the embedded clause is marked accusative.

We see these examples as instances of a type of mixed category and propose to analyze them via formal machinery first introduced in the computational ParGram[2] context, namely *complex categories*.

The next section provides some general background, section 3 presents the Tamil data. Section 4 discusses previous approaches to mixed categories within LFG and introduces the formal machinery of complex categories. Section 5 provides our complex category analysis and section 6 concludes.

2 Background and Motivation

Tamil is a Southern Dravidian language spoken natively by more than 80 million people across the world. It is recognized as a classical language by the Indian government due to over 2000 years of a continuous literary tradition.[3] It is an official language of Sri Lanka and Singapore, and has regional official status in Tamil Nadu and Pondichchery, India.

Despite its large speaker population and historical time depth, Tamil is an under-researched language that is also under-resourced from the perspective of Natural Language Processing (NLP). As part of a collaborative effort we have been working on creating resources for Tamil NLP by building a ParGram style (Butt et al. 1999) Tamil grammar, which includes a morphological analyzer. The grammar is implemented with the XLE development platform (Crouch et al. 2017), the morphological analyzer (Sarveswaran et al. 2019, 2018) is realized in FOMA (Hulden 2009).

One of our goals is to build a treebank for Tamil by using the Tamil ParGram grammar. To this end, we are using Tamil educational textbooks as our corpus and are also adding to the existing parallel ParGramBank (Sulger et al. 2013) on the INESS site (Rosén et al. 2012).[4] In going through our body of examples, we encountered a number of challenging phenomena, one of which we tackle in this paper, namely, nominalized complements.

3 Tamil Nominalized Complements

The morphological structure of the complements in examples (1) and (2) is complex. Both examples employ a relativization strategy to accomplish com-

[2]https://pargram.w.uib.no

[3]https://southasia.berkeley.edu/tamil-studies-initiative

[4]http://clarino.uib.no/iness

plement embedding, a process which is found in Dravidian more generally. One way to form nominal complements in Tamil involves the relativization of the embedded verb (1). Another strategy is to mark the complementizer with relativizing morphology (2).

3.1 Complementizers in Tamil

Tamil does not have complementizers of the *that*-type as in English. Rather, it uses a grammaticalized form of the verb *en* 'say'. In the examples below this is the frozen past participle form *enṛu*, which has been analyzed as a type of quotative (Amritavalli 2013, Balusu 2020). This is illustrated by (3), which is ambiguous between a quotative use and a complementizer reading. (4) illustrates a purely complementizer reading. Note that matrix complementation verbs can also take an accusative object that serves as a type of co-referent for the complementizer clause (4-b). In this case, we have a relativized structure, marked by the relative marker *-a*. Note that the resulting form is *enṛa* due to phonological processes.

(3) ravi [naan en nanban-ai santhi-tt-en] enṛu
Ravi.3SM.NOM [Pron.1S my friend-ACC meet-PAST-1S] QUOT
so-nn-an
say-PAST-3SM
'Ravi said that — "I saw my friend".'
'Ravi said that I saw my friend.'

(4) a. ravi [mazhai var-um enṛu] ninai-tt-aan
Ravi.3SM.NOM rain come-FUT.3SN COMP think-PAST-3SM
'Ravi thought that it will rain.'

b. [avan pizhai sey-tt-aan enṛ-a] **unmaiy-ai** ram
he mistake do-PAST-3SM COMP-REL truth-ACC Ram.NOM
nirupi-tt-aan
prove-PAST-3SM
'Ram proved the truth that he made mistakes.'

While the original meaning of *en* as 'say' remains transparent to speakers of Tamil, it is no longer in general use as a verb of communication. The Tamil situation is consistent with grammaticalization processes found in other languages. For instance, Klamer (2000) shows how verbs of reporting in Austronesian languages become quotatives and from there begin to function as complementizers.

Recall that Tamil has a long diachronic record. However, this diachronic information is difficult to access because Tamil is severely under-researched. Conducting an in-depth diachronic investigation goes beyond the scope of this paper, but a quotative use of the form *enṛu* can be found as far back as 450–500 CE (dates according to Zvelebil 1974), see (5).

(5) ira-pp-an ira-pp-aar-ai ellaam ira-pp-in kara-pp-aar
beg-FUT-1S beg-FUT-3PL-ACC all beg-FUT-COND hide-FUT-3PL
ira-van-min **enṛu**
beg-NEG-3PL QUOT
I will beg from all beggars "If you want to beg, do not beg from people who hide things they have." (*Kural*-1067, *Thirukkural*, 450–500 CE)

3.2 Relative Clauses in Tamil

Relative clauses (RCs) in Tamil do not have relative pronouns like in English. RCs are formed by adding an *-a* morpheme to a verb (6-a). In the future participle form with *-um*, the relative marker is null, as shown in (6-b). Krishnamurti (2003) analyzes the *-a* in RCs as an adjectivizing morpheme and the resulting "relative participles" as having an originally adjectival structure. We take no position on this analysis. In what follows we refer to the morpheme *-a* as a relativizer.

(6) a. [angu **nin-ṛ-a**] paiyan-ai naan paar-t-en
there **stand**-PAST-REL boy-ACC I.NOM.1S see-PAST-1S
'I saw the boy who stood there.'

b. [angu **nirk-um-∅**] paiyan-ai naan paar-pp-en
there **stand**-FUT-REL boy-ACC I.NOM.1S see-FUT-1S
'I will see the boy who will stand there.'

The head noun of the RC in (6) is 'boy'. But, in predicative contexts, one also finds RCs without a head noun, as in (7). In this case, the verb in the RC instead carries a pronominal form *-athu*. This *-athu* is form-identical with the indefinite pronoun *athu*.

(7) [angu nin-ṛ-a-**athu**] en thambi
there stand-PAST-REL-PRON.3SN my brother
'The **one** who stood there is my brother.'

In order to account for this, we posit a process of cliticization of the matrix clause pronoun onto the RC so that the pronoun is prosodically incorporated into the RC, with (8) showing a synchronically unattested unincorporated version we postulate as the source construction. This is in line with the general tendency of function words to cliticize (e.g., Selkirk (1995); for pronouns in particular see Lahiri et al. (1990), Bögel (2015)).

(8) [angu nin-ṛ-a] athu en thambi

The cliticization also took place in non-predicative contexts. The example in (9-a) involves a full head noun 'boy' in the accusative as the matrix object. In (9-b) an accusative pronoun *-avan* 'he' is substituted in. The head noun is outside of the RC, the pronoun is realized as part of the RC.

(9) a. [angu nin-ṛ-a] **paiyan-ai** naan paar-t-en
there stand-PAST-REL boy-ACC I.NOM.1S see-PAST-1S
'I saw the boy who stood there.'

b. [angu nin-ṛ-a-**van**-ai] naan paar-t-en
there stand-PAST-REL-PRON.3SM-ACC I.NOM.1S see-PAST-1S
'I saw the one (he) stood there.'

Having looked at relativization strategies in Tamil, we are now ready to unpack our introductory examples.

3.3 Nominalized Relative Clause

We begin with the nominalized relative, repeated in (10) from (1). We can now identify the indefinite pronoun *athu* 'one' within the complement, as well as the relativizer *-a*. Following the general pattern found with RCs, the relativizer is attached to a participle form of the embedded verb.

(10) [avan pizhai sey-t-a-athu-ai] ram
[he mistake do-PAST-REL-PRON.3SN-ACC] Ram.NOM
nirupi-tt-aan
prove-PAST-3SM
'Ram proved (it) that he made mistakes.'

Also in analogy with the pattern found with RCs, the accusative *athu-ai* 'one' has been prosodically attached to the relativized verb, with the source construction having an NP outside of the COMP, the possibility of which was illustrated in (9-a). The *athu* 'one' thus functions as the matrix object and as such is marked accusative.

Overall, we therefore have a structure that is originally an RC meaning something like: 'Ram proved it, that he made a mistake.' This type of modification of an indefinite head pronoun is very close to a complementizer reading and we posit that this is what results.

Although we hypothesize that the attachment of the *athu-ai* 'one-ACC' is the result of prosodic incorporation, we have no synchronic evidence for clitic status. Rather, the forms are unequivocally treated as affixes in the literature (Rajendran 2012, Lehmann 1993, Krishnamurti 2003) so that the structures must now be analyzed as mixed categories which have an "outer" nominal structure built on a relativized clause that has an "inner" verbal structure, except that because the embedded verb is in a participle form, there is no subject-verb agreement with the embedded subject. We find no complementizer as such in this construction. Rather, the relativization of the embedded verb provides the function and meaning of complementation.

3.4 Nominalized Complement

We are now ready to analyze the nominalized complement, repeated here in (11) from (2). The indefinite neutral pronoun *athu* 'one' is again found in the embedded clause, as well as the relativizer *-a*.

(11) [avan pizhai sey-tt-aan enp-a-athu-ai] ram
[he mistake do-PAST-3SM COMP-REL-PRON.3SN-ACC] Ram.NOM
nirupi-tt-aan
prove-PAST-3SM
'Ram proved (the fact) that he made mistakes.'

We posit that in analogy to the general pattern found with RCs, the accusative *athu* 'one' has been prosodically attached to the complementizer, with an original structure having had an NP outside of the COMP, the possibility of which has already been illustrated by (4-b).

The *enp* in (11) is a form of the verb *en* 'say', the verb we discussed as undergoing reanalysis as a complementizer. The form *enṛu* is a frozen past participle form and functions most like a "pure" complementizer. However, the underlying verb *en* 'say' has several other participle forms and can appear with the relativizer (*-a*/∅) in all of these forms: *enṛ-a* (past), *enkiṛ-a* (present) and *enum-∅* (future).

The forms *enṛathu*, *enkiṛathu* and *enpathu (enp-a-athu)* are essentially nominalized versions where the third person singular neuter pronoun *-athu* has been incorporated on top of the relative marker as in (11). Thus, if we unpack the complementizer form, we have a participle form of the verb *en* 'say', followed by the relativizer *-a*, followed by a form that was originally a pronoun *-athu*, which is in the accusative case *-ai*.

The overall original structure giving rise to these nominalized complements again parallels that of RCs. The difference between examples such as in (11) and what we have called a nominalized relative in (10) is the presence of the complementizer/quotative (cf. section 3.1) within the embedded clause. The accusative marking is a result of *-athu* originally being treated as a complement of the matrix verb, cf. (4-b).

The presence of the quotative/complementizer within the embedded clause has both syntactic and semantic effects on the embedded complement. In terms of syntax, the embedded verb in (11) anchors tense and shows subject-verb agreement, unlike the nominalized relative in (10). In both structures the embedded verbs predicate fully.

In terms of semantics, the presence of the quotative/complementizer appears to make an interpretational difference. As first reported by Lehmann (1993), nominalized complements as in (11) embed factive complements. That is, the embedded clause must represent a true proposition.[5]

[5]A reviewer notes that evidentiality is likely to play a role. We agree that this needs

Note that while we have identified the individual parts of the nominalized complementizer, the existing literature treats items like *athu* as pronominal suffixes with a nominalizing function (Krishnamurti 2003, Lehmann 1993).

3.5 Nominalizations in Tamil

Rajendran (2001) distinguishes between several different kinds of nominalizations in Tamil. One category involves nominalizing suffixes which are added directly onto the verb root, as illustrated in (12) with the suffix *-tal*. The second category involves nominalization of adjectival participial forms as in (1), the third the nominalization through complementizers as in (2).

(12) ram [kumar-in pizhai sey-tal-ai]
Ram.NOM.3SM Kumar.3SM-GEN mistake do-NOMLZ-ACC
so-nn-aan
tell-PAST-3SM
'Ram told (of) Kumar's doing wrong.'

Like in our running examples (1) and (2), the nominalized clause functions as the object of the matrix clause and is appropriately marked with the accusative case. In contrast to our running examples, however, the agent argument of the embedded verb is nominally licensed and is therefore realized with the genitive case. These verbal nouns are a classic case of mixed categories as they show both verbal and nominal properties. The arguments of the embedded clause are inherited from the verbal base, but the agent cannot be verbally licensed. Rajendran (2001) accounts for the differences between examples such as (12) and our running examples by positing nominalization at the sentence ((1) and (2)) vs. the lexical (12) level. Rajendran (2001) further notes that the nominalized complements and relatives are modifiable by adverbs, not adjectives, indicating an internal verbal structure. On the other hand, while the nominalized complements and relatives can be case marked, they cannot receive inflectional plural morphology. This indicates a less than full alignment with overall nominal properties.

Schiffman (1969) and Arden (1962) use a slightly different categorization and nomenclature in their studies of Tamil nominalizations, but both include (1) and (2) as instances of morphological nominalization.

Before moving on to our own analysis of complement nominalizations, we briefly touch on the issue of scrambling. Tamil allows scrambling of its major constituents in a clause, but generally shows restrictions within NPs. A natural question to inquire into is the scrambling possibilities of the various nominalized structures. We find that the nominalized relative (1), the nominalized complementizer (2) and the verbal noun (12) do not differ in terms of scrambling: all allow scrambling of all major constituents

to be investigated more deeply.

within the embedded clause, but the nominalized verb or complementizer is generally the final element in the embedded clause. This is as expected if the embedded clause is headed by a verb.

4 Mixed Categories and Complex Categories

We propose to analyze the complementizers found in our core examples in (1) and (2) as instances of **mixed categories**. Internally to the complementizer clause we have a verb (*sey*, V) and complementizer (*en*, C), respectively. However, the V and the C carry relativizing and nominalizing morphology. As discussed above, the current complementizer strategy appears to have evolved through a combination of diachronic developments within Dravidian. This fits with historical change having been identified as one reason for the existence of mixed categories (Nikitina 2008): One category is reanalyzed as another and gradually accumulates more of the properties associated with the "new" category during the change. Our Tamil complements seem to be classic examples of change in progress in that a verb of communication ('say') is being reanalyzed as a complementizer via an intermediate stage as a reportative/quotative (cf. Klamer 2000). Indeed, native speakers perceive the combination of relativizer+pronoun+case as an unanalyzable unit, indicating that language change is taking place.

In what follows, we first briefly discuss previous analyses of mixed categories within LFG, then introduce the formal notion of **complex categories** as implemented within the XLE grammar development platform (Crouch et al. 2017). In section 5 we then show how we propose to use this formal mechanism to model the phenomena associated with mixed categories.

4.1 Mixed Categories in LFG

The literature on mixed categories is large, with several different approaches having been put forward. A central problem posed by mixed categories is how to characterize them. One could simply admit categories such as VN (nominalizations) or VA (deverbal adjective) to one's inventory of categories, but the question then arises as to what the full inventory of categories should be and whether it is language universal. Computational efforts at defining inventories for Part-of-Speech (POS) tagging (Jurafsky and Martin 2009) have differed considerably, with tag sets having been proposed that range from including less than 20 POS tags to over a hundred. The Universal POS tag set arrived at by Universal Dependencies effort posits 14 basic word classes, none of which include mixed categories.[6] The reason for this perhaps is that mixed categories tend to be the result of the application

[6]https://universaldependencies.org/u/pos/

of derivational morphology: it seems counterintuitive to include categories derived by morphological processes in a basic inventory.

A different approach is represented by a definition of syntactic categories through feature bundles. A classic and simple approach involves the feature set [±N, ±V] (Chomsky 1981). Within LFG the feature set [±predicative,±transitive] has been used (Bresnan 2001, Bresnan et al. 2016). More complex feature bundles seek to model relevant morphological, syntactic and semantic properties, other approaches work with notions of prototypicality (Croft 1991) or canonical categories (Corbett 2006, 2007). Each of these proposals comes with their own set of resulting challenges and shortcomings. See Nikolaeva and Spencer (2020) and Lowe (2016) for comprehensive overviews and discussion.

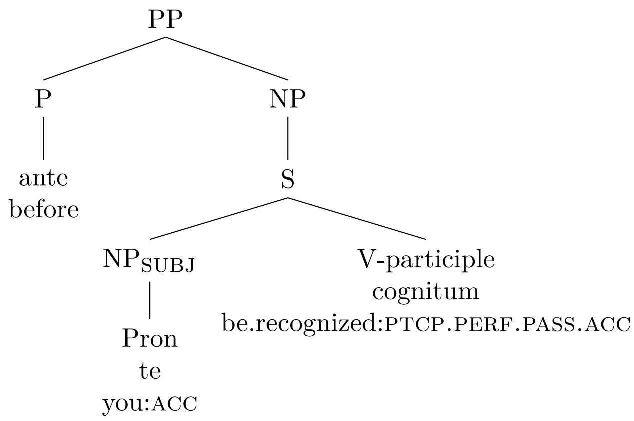
Nikolaeva and Spencer (2020) develop an HPSG-inspired approach to adjectivized nouns that are able to modify other nouns. As part of their discussion, they define several different types of mixed categories. Our Tamil constructions fit the definition of *syntagmatic mixing*, by which a derived form displays distributional and selectional properties from the underlying category as well as the derived category (Nikolaeva and Spencer 2020, 24).

This syntagmatic mixing presents a problem for formal syntactic analyses that operate with principles governing the projection of words into phrases. Since the excesses of Transformational Grammar, formal syntax has developed an understanding that categories should not project randomly into phrases (e.g., so that an adjective heads a CP or a noun an IP), but be governed by constraints, such as X′ syntax (Bresnan 1976). Within LFG, the central problem posed by syntagmatic mixing can be stated in terms of the Principle of Endocentricity, which expects that "every phrasal projection has a unique lexical head which determines its categorial properties" (Bresnan and Mugane 2006, 203).

Work within LFG has offered up several different approaches to solve this fundamental violation of endocentricity. Central among these is the application of the theory of extended heads (Bresnan et al. 2016) by which lexical (but not functional) categories are assumed to have an extended head. This extended head mostly works out to be a functional category such as I or D. Bresnan et al. (2016) illustrate this analysis with respect to English gerunds and Bresnan and Mugane (2006) apply it to explain the properties of agentive nominalization in Gĩkũyũ. Nikitina and Haug (2016) appeal to the English gerund analysis by Bresnan et al. (2016) and propose a parallel analysis of Latin 'dominant participles'. LFG's projection architecture very naturally allows for more than one c-structure node to project to the same f-structure, and the extended head theory governs which types of c-structure nodes may serve to co-predicate, thus constraining the range of c-structural possibilities while accounting for mixed categorical properties.

The c-structure in (13) shows how Nikitina and Haug (2016, 38) treat Latin deverbal participles, which are analyzed as instances of clausal nominalizations. The verbal properties are licensed by the V within an exocentric category S, the nominal properties by the NP dominating the S.

(13)



Although agentive nominalizations in Gĩkũyũ work very differently from our Tamil complementizers and the Latin dominant participles, the analysis from Bresnan and Mugane (2006, 230) serves to illustrate how the projection across different nodes in the c-structure works. The lexical entry for the nominalized form in (14) contains a subcategorization frame that is licensed by the underlying verb. The lexical entry also contains information which ensures that the word must be part of both a nominal and a verbal projection. As the f- and c-structure in Figure 1 show, this is indeed ensured, with the N, NP and VP nodes all contributing to the same f-structure, thus accounting for the mixed properties of the agentive nominalization.

(14) mũthĩĩnji: N: (↑PRED) = 'slaughterer<<(↑OBJ)>$_v$>$_n$'
v: VP ε Cat(ϕ^{-1}(PRED ↑))
n: NP ε Cat(ϕ^{-1}(PRED ↑))

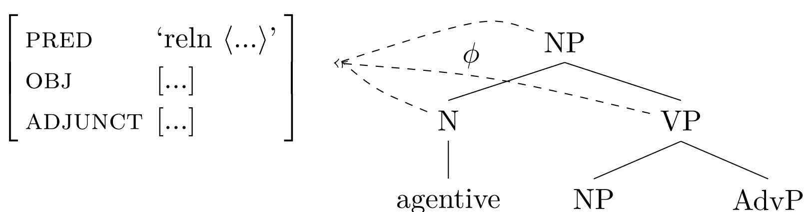


Figure 1: Analysis of Gĩkũyũ Agentive Nominalizations

While the analyses of Latin dominant participles and Gĩkũyũ agentive nominalizations provide crucial insights into their behavior and structure, the lexical entry in (14) taken together with the tree in Figure 1 means that an unheaded VP is postulated in order to satisfy the mixed category requirement. And while Nikitina and Haug (2016) appeal to the analysis of English gerunds by Bresnan et al. (2016), it is not clear how the analysis of Latin participles conforms to the extended head principle, since the deverbal participle projects to an exocentric S. Furthermore, given that we have no independent evidence for a DP in Tamil and we have a situation in which a V in principle projects to a CP which in turn projects to an NP, it is not clear to us how we could straightforwardly apply an extended head analysis.

Nikolaeva and Spencer (2020) put forward a very different and complex proposal that focuses on modeling the lexical relatedness between basic and derived forms through an interplay between morphology, syntax and lexical semantics. We particularly find the argument-structure considerations introduced by Spencer (2015) and Nikolaeva and Spencer (2020) important, but these are less relevant for our Tamil complementizers. Indeed, Lowe (2016) takes stock of the literature on mixed categories and argues that phenomena which involve a consistent internal syntax coupled with a consistent external distribution are not true instances of mixed categories. He also suggests that these "lesser" versions of mixed categories could be treated by the formal means of complex categories, as developed within XLE (Crouch et al. 2017). Our Tamil nominalized complement structures mostly display a consistent internal syntax (C/V) and a consistent external distribution (N), with some differences being the inability to take plural morphology despite the external N distribution and the absence of subject-verb agreement in the nominalized relatives. In the remainder of the paper, we take up Lowe's suggestion and investigate how an analysis in terms of complex categories would play out.

4.2 Introducing Complex Categories

Complex categories were developed within ParGram (Butt et al. 1999) and implemented as part of XLE[7] in order to allow for a parameterization of syntactic categories. This parameterization enables the activation of one family of rules vs. others. In the English ParGram grammar complex categories are used to steer auxiliary selection (the "affix hopping" effects).[8] In the German grammar, complex categories are applied towards modeling parameters of how the verbal complex is realized. German is generally described as a V2 language, by which finite verbs in matrix clauses must appear in (roughly) second position and non-finite verbs (as well as verb particles) in clause final position. In embedded and relative clauses, on the other hand, all parts of the verbal complex are collected in the verb final position. The precise realization of the verbal complex differs according to the type of modals/auxiliaries contained within it and as to whether there is a coherent

[7]https://ling.sprachwiss.uni-konstanz.de/pages/xle/doc/notations.html#N3.4

[8]For an illustration, see the English grammar on the XLE-Web INESS site (https://clarino.uib.no/iness/xle-web) and try parsing *Helge had been having a nice day.*

verb such as *lassen* 'let', which disallows the *zu* 'to' infinitive. These lexical properties of verbs and auxiliaries/modals necessitate specialized rules for parts of the verbal complex, but scrambling possibilities of arguments and adjuncts or the overall licensing of arguments remain the same.

After much unsatisfactory experimentation with standard phrase structure rules to model the intricate details of German clause structure, the application of complex categories provided a computationally efficient and conceptually elegant way forward. In the current implementation verbs have a single entry for the stem. This stem specifies the subcategorization frame, case marking, compatibility with verbal particles and whether the item in question is a an auxiliary/modal [aux], a standard verb [v], or a verb with coherent properties [coh]. The inflectional morphology (coming out of a finite-state morphological analyzer; Schiller 1994) triggers a further parameterization according to: finite [fin], infinite [inf], participle [part].

In the syntax these lexical and morphological properties play out by allowing for rule parameterization through the formal tool of complex categories. Essentially, categories are "decorated" with a feature specification in square brackets, e.g., V[fin], V[inf], V[part]. One can add a feature declaration specifying legal values for a feature. Once the features are instantiated, they are not optional, that is, a feature cannot be left unspecified.

The current German ParGram grammar (Butt et al. 1999, Dipper 2003, Rohrer 2009)[9] assumes that verbs have two features: (_type, _infl) with `v,` `coh` and `aux` instantiating type, and `fin, inf` and `part` as values for infl.[10]

As determined by the lexicon and the morphology, a coherent finite verb, for example, is `V[coh,fin]`, while the participle of a standard verb is `V[v,part]`. This bottom up specification interacts with complex category rules in the syntax, triggering the appropriate syntactic behavior.

Let us begin with the matrix clause. The Cbar rule encompasses material from the finite verb onwards. This includes embedded complements. As the simplified version of the rule below shows, there are multiple possibilities. One is for a finite verb to be followed by a VP containing its arguments, the other is for a coherent verb to embed an XCOMP VP, the third accounts for the periphrastic *will* future, which requires a non-finite VP that could be headed by either a coherent or a standard verb, as seen in the `VPinf` rule.

```
Cbar --> { V[v,fin]   "either finite verb in single clause"
           VP
         | V[coh,fin] "or finite verb with XCOMP"
           VP: (^XCOMP = !)
         | V[aux,fin]  "or will-future"
           VPinf  }.
```

[9]See XLE-Web INESS website https://clarino.uib.no/iness/xle-web.

[10]The feature declaration is: `V[_type $ {v coh aux}, _infl $ {fin inf part}]`.

```
VPinf = { VP[v,inf]
        | VP[coh,inf] }.
```

The features specifying more details about the basic syntactic categories can function as variables which are instantiated as part of parsing. The VP rule is thus on the one hand very general, but on the other hand is prepared for features to be passed in from an outside rule activation, or for features to be instantiated by a lexical entry. For example, the third option in the Cbar rule could instantiate the (simplified) VP rule below as `VP[coh,inf]` as one possibility. In this case, the VP will call up the coherent version, as determined by checking for the feature `_type = coh`. This difference determines XCOMP embedding and also allows for recursive calls of VP embeddings.

```
VP[_type $ {v coh}, _infl $ {fin inf part}]   -->
         {  e: _type = v;
            @(VPconst ^)
         | e: _type = coh;
            @(VPconst (^XCOMP)) }
         { VC[_type,_infl]  "generic verbal complex"
         | VCflip[coh,fin]  "allow for auxiliary flip"}.
```

The final part of the rule above allows for either a generic verbal complex or for a special version with a flipped position of the auxiliary in embedded clauses. This is only possible with certain verbs, e.g., with coherent ones.

The introduction of the new formal tool of complex categories allowed for a new analytical perspective on well known intricate phenomena such as English auxiliary selection and German clause structure. Within the ParGram context, it was found that the introduction of complex categories allowed for conceptually cleaner analyses that were pleasingly coupled with computational efficiency as using complex categories is more efficient than performing f-structure checking on morphosyntactically determined features. In the following section, we turn to applying the concept of complex categories to an entirely different domain, namely mixed categories as found in Tamil nominalized complements and suggest that here too, complex categories open up a fruitful new analytical perspective.

5 Mixed Categories as Complex Categories

The intuition put forward in this section is to apply the possible parameterization of rule space to the problem of mixed categories by accumulating the features due to both derivational morphology and on-going historical change onto the major category. For example, we can model a gerund by assuming that the main category is a V, but that it also carries a feature n, resulting in the mixed category V[n]. This models a composite category in which the V allows for the internal verbal licensing of arguments (nominative subject, etc.), but the [n] feature permits the simultaneous playing out of nominal features, such as case marking, perhaps projecting to an NP and, as a consequence, showing the external distribution of an NP. However, since the V[n] is not a full N, it can be limited to expressing a subset of nominal properties (e.g., no plural marking).[11]

We see the features on the complex categories as resulting from: 1) the effects of synchronic derivational morphology; 2) the effects of on-going diachronic reanalysis. As is well-known and discussed by Nikitina (2008) with respect to several case studies including verbal nouns and deverbal adjectives, one reason for the existence of mixed categories is gradual historical change by which lexical items are recategorized via reanalysis as they gradually accumulate more of the properties associated with one category rather than another. We analyze the Tamil complement patterns as classic cases of change in progress and posit complex C and V categories. We propose that complex categories provide a potentially elegant way of modeling gradual diachronic reanalysis by allowing for the definition of a possible parameter space which is affected by historical change and a coding of these parameters via features on complex categories, with attendant effects on the grammar.

5.1 Analysis of Nominalized Complements

The analysis we propose for (2), repeated below in (15), is shown in Figure 2. Our implementation was done within XLE by means of a small grammar of Tamil, which does not include a separate morphological analyzer and also does not do justice to Tamil's beautiful and complex orthography.[12] As such, we show the sublexical analysis simply as part of the c-structure and render the Tamil in a transliterated form.

We analyze the complement as being a CP which is headed by a C. This C is derived with the help of the original relativizer *-a* from an original quotative use of the verb 'say'. We do not provide a relative clause analysis of this at the featural level, but treat the *enp+a* as a combined form. This C has accumulated some nominal properties due to the incorporation of the pronoun, licensing the accusative case marking and triggering the external distribution of an NP, but not allowing for pluralization. The [nom] feature

[11]Our proposal bears similarities to Malouf's (2000) HPSG analysis of mixed categories in terms of inheritance hierarchies, by which a verbal noun, for example, can inherit both verbal and nominal properties. We are allowing the accumulation of mixed properties, but without invoking the formal restrictions and properties of inheritance hierarchies within the lexicon, see also Ash Asudeh and Toivonen (2008) for some discussion.

[12]We have implemented these as part of the larger Tamil ParGram grammar (Sarveswaran et al. 2018, 2019), which is also available on the INESS website.

on the complex category C percolates up to the CP because the instantiation of [nom] through the incorporated pronoun triggers the family of [nom] rules.

(15) [avan pizhai sey-tt-aan **enp-a-athu-ai**]
[PRON.3SM.NOM mistake do-PAST-3SM COMP-REL-PRON.3SN-ACC]
ram nirupi-tt-aan
Ram.NOM prove-PAST-3SM
'Ram proved (the fact) that he made a mistake.'

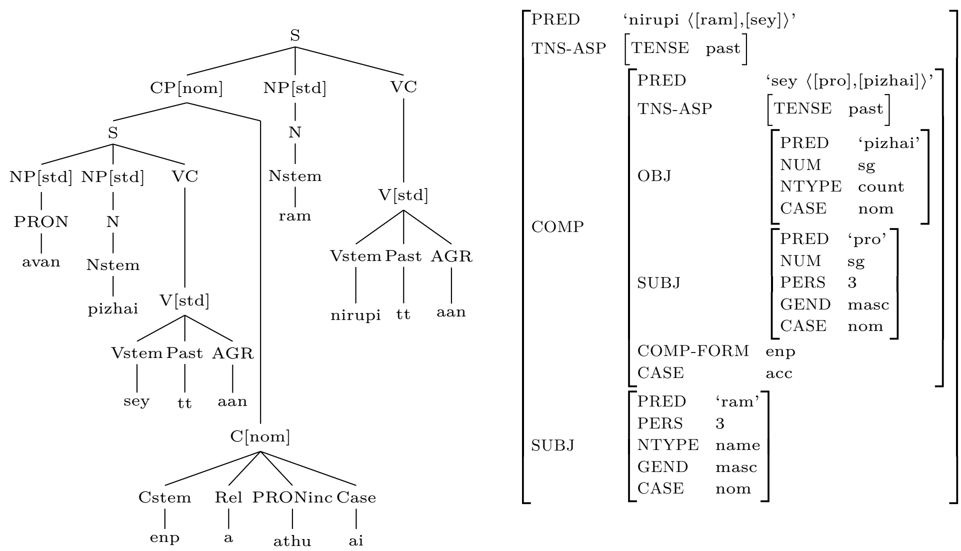


Figure 2: Complex Category Analysis of Nominalized Complement

The CP standardly contains an S, which is the default S found in the language and which exhibits all the scrambling properties (major constituents can scramble) of an S. The entire CP functions as a COMP, rendering a standard finite complementizer analysis at f-structure. The mixed category "oddities" of (16) in this case only play out in terms of the c-structure.[13]

5.2 Analysis of Nominalized Relative

The analysis of the nominalized relative (1), repeated below in (16), is along similar lines. We also posit a CP, but this CP has a c-structure that is analogous to that of a relative clause. The CP is headed by a V, as it would be in a RC. This V has been relativized, with the feature [rel] licensing the projection to the CP. The V has also been nominalized due to the incorporation of the pronoun, with this part of the feature licensing the accusative case marking and the external distribution as an NP, but prohibiting num-

[13]The NP and V carry the feature [std] (standard) vs. nominal [nom], verbal [v] or relative [rel]. Recall that once a type has been specified, it must always be instantiated.

ber marking. The nominalization is percolated up to the CP because the [nom] family of grammar rules is triggered by the nominal feature on the V. The relativization of the V means that subject-verb agreement cannot take place. But because the main category continues to be a V, all of the arguments predicated by the embedded verb can be realized with verbally licensed case. With respect to the f-structure, the embedded constituent functions as a COMP and is more in line with the f-structure analysis in Figure 2 than that of the f-structure analysis of relative clause in Figure 4.

(16) [avan pizhai **sey-t-a-athu-ai**]
[PRON.3SM.NOM mistake do-PAST-REL-PRON.3SN-ACC]
ram nirupi-tt-aan
Ram.3SM.NOM prove-PAST-3SM
'Ram proved (it) that he made a mistake.'

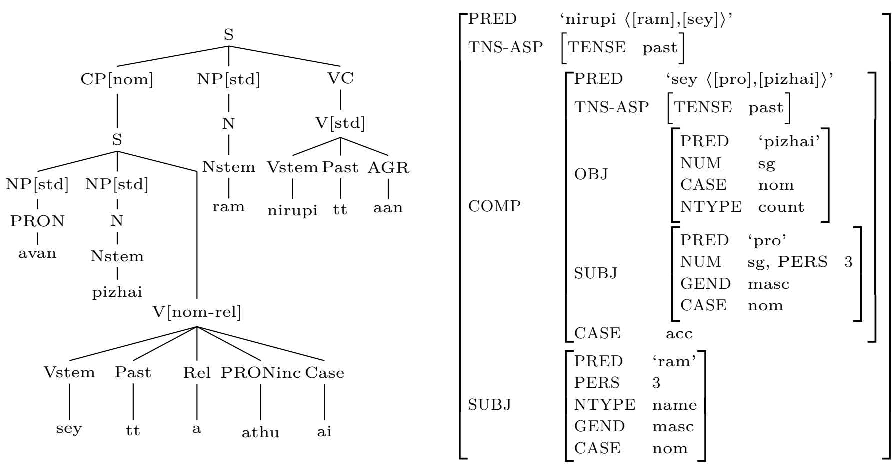


Figure 3: Complex Category Analysis of Nominalized Relative

For the sake of completeness, we also provide an analysis of the relative clause in (9-a), repeated below in (17). The relative clause modifies a head noun and is headed by a relativized verb. The [rel] feature is instantiated on the verb via the relativizer *-a* and percolates up to the CP because the [rel] on the V triggers the family of [rel] rules in the grammar via the complex category analysis.

(17) [angu nin-ṛ-a] paiyan-ai naan paar-t-en
there stand-PAST-REL boy-ACC I.NOM.1S see-PAST-1S
'I saw the boy who stood there.'

The f-structure analysis follows the standard ParGram analysis of relative clauses so that it is represented as an adjunct modifying the head noun 'boy', with a 'pro' functioning as the subject of the relative clause.

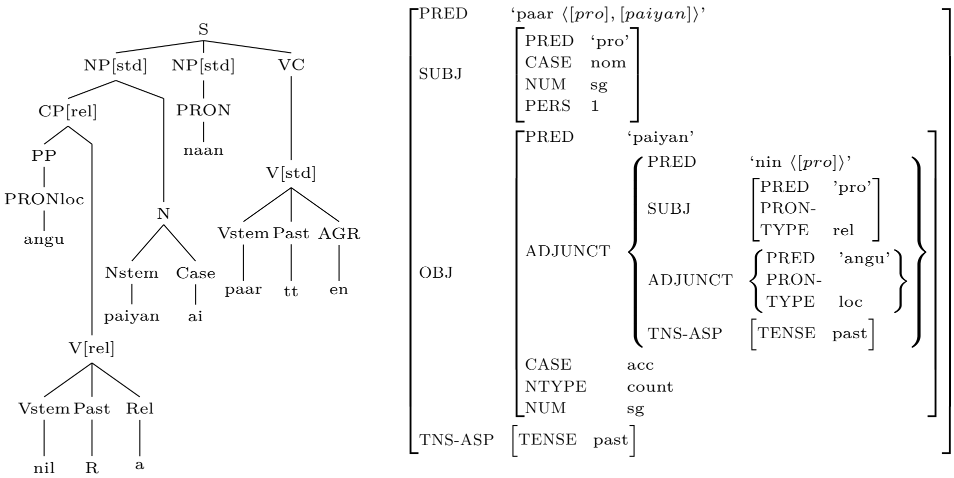


Figure 4: C-structure and F-structure for a Relative Clause

6 Conclusion

This paper has presented an analysis of Tamil nominalized complements. We have identified them as a type of mixed category, whereby the nominalization is due to the incorporation of a pronoun into the head of the CP. We analyzed two different constructions, one containing a complementizer that is related to a quotative use of the verb ‘say’. Both constructions feature relativization, which seems to be a basic way forming embedded nominal complement clauses in Tamil.

We proposed to analyze the complicated morphology found on the (originally) verbal stems in terms of complex categories, with the intuition being that the mixed properties of syntactic categories can be modeled through features on a syntactic category such as V or C. This allows for a parameterization of the grammar rules according to these features and also allows a projection of a CP from a relativized V or the projection of an NP from a nominalized V.

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XLE+Glue – A new tool for integrating semantic analysis in XLE

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Abstract

This paper presents the XLE+Glue system which provides an interface between XLE and the Glue Semantics Workbench, a tool for computational Glue semantics. It describes how to develop grammars encoding glue premises and how to calculate meanings based on these premises.

1 Overview

In this paper, we present XLE+Glue,[1] a resource for grammar developers that integrates semantic capabilities into the Xerox Linguistics Environment (XLE; Crouch et al. (2017)). Although XLE is the main computational implementation of LFG in general, it mainly focuses on the syntactic components of the grammar theory. While there exist notable approaches to semantic analysis paired with the system (see Crouch and King (2006), Crouch (2005)), resources for the theoretically founded formalism of Glue semantics remain sparse. To address this shortcoming, we developed an interface for XLE which integrates a glue prover – the Glue Semantics Workbench (GSWB; Meßmer and Zymla (2018)) – making it possible to derive semantic representations via linear logic (Dalrymple 1999).

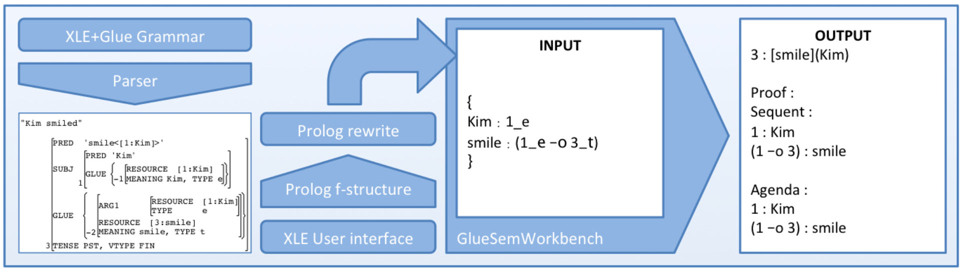

Figure 1: The XLE+Glue pipeline includes a glue prover (GSWB)

Figure 1 illustrates the overall structure of the XLE+Glue system. The system requires an XLE+Glue grammar, i.e., a grammar which encodes glue premises (meaning constructors) in its output (see the f-structure in Figure 1). The system processes the output of the parser using a Prolog rewrite script: on the basis of the Prolog representation of a given XLE parse, it creates an input file to the GSWB which is used to derive a glue proof as described in Meßmer and Zymla (2018).

Glue meaning constructors consist of a semantic side (any semantic formalism) and a glue side (a linear logic expression of linguistic resources of a given type). The up and down metavariables in lexical entries are instantiated to indices representing particular f-structures (or s-structures; Dalrymple (1999)), for instance:

(1) a. $Kim : \uparrow_e \quad \Rightarrow \quad Kim : k_e$

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[1] The system is available from https://github.com/Mmaz1988/xle-glueworkbench-interface. For information on installing and running XLE+Glue, see the README or the manual in the repository.

b. $\textit{smile} : (\uparrow \textsc{subj})_e \multimap \uparrow_t \quad \Rightarrow \quad \textit{smile} : k_e \multimap s_t$

In the first part of this paper, we explain the encoding of meaning constructors in XLE+Glue grammars; for ease of presentation, we make several assumptions. First, we assume simple untyped meaning representations such as *Kim* and *smile* which serve as placeholders for various potential meaning languages.[2] Second, we assume that the glue side of meaning constructors refers to f-structures (as in our sample grammar `glue-basic.lfg`) rather than their semantic projections or other linguistic levels. However, our system can handle meaning constructors referring to other linguistic levels (as demonstrated in our sample grammar `glue-basic-semstr.lfg`, which includes a semantic projection).

Our system provides two ways of encoding meaning constructors. Both methods rely on the presence of a special GLUE attribute whose value is a set of meaning constructors in AVM format. The left-hand side of Figure 1 illustrates the embedded encoding: meaning constructors are encoded in an attribute-value matrix (AVM) format in which embedding in the AVM mirrors the structure of the glue side of the meaning constructor. We describe this method in Section 2. In the string-based method, the meaning constructor is represented as a sequence of substrings which are values of an ordered set of attributes, as described in Section 5.2.

In the second part of this paper, we explain how XLE interacts with the GSWB to provide Glue semantics derivations. First, we explain the requirements imposed by the GSWB in Section 3. Based on this knowledge, we describe in Section 4 the Prolog rewrite script which serves as the bridge between XLE and the GSWB.

Finally, in Section 5 we describe various ways in which the system can be adapted to particular use cases. As mentioned above, there are two alternative methods of encoding meaning constructors in the XLE output. Furthermore, the system allows for variation in terms of meaning constructors: we focus on the possibility of using different semantic formalisms on the meaning side of XLE+Glue meaning constructors. Section 6 concludes the paper.

2 Encoding meaning constructors as AVMs

(2-a) illustrates the meaning constructor for the proper name *Kim* in the standard format, and (2-b) illustrates the corresponding AVM encoding, where the meaning constructor appears as a member of the GLUE set. In this section, we follow the usual notational convention of referring to f-structures by means of letters like k and s, but in later sections we will use numbers instead, since the Prolog rewrite script relies on the numeric indices assigned to f-structures (or other relevant structures) in the Prolog output format of XLE. We start with examples where each GLUE set contains only one meaning constructor, but in other cases several meaning constructors appear as members of the GLUE set, as we show in Section 2.2.

[2] See Section 3.2 for discussion of the ways in which meanings can be represented in the system, including as terms of the typed lambda calculus.

(2) a. *Kim*: k_e

b. $k : \left[\begin{array}{ll} \textsc{pred} & \text{‘}\textsc{Kim}\text{’} \\ \textsc{glue} & \left\{ \left[\begin{array}{ll} \textsc{meaning} & \textsc{Kim} \\ \textsc{resource} & k \\ \textsc{type} & e \end{array}\right] \right\} \end{array}\right]$

In the AVM encoding,[3] each glue meaning constructor minimally consists of three attributes. The value of MEANING is the semantic (left-hand) side of the meaning constructor, while RESOURCE and TYPE specify the glue (right-hand) side: RESOURCE points to the relevant linguistic resource, while TYPE specifies RESOURCE's type. In XLE notation, the f-structure constraints contributed by a proper name like "Kim" are:

(3)
```
(^ PRED) = 'Kim'
(%mc MEANING) = Kim
(%mc RESOURCE) = ^
(%mc TYPE) = e
%mc $ (^ GLUE)
```

`%mc` is a local name (see Section 2.3.4) used to construct an attribute-value structure containing attributes specifying the glue meaning constructor (`MEANING`, `RESOURCE`, `TYPE`). This f-structure is added to the `GLUE` set by specification of the constraint `%mc $ (^ GLUE)`.

A glue meaning constructor may also involve implication, as for a verb like *smile* in (4), where a resource is consumed in order to produce another resource. The standard meaning constructor for the verb *smile* is given in (4-a), and the AVM translation is given in (4-b). In the AVM encoding, ARG1 is the first resource to be consumed, ARG2 the second, etc. The resources to be consumed are specified using the RESOURCE and TYPE attributes. See (5) for constraints contributed by *smile*:

(4) a. *smile*: $k_e \multimap s_t$

b. $s : \left[\begin{array}{ll} \textsc{pred} & \text{‘}\textsc{smile}\text{<}\textsc{subj}\text{>’} \\ \textsc{subj} & k:[\ ] \\ \textsc{glue} & \left\{ \left[\begin{array}{ll} \textsc{meaning} & \textsc{smile} \\ \textsc{arg}1 & \left[\begin{array}{ll} \textsc{resource} & k \\ \textsc{type} & e \end{array}\right] \\ \textsc{resource} & s \\ \textsc{type} & t \end{array}\right] \right\} \end{array}\right]$

(5)
```
(^ PRED) = 'smile<(^ SUBJ)>'
(%mc MEANING) = smile
(%mc RESOURCE) = ^
(%mc TYPE) = t
```

[3]Here and in the rest of this section, glue premises are presented in the embedded encoding format. We discuss the alternative flat encoding format in Section 5.2.

```
(%mc ARG1 RESOURCE) = (^ SUBJ)
(%mc ARG1 TYPE) = e
%mc $ (^ GLUE)
```

The f-structure for the sentence “Kim smiles” is shown in (6). The Prolog rewrite component (described in Section 4) collects up all of the premises in the GLUE sets, rewrites each premise into a format suitable for input to the prover (as shown in (7)), and passes the complete set of premises to the prover.

(6)
$$s : \left[\begin{array}{ll} \text{PRED} & \text{`SMILE<SUBJ>'} \\ \text{SUBJ} & k : \left[\begin{array}{ll} \text{PRED} & \text{`KIM'} \\ \text{GLUE} & \left\{ \left[\begin{array}{ll} \text{MEANING} & \text{KIM} \\ \text{RESOURCE} & k \\ \text{TYPE} & e \end{array}\right] \right\} \end{array}\right] \\ \text{GLUE} & \left\{ \left[\begin{array}{ll} \text{MEANING} & \text{SMILE} \\ \text{ARG1} & \left[\begin{array}{ll}\text{RESOURCE} & k \\ \text{TYPE} & e\end{array}\right] \\ \text{RESOURCE} & s \\ \text{TYPE} & t \end{array}\right] \right\} \end{array}\right]$$

(7)
```
{
Kim : k_e
smile : k_e -o s_t
}
```

2.1 Universal quantification over meaning constructors

In (8-b), the f-structure labeled e is the attribute-value encoding of the meaning constructor for the generalized quantifier “every” given in (8-a). It has two arguments: ARG1 represents the restriction of the quantifier, and ARG2 represents its scope. The value of the ARG1 attribute encodes the implication $(p_e \multimap p_t)$ (where p is the value of the PRED attribute of the noun phrase, as shown in (8-b)), which corresponds to a common noun meaning.[4] The value of the ARG2 attribute encodes an implication from m_e to F_t, where F is a variable bound by a universal quantifier, representing the scope of the quantifier, which is freely chosen: the universal quantifier $\forall$ allows for a choice among various scope possibilities. At the top level we have a new attribute FORALL,[5] which encodes the universal quantifier $\forall$ in (8-a).

[4]Our sample grammars make the non-standard assumption that the meaning of a common noun is a function from its PRED value of type e to its PRED value of type t; that is, a common noun like “person” has a lexical entry of the following form:

person: $(\uparrow \text{PRED})_e \multimap (\uparrow \text{PRED})_t$

This is done for simplicity, to avoid the introduction of attributes encoding VAR and RESTR as in standard treatments, and is not a necessary feature of the implementation.

[5]To display the attribute FORALL in XLE, select “constraints” in “Views” menu (or press “c”) in the window containing the glue premises in AVM format.

(8) a. *every*: $\forall F.(p_e \multimap p_t) \multimap (m_e \multimap F_t) \multimap F_t$

b. $$m : \left[\begin{array}{ll} \mathrm{PRED} & \boxed{1}\, p \\ \mathrm{GLUE} & \left\{ e : \left[\begin{array}{ll} \mathrm{MEANING} & \textit{every} \\ \mathrm{FORALL} & F \\ \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & e \end{array}\right] \\ \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & t \end{array}\right] \\ \mathrm{ARG2} & \left[\begin{array}{ll} \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{RESOURCE} & m \\ \mathrm{TYPE} & e \end{array}\right] \\ \mathrm{RESOURCE} & F \\ \mathrm{TYPE} & t \end{array}\right] \\ \mathrm{RESOURCE} & F \\ \mathrm{TYPE} & t \end{array}\right] \right\} \end{array}\right]$$

2.2 Multiple meaning constructors contributed by a single word

(9) a. *every*: $\forall F.(p_e \multimap p_t) \multimap (m_e \multimap F_t) \multimap F_t$
person: $p_e \multimap p_t$

b. $$m : \left[\begin{array}{ll} \mathrm{PRED} & \boxed{1}\, \textit{everyone} \\ \mathrm{GLUE} & \left\{ \begin{array}{l} e : \left[\begin{array}{ll} \mathrm{MEANING} & \textit{every} \\ \mathrm{FORALL} & F \\ \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & e \end{array}\right] \\ \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & t \end{array}\right] \\ \mathrm{ARG2} & \left[\begin{array}{ll} \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{RESOURCE} & m \\ \mathrm{TYPE} & e \end{array}\right] \\ \mathrm{RESOURCE} & F \\ \mathrm{TYPE} & t \end{array}\right] \\ \mathrm{RESOURCE} & F \\ \mathrm{TYPE} & t \end{array}\right] \\ n : \left[\begin{array}{ll} \mathrm{MEANING} & \textit{person} \\ \mathrm{ARG1} & \left[\begin{array}{ll} \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & e \end{array}\right] \\ \mathrm{RESOURCE} & \boxed{1} \\ \mathrm{TYPE} & t \end{array}\right] \end{array} \right\} \end{array}\right]$$

Example (9) illustrates the encoding of the meaning constructor for the quantifier *everyone*, decomposed into a meaning constructor contributing the “every” part of the meaning and another meaning constructor contributing the "person" part. This allows for the modification of the restriction of the quantifier in examples like *everyone who smiled*, and illustrates the possibility for a single word to contribute more than one meaning constructor to the GLUE set. In (9-b), the f-structure labeled e is the same as the attribute-value encoding of the meaning constructor for *every* given in (8-b) in the previous section. The second member of the set, labeled n, is the same as the contribution we would expect for the common noun *person*.

2.3 Templates for meaning constructors

The XLE+Glue system features a number of sample grammars that we refer to in this paper. These grammars provide a set of templates for encoding meaning constructors which may be generally useful, though it is of course possible for grammar writers to develop their own set of templates or to modify the sample templates as needed. We describe the basic templates here; more discussion and a detailed description of the sample grammars can be found in the XLE+Glue manual available in the GitHub repository (see footnote 1) as well as in the comments in the grammar files.

2.3.1 The basic definitions

All of the templates which are used in defining meaning constructors in the sample grammars using the AVM encoding call the two basic templates `GLUE-RESOURCE` and `GLUE-MEANING`. The template `GLUE-RESOURCE` specifies an attribute-value structure `TypedRES` as having the value `R` for the attribute `RESOURCE` and the value `TY` for the attribute `TYPE`. The attributes `RESOURCE` and `TYPE` and their values must appear in all meaning constructors in the embedded encoding format[6] and argument specifications, to identify the relevant linguistic resource and its type.

(10)
```
GLUE-RESOURCE(R TypedRES TY) =  (TypedRES RESOURCE) = R
                                (TypedRES TYPE) = TY.
```

The template `GLUE-MEANING` specifies an attribute-value structure `TypedRES` as having the value `M` for the attribute `MEANING`. This attribute corresponds to the left-hand (meaning) side of the meaning constructor, and must appear once, at the top level of all AVM meaning constructors.

(11)
```
GLUE-MEANING(TypedRES M) =  (TypedRES MEANING) = M.
```

2.3.2 Non-implicational meaning constructors: Proper names

In the sample grammar `glue-basic.lfg`, the lexical entry for the proper name *Kim* is as in (12):

[6]This requirement does not apply to grammars which, instead of the embedded encoding, use the alternative string-based encoding of glue premises described in Section 5.2.

(12) `Kim    N    *   @(PROPERNOUN Kim).`

The sample grammar `glue-basic.lfg` provides the template in (13) for proper names. It defines the f-structure `PRED` value, and calls the template `GLUE-PROPERNOUN` to define the meaning constructor in AVM format, passing in the argument `P`.

(13)
```
PROPERNOUN(P) =  (^ PRED) = 'P'
                 @(GLUE-PROPERNOUN P).
```

In `glue-basic.lfg`, the argument `P` of `PROPERNOUN` is used to construct the f-structure semantic form as well as appearing as the value of the `MEANING` attribute in the AVM meaning constructor. If it is desirable for the f-structure `PRED` value to be different from the `MEANING` value of the AVM meaning constructor, the `PROPERNOUN` template would have to be defined to take two arguments, one providing the `PRED` value and the other providing the `MEANING` value.

`GLUE-PROPERNOUN` simply calls `GLUE-REL0-MC` (mnemonic for "meaning constructor for relation of arity 0": in other words, a meaning constructor that requires no arguments). It specifies the first and second arguments of the template as `^` and `e` for all proper nouns, and passes in the value of `P` as the third argument.

(14) `GLUE-PROPERNOUN(P) =  @(GLUE-REL0-MC ^ e P).`

In the `glue-basic.lfg` grammar, it would also have been possible for the `PROPERNOUN` template to call `GLUE-REL0-MC` directly, providing the arguments `^` and `e`. The intermediate template `GLUE-PROPERNOUN` allows for the possibility that in scaling up to a more complete grammar, additional specifications may be associated with the `GLUE-PROPERNOUN` template, besides the definition of the meaning constructor.

The definition of `GLUE-REL0-MC` is:

(15)
```
GLUE-REL0-MC(R TY M) =  @(GLUE-RESOURCE R %mc TY)
                        @(GLUE-MEANING %mc M)
                        %mc $ (R GLUE).
```

This template calls two basic templates: `GLUE-RESOURCE` and `GLUE-MEANING`. The call to `GLUE-RESOURCE` specifies properties of the AVM meaning constructor `%mc`: it has an attribute `RESOURCE` whose value is `R`, and it has an attribute `TYPE` whose value is `TY`. The call to `GLUE-MEANING` provides the value `M` for the attribute `MEANING` in `%mc`. The final line requires `%mc` to appear as a member of the `GLUE` set in the f-structure `R`.

When the template `GLUE-REL0-MC` is called with arguments `^`, `e`, and `Kim`, an AVM `%mc` is created which corresponds to the simple meaning constructor *Kim*:$\uparrow_e$. This AVM has three attributes: `RESOURCE`, whose value is `^`; `TYPE`, whose value is `e`; and `MEANING`, whose value is `Kim`. The final line of this template specifies that `%mc` is a member of the `GLUE` set in the f-structure `R`. Thus, the template call `@(PROPERNOUN Kim)` produces the f-description given in (3).

2.3.3 Meaning constructors requiring arguments: Intransitive verbs

In `glue-basic.lfg`, the lexical entry for the intransitive verb *smiled* is:

(16)
```
smiled   V   *  @(VERB-SUBJ smile)
                @VPAST.
```

The template `VPAST` specifies a past tense feature in the f-structure; we do not discuss this template here. The template `VERB-SUBJ` is defined as:

(17)
```
VERB-SUBJ(P) =  (^ PRED) = 'P<(^ SUBJ)>'
                @(GLUE-VERB-SUBJ P).
```

As with the proper name template described in the previous section, the template argument `P` is used to define both the f-structure semantic form and the `MEANING` value of the AVM meaning constructor. If this is not desirable, the template `VERB-SUBJ` should be defined to take two arguments, one specifying the semantic form and the other the value of the `MEANING` feature in the AVM meaning constructor. The template `GLUE-VERB-SUBJ` is defined as:

(18)
```
GLUE-VERB-SUBJ(P) =  @(GLUE-REL1-MC (^ SUBJ) e ^ t P).
```

As with the `GLUE-PROPERNOUN` template, the `GLUE-VERB-SUBJ` template simply calls `GLUE-REL1-MC` (mnemonic for "meaning constructor for relation of arity 1": in other words, a meaning constructor that requires one argument). In scaling up to a more complete grammar, there may be additional semantic specifications associated with `GLUE-VERB-SUBJ`. The template `GLUE-REL1-MC` is defined as:

(19)
```
GLUE-REL1-MC(A1 A1TY R TY M) =
         @(GLUE-RESOURCE R %mc TY)
         @(GLUE-RESOURCE A1 (%mc ARG1) A1TY)
         @(GLUE-MEANING %mc M)
         %mc $ (R GLUE).
```

The first, third, and fourth lines of this template are the same as for the template `GLUE-REL0-MC`: they specify that the meaning constructor in the `GLUE` set of this verb is called `%mc`, that it has an attribute `RESOURCE` with value `R`, and that it has an attribute `TYPE` with value `TY`. The additional specification in the second line adds an attribute `ARG1` to the structure, whose value for the `RESOURCE` feature is `A1`, and whose value for the `TYPE` feature is `A1TY`. When the template `GLUE-REL1-MC` is called with arguments `(^ SUBJ), e, ^, t`, and `smile`, the resulting f-description is as in (5).

2.3.4 Scope of local names

When writing an XLE+Glue grammar, it is important to be aware of the scope of local names (variables prefixed with `%`) in XLE. The scope is limited to the c-structure category in which the variable is used.[7] This means that every time a given local name (for example: `%test`) is used within the same c-structure category, it refers to the same object. For instance, if there are two template calls using the same local name (`%test`) within one lexical entry, these template calls will impose constraints on the same object (one that corresponds to `%test`).

Depending on the intended effect, such behaviour of local names with respect to their scope may be a feature (when it is the intention to constrain the same object by separate template calls) or it may be undesired (when the intention is to impose constraints on two distinct objects by separate template calls) – this is why it is crucial to be aware of this when using local names.

This practical issue arises in sample grammars when a given c-structure category contributes more than one glue premise (see Section 2.2). For instance, as explained in the sample grammar `glue-basic.lfg`, the template `GLUE-NOUN0-MC` providing the meaning constructor for (common) nouns uses the local name `%mcn`, because it must be different from the local name `%mc` used by the template `GLUE-QUANT-MC` – both templates are called by the template `QUANT` which is called in the lexical entry of the quantifier "everyone". Another example can be found in the template `GLUE-ADJ0` which provides two meaning constructors for prenominal adjectives – the call to the template `GLUE-REL1-MC` uses the local name `%mc` to provide the meaning constructor for the basic meaning of the adjective, while the call to the template `GLUE-ADJ-MODIFIER` provides the meaning constructor combining the adjective with the noun by calling the template `GLUE-MODIFIER1` which uses the local name `%mcm` to build this meaning constructor.

2.4 Interim summary

So far, we have explained how to encode meaning constructors as AVMs, including how to make use of templates which are prevalent in grammar development with XLE. The main benefit of the AVM encoding is that it makes use of XLE's capabilities to ascertain well-formedness of the underlying structures. Meaning constructors are stored in the Prolog output of XLE, so it is important to provide a principled way of encoding them that does not clutter the output.

In the next part of the paper, we explain some technical details related to the encoding of meaning constructors as required by the GSWB. One of the main contributions of the XLE+Glue system is the translation between the meaning constructors encoded in XLE output and the input format for meaning constructors required by the GSWB. This is crucial for the system, since the output of XLE is based on Prolog, while the GSWB uses a more general format aimed at mimicking the way in which meaning constructors are encoded in Glue semantics theory.

[7] https://ling.sprachwiss.uni-konstanz.de/pages/xle/doc/notations.html#N4.1.6: "A local name can be used as a variable whose scope is limited to the schemata associated with a particular category or lexical item."

3 Semantic representations and the prover

The GSWB takes a set of premises, i.e., instantiated meaning constructors encoded in a specific string format, as input to calculate the semantics of an utterance. In this section, we describe the required input for the GSWB: Section 3.1 explains the encoding of linear logic formulas on the glue side, while Section 3.2 presents different ways of encoding the meaning side of a meaning constructor.

The GSWB uses a parser for semantic types which is shared between the semantic parser and the linear logic parser. See (20) for the available atomic types.[8] Complex types consist of atomic types, commas and angular brackets: see (21).

(20) Atomic types: e, s, v, t

(21) Complex types:
- a. $< e, < e, < s, t >>>$
- b. $<< s, t >, < s, t >>$
- c. $<< e, t >, t >$
- d. $<< e, t >, << e, t >, t >>$
- e. $<< e, < s, t >>, < s, t >>$

3.1 Encoding the glue side

3.1.1 Parsing linear logic formulas

The GSWB encodes linear logic formulas in a simple string format that is visually similar to the actual symbols used in linear logic. For example, the $\multimap$ symbol is replaced by `-o`. This is illustrated in (22), where some sample formulas from the fragment of linear logic that is covered by the parser are shown. As shown in (23), formulas can also be stated without type declarations.[9]

(22)
```
a. g_e
b. (g_e -o (d_e -o (i_s -o h_t)))
c. ((i_s -o h_t) -o (t_s -o f_t))
d. AX_t.((d_e -o X_t) -o X_t)
e. ((g_e -o g_t) -o AX_t.((d_e -o X_t) -o X_t))
f. AX_t.AY_s.((d_e -o (Y_s -o X_t)) -o(Y_s -o X_t))
```

(23)
```
((g -o g) -o AX.((d -o X) -o X))
```

Examples (24) and (25) describe the formation of linear logic formulas that are well-formed from the perspective of the parser implemented in the prover. Most importantly, the parentheses around linear logic formulas are obligatory. Type declarations should either be applied to all constants and variables, or to none. Type

[8]Types need to be specifically declared in the code of the GSWB, so it is not straightforward to introduce new types. We intend to address this issue in future iterations of the GSWB. In the meantime, you can contact the authors to get help with the implementation of new types.

[9]An element without a type declaration is treated as an element of type *t*.

declarations are indicated by an underscore, e.g., `_t`. Universal quantification over linear logic formulas is encoded using an upper-case `A` followed by some variable (e.g. `X`) and a dot. As of now, the scope of a linear logic quantifier is the rest of the formula and does not need to be indicated, and in fact should not be indicated via parentheses or brackets.[10] This means that linear logic quantifiers behave differently from the first-order logic quantifiers introduced in Section 3.2.2.

(24) Atomic elements:

a. *Constants:* String of lower-case alphanumeric characters; optionally with type declaration

b. *Variables:* String of upper-case alphanumeric characters; optionally with type declaration

(25) Linear logic formulas:

a. *Linear implication:* (ϕ -o ψ), where ϕ, ψ are well-formed formulas

b. *Linear quantification:* AX. ϕ, where ϕ is a well-formed formula

3.2 Encoding the meaning side

The GSWB currently supports three modes for encoding meaning representations. Each mode needs to specify a procedure for encoding functional application and abstraction. The default mode of the GSWB is a simple concatenation mode.

3.2.1 Concatenation mode

In this mode, any (string-based) format of semantic representation is compatible with XLE+Glue. In this simple format, functional application is expressed in the output by wrapping the argument in parentheses and concatenating functor and argument as in (26-a). Abstraction is handled by introducing a corresponding lambda binder as in (26-b).

(26) a. Combining $(1 \multimap 0)$: smile and 1 : Kim
to: 0 : smile(Kim)

b. smile(x) to λx.smile(x)

3.2.2 Semantic parser mode

This is the second input mode for the GSWB. The semantic parser provided by the GSWB can parse lambda expressions in accordance with a GSWB-internal semantic fragment, supporting alpha- and beta-conversion. This section describes how to use this semantic parser and provides guidelines for writing lambda expressions that can be parsed by it.

To activate the semantic parser, change the value of the variable `semParser` to `1` (instead of `0`) in the `xlerc` file. When this mode is active, unparsable input on

[10]This behaviour is currently investigated and might change in the future.

the meaning side will result in a parsing error. The current version of the semantic parser is completely independent of the glue side, which means that type restrictions need to be manually added. Furthermore, eta-conversion is not possible. This may change in the future.

The semantic parser parses lambda expressions and first-order logic terms. First-order predicates are encoded in the classic prefix notation. There is no convention with respect to the casing of predicates or constants, thus, the FOL terms in (27) all express a *liking* relation between two constants.

(27) a. `like(mary,semantics)`
     b. `LIKE(mary,semantics)`
     c. `like(MARY,SEMANTICS)`

Lambda expressions are introduced via a scope defining bracket and a slash, followed by the variable that the lambda operator binds. Variables require a type declaration to be distinguished from constants. This is done by using an underscore and a type as specified at the beginning of Section 3. Bound occurrences of a variable should not be typed again. The scope of the lambda function is separated from the binder via a dot. It can be any kind of well-formed (lambda) expression. See (28) for some examples of lambda expressions.

(28) a. `[/x_e.sleep(x)]`
     b. `[/x_e.[/w_s.sleep(x,w)]]`
     c. `[/P_<e,t>.[/Q_<e,t>.[/x_e.(P(x) & Q(x))]]]`

The basic **logic operators** $\wedge$, $\vee$ and $\rightarrow$ can be used as infix operators (see (29-a)–(29-c)), although their scope has to be defined via brackets or parentheses. Brackets may indicate operator and quantifier scope simultaneously (see (29-d)). Other operators must be encoded as FOL predicates in prefix notation (see (29-e)).

(29) a. Logical 'and' ($\wedge$): `(P(x) & Q(x))`
     b. Logical 'or' ($\vee$): `(P(x) v Q(x))`
     c. Logical 'implication' ($\rightarrow$): `(P(x) -> Q(x))`
     d. Variant with brackets: `Ex_e[P(x) & Q(x)]`
     e. Prefix notation: `equals(x,y)`

Quantifiers are introduced via the upper-case letters `A` and `E`, and the typed variable that they bind. The scope is defined via brackets as shown in (30).[11]

(30) a. `Ex_e[dog(x) & bark(x)]`
     b. `Ax_e[cat(x) -> sleep(x)]`

Functional application steps such as in the semantic terms for quantifiers are determined contextually. Consider `P(x)` and `Q(x)` in example (31). The P and Q

[11] Since `A` and `E` are reserved for quantifiers, these letters should not be used to encode other terms, e.g., variables, or constants.

variables over predicates followed by the x variable as an argument are translated as functional application steps (apply P/Q to x), rather than as a one-place predicate with a bound variable ($P(x)$).

(31) `[/P_<e,t>.[/Q_<e,t>.Ex_e[P(x) & Q(x)]]]`

Abstraction is handled in the same way as in the concatenation mode: by adding a lambda binder to semantic formula, that is represented in terms of the λ symbol.

3.2.3 Prolog mode for external semantic representations

The third mode supported by the GSWB is the Prolog mode, which shows how the GSWB can be made compatible with other semantic resources. It can be activated by setting the `semParser` value to `2` in the `xlerc` file. This mode implements an alternative string encoding of semantic objects based on the system presented in Blackburn and Bos (2006). Using this system means that all constants are expressed in terms of lower-case letters and all variables are encoded as (starting with) upper-case letters. Functional application is expressed in terms of the two-place predicate `app/2`, where the first argument is the functor and the second argument is the argument. Lambda expressions, and, thus, lambda abstraction, are introduced by wrapping a term in the two-place predicate `lam/2`. The first argument denotes the variable that is bound by the lambda and the second argument of `lam/2` denotes the body of the function. (32-a) is an example of a lambda expression in Prolog notation. This corresponds to the functional application shown in (32-b). In the complex argument of this formula, *x* is combined with $\lambda v.bone(v)$, which is visually indicated as a function in terms of the square brackets. The variable *x* is then abstracted over by adding λx to combine with the quantifier.

(32) a. `app(lam(R,lam(S,every(Y,imp(app(R,Y),app(S,Y))))),`
`lam(X,app(lam(V,bone(V)),X)))`

b. $\lambda R.\lambda S.\forall y[R(y) \rightarrow S(y)](\lambda x.[\lambda v.bone(v)](x))$

4 Prolog rewrite component

The Prolog rewrite component takes the Prolog output of an XLE parse[12] as input and translates it into a set of premises based on the specifications introduced in the previous section. It does not rely on any particular assumptions about where the GLUE attributes must appear; GLUE attributes and their values are a part of f-structure in our sample grammar `glue-basic.lfg`, while our sample grammar `glue-basic-semstr.lfg` places them at s-structure. Indeed, the system works even if some GLUE attributes appear at f-structure, and others appear in other structures. It is also not necessary for the meaning constructors to be distributed in any particular way in the structure in which they appear; the system simply gathers

[12] https://ling.sprachwiss.uni-konstanz.de/pages/xle/doc/xle.html#Prolog_Output

up all members of every GLUE set in the input representation, rewrites them into the standard format, and passes the resulting set of standard-format meaning constructors to the prover. Thus, decisions about which structure hosts the GLUE attribute and its values should be made on the basis of linguistic considerations, and are not determined by properties of the implementation. Attributes other than the GLUE attributes and their values are ignored and discarded by the rewrite component.

Each element of the GLUE set provides one premise: as explained in Section 2 for the embedded encoding format of premises, the value of MEANING provides the semantic side, while RESOURCE, TYPE, and the ARG1…N attributes provide the glue side.[13]

The values of the RESOURCE attributes are instantiated to the numeric labels provided by XLE. Because the numeric indexing for semantic forms in the Prolog output format is independent of the numeric indexing for other structures (for example, there may be an f-structure with numeric index 1 and also a semantic form with numeric index 1 in the same f-structure), the numeric index of a semantic form is additionally prefixed with an S, e.g., S1, to ensure uniqueness of indices. As described in Section 2.1, the FORALL attribute is used to encode linear quantification. Different quantified variables are distinguished by combining the label F with the unique f-structure index.

(33) a. `AF11_t.((s1_e -o s1_t) -o ((4_e -o F11_t) -o F11_t))`

b. $\forall F11_t.((s1_e \multimap s1_t) \multimap ((4_e \multimap F11_t) \multimap F11_t))$

c. $$4:\left[\begin{array}{ll} \text{PRED} & \texttt{1} \\ \text{GLUE} & \left\{ \left[\begin{array}{ll} \text{MEANING} & \textit{every} \\ \text{FORALL} & \texttt{F11} \\ \text{ARG1} & \left[\begin{array}{ll} \text{ARG1} & \left[\begin{array}{ll} \text{RESOURCE} & \texttt{1} \\ \text{TYPE} & e \end{array}\right] \\ \text{RESOURCE} & \texttt{1} \\ \text{TYPE} & t \end{array}\right] \\ \text{ARG2} & \left[\begin{array}{ll} \text{ARG1} & \left[\begin{array}{ll} \text{RESOURCE} & \texttt{4} \\ \text{TYPE} & e \end{array}\right] \\ \text{RESOURCE} & \texttt{F11} \\ \text{TYPE} & t \end{array}\right] \\ \text{RESOURCE} & \texttt{F11} \\ \text{TYPE} & t \end{array}\right] \right\} \end{array}\right]$$

Example (33-a) shows the output produced by the rewrite component for a gener-

[13] In fact, only the attributes MEANING, RESOURCE, TYPE, and FORALL have a special status in the embedded encoding format. All other attributes are assumed to represent arguments, which are consumed according to alphabetical order. It would also be possible to use A, B, C; A1, A2, A3; or any other alphabetically ordered series of attributes for arguments. It is not possible to substitute other names for the special attributes MEANING, RESOURCE, TYPE, FORALL when the embedded encoding format is used.

alized quantifier encoded in AVM format as (33-c) (as discussed in example (8)), corresponding to the standard format meaning constructor in (33-b). All of the conventions discussed above are illustrated in (33-a): `F11` is bound by a universal quantifier, `s1` refers to the semantic form whose index is 1, and `4` refers to the f-structure whose index is 4.

5 Illustrating the flexibility of the system

In this section, we present a variety of different modifications of the XLE+Glue system, including the possibility to use different semantic formalisms, as well as alternative encodings of glue premises in XLE. We also show how additional (semantic) resources can be added to the pipeline. Through this, we demonstrate how to enhance the functionality and coverage of the system.

5.1 Different semantic representations

5.1.1 Event semantics (with semantic parser)

While `glue-basic-semparser.lfg` is the sample grammar using the semantic parser (see Section 3.2.2), `glue-basic-semparser_ND.lfg` is its modified version using Neo-Davidsonian event semantics (Parsons 1990).

Rather than using predicates with variable arity (depending on the number of arguments of the predicate), in event semantics the predicate has only one argument, the event variable, while the dependents of the predicate are related to it using separate predicates whose names correspond to the semantic role of the given dependent (such as *agent*, *theme*, etc.).

The examples below provide semantic representations of the running example "Kim smiled" produced by the grammars `glue-basic-semparser.lfg` and `glue-basic-semparser_ND.lfg`, respectively: in (34-a) the predicate $smile$ has one argument (Kim), while in (34-b) the only argument of $smile$ is the event variable (here: z), while Kim is related to the event z using the $agent$ predicate (Kim is the $agent$ of z).

(34) a. `smile(Kim)`
b. `exists([λz_v.and(smile(z),agent(z,Kim))])`

5.1.2 DRT semantics (with Prolog mode)

In Section 3.2.3, we demonstrated that the GSWB supports Prolog-style encoding of semantic formulas as output. Using this mode, we provide a DRT-mode in XLE+Glue to illustrate the possibility to interact with different semantic resources. To activate the DRT-mode, set the following values of variables in the `xlerc` file: `processDRT` to `1`, `semParser` to `2` (Prolog mode on).

The DRT-mode makes use of the Boxer DRT system (Bos 2008, 2015, Blackburn and Bos 2006) optimized to interpret λ-DRT formulas as described in Gotham

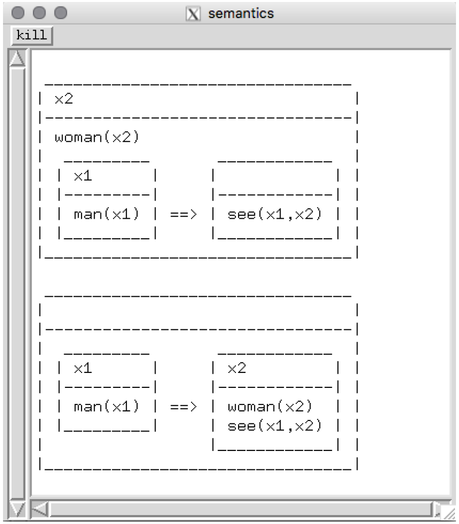

Figure 2: Boxer-style DRT representation: *Every man saw a woman*

and Haug (2018).[14] To include those two components, we extended the λ-DRT system with some simple wrapper code to execute it from within XLE+Glue. Thanks to the Prolog-style encoding option of the GSWB, the lambda DRT component can directly process the GSWB's output and produce a graphical Boxer-style representation of the Prolog term that is presented in the output window of XLE+Glue. This is shown in Figure 2.

5.2 Meaning constructors encoded as strings

Section 2 describes the f-structure encoding of meaning constructors as AVMs, using the attributes RESOURCE, TYPE, MEANING, and ARG1…ARGN. In this encoding, the embedding in the AVM representation reflects the structure of the linear logic expression that is encoded, since material on the left-hand side of a linear implication is represented as the f-structure value of an attribute such as ARG1.

This section describes an alternative encoding: the string-based, flat encoding. In this encoding, the substrings of the meaning constructor are encoded as values of the attributes in a single AVM, which are concatenated together to produce the input to the prover. This is in some ways a simpler encoding, since it does not require the construction of a complex AVM to reflect the structure of the linear logic term. However, it requires a detailed understanding of the input format required by the GSWB prover, and it is also easier to make mistakes in the encoding, which can make it harder to use.

The flat encoding is illustrated in (35), where 1 is the label assigned by XLE to the outermost f-structure:

[14]We thank Johan Bos and Matthew Gotham for making their λ-DRT tools available to us.

(35) a. `Kim:1_e`

b. $$1:\left[\begin{array}{ll}\textsc{pred} & \text{`}\textsc{Kim}\text{'}\\ \textsc{glue} & \left\{\left[\begin{array}{ll}\text{A1} & \textsc{Kim}\\ \text{A2} & :\\ \text{A3} & 1\\ \text{A4} & \_\\ \text{A5} & \text{e}\end{array}\right]\right\}\end{array}\right]$$

c.
```
Kim   :   1   _   e
 A1   A2  A3  A4  A5
```

In this encoding, the substrings of the meaning constructor input to the GSWB prover are encoded directly. By convention, this encoding uses the attributes A1,A2,..., but in fact any attributes can be used except for the special attribute MEANING, which indicates to the transfer component that the embedded encoding is being used. It is possible to have meaning constructors encoded in the string-based format and the standard embedded format coexisting in the same f-structure, or even in the same GLUE set.

In the transfer component using the flat encoding, the attributes are sorted into alphabetical order, and the substrings of the meaning constructor are concatenated according to that ordering. (35-c) shows the correspondence between the attributes of the f-structure in (35-b) and the resulting meaning constructor. A cautionary note: if there are 10 or more meaning constructor substrings encoded via attributes `A1...A10...` in an AVM, the attribute `A10` will sort alphabetically between the attributes `A1` and `A2`; in that case, therefore, the single-digit attributes should be prefixed with 0 (`A01,A02,...A10,A11,...`) to ensure that the values of the attributes are concatenated in the correct order.

In the sample grammar `glue-basic-flat-encoding.lfg`, the lexical entry for *Kim* shown in (12) calls the `PROPERNOUN` template in (13), which in turn calls the template `GLUE-REL0-MC` defined in (14). In the string-based, flat encoding, `GLUE-REL0-MC` is defined as follows:

(36)
```
GLUE-REL0-MC(R TY M) =  (%mc A1) = M
                        (%mc A2) = `:
                        (%mc A3) = R
                        (%mc A4) = _
                        (%mc A5) = TY
                        %mc $ (R GLUE).
```

The value of the attribute `A1` is the meaning term, which is the first component of the meaning constructor for *Kim*. The value of `A2` is the colon separating the meaning side of the meaning constructor from the glue side, which must be quoted with a backquote. The value of `A3` is the f-structure for *Kim*, the value of `A4` is the underscore separating the f-structure from its type, and the value of `A5` is its type, as specified by `TY` in the template call to `GLUE-REL0-MC`. Further examples can be found in the sample grammar `glue-basic-flat-encoding.lfg`.

6 Conclusion

In this paper we presented the XLE+Glue system, which provides an interface between XLE and the GSWB with the goal to contribute to the ongoing reinvigoration of computational Glue semantics.

We paid particular attention to the encoding of glue formulas within XLE grammars for which we have presented several alternatives to show that the system can deal flexibly with different ways of tackling the issue. In particular, we presented a novel encoding of glue premises in terms of AVMs, where linear logic terms are encoded in a hierarchical structure. However, we also demonstrated that an alternative flat encoding is possible. Furthermore, we showed how the XLE+Glue system can be made compatible with different semantic formalisms as well as additional semantic resources.

Although this paper presents the XLE+Glue resource in terms of a co-descriptive approach to Glue semantics in the sample grammars, the encodings presented in this paper are in fact agnostic with respect to ideas about the syntax/semantics interface and the choice of semantic formalism. This means that we provide a flexible system for computational Glue semantics that can be optimized to cater for the needs of an individual grammar developer and the needs of the given grammar theory that the developer wants to implement.

This paper provides an introduction to the XLE+Glue system and describes some of the more important technical details. However, we strongly encourage the reader to consult the manual provided in the XLE+Glue GitHub repository (see footnote 1) before starting to work with the system, as it describes its technical underpinnings in more detail. For a quick start guide to experiment with the system, see the README file in the repository which provides a minimal description for setting up the system. Both of these resources will be continuously updated as new features are introduced to XLE+Glue to make the system a long-lasting resource for computational linguists.

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Grammatical function selection in Swedish object shift

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Abstract

Object shift, the word order where light object pronouns precede sentential adverbs, has received a lot of attention since it was first described in the theoretical literature in Holmberg (1986). The early studies discussed basic syntactic and prosodic conditions on this word order. More recently researchers have investigated pragmatic and information structural constraints on when object shift can or cannot apply. In this paper we take a syntactic approach following a proposal in Ørsnes (2013). After having carried out a survey of which types of verbs allow or disallow object shift in Swedish, we propose a generalization in terms of subcategorization. We find that object shift is possible, modulo information structural restrictions, with verbs that subcategorize for the closed functions OBJ and COMP but not with raising verbs that subcategorize for the open function XCOMP.

1 Introduction

Swedish is a Germanic verb second language where lexical objects follow the verb. When the main verb appears in second position, a lexical object has to follow any sentence adverbials:

(1) a. Jag har inte kysst Eva. [Sw.]
I have not kissed Eva
'I haven't kissed Eva.'

b. Jag kysste inte Eva.
I kissed not Eva
'I didn't kiss Eva.'

Object shift (OS) is the term used for the word order shown in (2) where a pronominal object precedes a sentential adverb.

(2) Jag kysste henne inte. [Sw.]
I kissed her not
'I didn't kiss her.'

Previous research on object shift OS in the Scandinavian languages has revealed that it is a multi-faceted phenomenon involving prosody, syntax, semantic-pragmatic factors as well as processing aspects related to the cognitive status of the referents. In this paper we discuss the role of subcategorization, an aspect first brought up in Ørsnes (2013). We agree with Ørsnes that there is a syntactic constraint but we believe that the relevant distinction is not whether the verb subcategorizes for an NP/OBJ or not but whether the verb takes an open or closed function as complement.

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In section 2 we briefly summarize previous research on OS before identifying three types of verbs in section 3. In section 4 we investigate the subcategorization of propositional complements more closely, looking also at *equi* and *raising* verbs. In section 5 we propose an LFG analysis for Swedish which involves a minor modification of the proposal in Sells (2001). In section 6 we summarize Ørsnes' analysis of Danish and show how it differs from our analysis of Swedish. Our analysis raises the question why the difference between XCOMP and COMP with obligatory anaphoric control would have consequences for a phenomenon that is in general seen as being conditioned by information structural factors.

2 Previous research on object shift

Early on it was established that only unstressed pronouns could be shifted and only in matrix clauses with a single finite verb, as in example (2), see Holmberg (1986) and Hellan and Platzack (1995). Examples where the pronoun is stressed or where there is an auxiliary verb are impossible:

(3) a. *Jag kysste HENne inte.
I kissed HER not

b. *Jag har henne inte kysst.
I have her not kissed

At first it was thought that in Norwegian and Danish, OS is obligatory when its syntactic conditions are met and the pronoun is unstressed, whereas it is optional in Swedish. But more recent research has shown that in all the languages other conditions play a role. Specifically the behavior of *det* 'it' as a sentential or VP anaphor has drawn much attention as it is more likely to resist OS than anaphors with nominal antecedents. Andréasson (2008) shows that in her corpus of Danish and Swedish, pronouns with entity antecedents were highly likely to shift (above 90%) whereas pronouns with sentential antecedents shifted in around 70% of the cases. Anderssen and Bentzen (2012) and Bentzen and Anderssen (2019) appeal to differences in topicality, whereas others cast this in terms of the accessibility of the referent in the mind of a listener or speaker. Andréasson (2013) discusses the relative strength of referent type, accessibility and factivity in an Optimality Theory analysis that makes use of the feature ACTVN from O'Connor (2006). She suggests that only elements that are highest on the *givenness hierarchy* of Gundel et al. (1993) may shift. Borthen (2004) and Lødrup (2012b) have shown that when an entity pronoun is used with a *type* reading, it is less acceptable in shifted position. Several researchers have pointed out that referents that are introduced by *factive* verbs are more likely to shift (see e.g. Andréasson 2010). Ørsnes (2013) and Bentzen and Anderssen (2019) among others link this to the fact that factive complements are more likely to be treated as part of the common ground. An LFG syntactic treatment for Swedish is given in Sells (2001).

3 Object shift and subcategorization

In this paper we focus on a syntactic constraint that was first pointed out for Danish in Ørsnes (2013). He argues that the subcategorization of the verb governing the pronoun plays an important role: only verbs that subcategorize for both NP/OBJ and VP/XCOMP complements allow OS. Ørsnes compares verbs like *savne* 'to miss' which alternate between a VP complement and an NP complement, see (4a), with subject raising verbs like *pleje* 'to use to' which only take VP complements, (4b).

(4) a. Jeg savner [at drikke øl / øldrikning]. [Da.]
I miss to drink beer / beer.drinking
'I miss drinking beer.'

b. Jeg plejer [at drikke øl / *øldrikning].
I use.to to drink beer / beer.drinking
'I usually drink beer.'

Ørsnes then shows that this affects OS, using the proform *det* 'it' which can take either a VP or an NP as antecedent. With *savne* both the in situ and the shifted positions are possible. Which version is chosen in a particular context depends, according to Ørsnes (2013), on the information structural status of the pronoun. With *pleje*, only the in situ version is possible.

(5) a. Savner du det ikke / ikke det? [Da.]
miss you it not / not it
'Don't you miss it?'

b. Plejer du *det ikke / ikke det?
use.to you it not / not it
'Don't you usually do that?'

Corresponding examples in Swedish behave similarly but we think that the generalization is slightly different from the one Ørsnes proposes. We have investigated verbs that take clausal complements, either VP or SENTENTIAL ones, using both large text corpora and native speakers' judgments.[1] With respect to OS, we find three patterns.

- Type A: verbs that allow OS
- Type B: verbs that only allow OS under certain circumstances
- Type C: verbs that don't allow OS

Type A verbs allow the complement to be replaced by the VP anaphor *det* both in situ and shifted, as shown in (6).

[1] We have primarily searched in the Swedish Language Bank (2.1 G tokens) using the *Korp* search engine `https://spraakbanken.gu.se/korp`.

(6) a. De accepterade att betala högre skatt. [Sw.]
they accepted to pay higher tax
'They accepted to pay higher taxes.'

b. De accepterade det inte / inte det.
they accepted it not / not it
'They didn't accept it.'

Type B verbs are more seldom used with OS. They include verbs of propositional attitudes like *tro* 'think, believe' and *anta* 'assume'. OS is clearly dispreferred in (7).

(7) 'Will you come to the party tonight?'

a. Jag tror inte det. [Sw.]
I think not it
'I don't think so.'

b. #Jag tror det inte.
I think it not

But, as Andréasson (2013) points out, there are contexts where contrastive stress on another element than *det* is motivated and then the shifted version is preferred, as for instance in the corpus example in (8).

(8) So you think that she is a murderer?

a. Jag tror det inte. Jag fruktar det. [Sw.]
I think not it I fear it
'I don't think so. I fear that it is so.'

b. Jag TROR det inte. Jag FRUKtar det.
I think it not I fear it

In (8a) the verb *tror* is contrasted with the verb *frukta*. If spoken, there would be contrastive stress on the two verbs, as shown in (8b) and destressing of the pronoun. The contrastive stress does not need to be on the verb, as shown in (9).

(9) Vi antog att vattnet var tjänligt, våra GRANnar antog det
*we assumed that water.*DEF *was drinkable our neighbours assumed it*
inte. [Sw.]
not
'We assumed that the water was drinkable, our neighbours didn't.'

Type C verbs don't allow OS at all, not even with contrastive stress. They are auxiliary verbs such as temporal *ha* 'have'. Given the question in (10), it is natural to stress the verb in the reply, but still only the unshifted option is possible.

(10) Visst har du varit i Oslo?
'You have been to Oslo, haven't you?'

a. Nej, jag HAR inte det. [Sw.]
no I have not it
'No, I haven't.'

b. *Nej, jag HAR det inte.
no I have it not

c. *Nej, jag HAR inte.
no I have not

In English, the answer would most likely involve VP deletion, as shown in the translation of (10a). Deleting the proform *det* is not possible in Swedish, see (10c).

The habitual *bruka* 'use to', cf. Danish *pleje* in (5), is also a type C verb.

(11) Olle dricker visst kaffe idag.
'Look, Olle is drinking coffee today.'

a. BRUkar han inte det? [Sw.]
use.to he not it
'Doesn't he usually do that?'

b. *BRUkar han det inte?
use.to he it not

In the next section we look at what complements these three types of verbs subcategorize for.

4 Subcategorization of propositional complements

In LFG a distinction is made between COMP and XCOMP. The primary example of COMP complements are tensed embedded clauses such as *that*-clauses in English. In these cases, the arguments of the main predicate of the embedded clause are realized locally, except when functional uncertainty constraints allow for the non local realization of one of the arguments. Functions that contain all the arguments of their primary predicate locally are called **closed** functions.

The canonical example of an XCOMP relation is the raising construction. Here one argument of the embedded clause is realized in the main clause and is related to the embedded predicate via functional control. The syntactic subject of the matrix verb is not a thematic dependent of that verb. The motivation for this are the well-known arguments for raising: e.g. *seem* doesn't impose thematic co-occurrence restrictions on its SUBJ: they are inherited from the lower verb, see the lexical entry for *seem* in (12).

(12) **seem** $\langle$ ($\uparrow$ XCOMP) $\rangle$ ($\uparrow$ SUBJ) ; ($\uparrow$ SUBJ) = ($\uparrow$ XCOMP SUBJ)

The functional control equation, however, manages syntactic properties, not thematic ones; it insures unification of the higher and the lower subject, so that the syntactic constraints are the same. A good illustration of these are the Icelandic raising facts; when the lower verb selects for a non-nominative subject, the higher subject will exhibit the same case marking (Andrews 1982). Functions that depend on functional control for the satisfaction of functional completeness are **open** functions.

In early LFG infinitival *equi* complements were often analyzed as XCOMPs. However they differ from raising complements in that the matrix subject is a thematic argument of the matrix verb as well as of the embedded one. This means that the subjects do not have to be unified syntactically; only the referential indices have to be the same. For instance, in Icelandic, the case agreement facts that are found with *raising* are not found with *equi*. More recently (see e.g. Dalrymple et al. 2019) it has been argued that the complements of equi verbs are COMPs but a special type that involves *obligatory anaphoric control*. Anaphoric control is in general not obligatory; the antecedent of a pronoun can be found in various not syntactically specified positions. With *equi* however, the referential index of the embedded SUBJ is shared with the referential index of the SUBJ of the matrix verb.[2]

To insure that the subject of the embedded clause is a PRO that is coreferent with the matrix subject, we could write the following equations (but it is most likely better left to the semantic component as in Dalrymple et al. (2019, 593ff.)).

(13) **try** V (↑PRED) = 'TRY'⟨(↑SUBJ), (↑COMP)⟩
(↑ COMP SUBJ PRED) = 'PRO'
(↑ SUBJ INDEX) = (↑ COMP SUBJ INDEX)
(↑ COMP FINITE) $=_c$ -

(The last of these equations insures that the complement of *try* is not finite.)

The partition of complements between OBJ and COMP has also come up for revision. Traditionally it was assumed that only DPs can be OBJ but Dalrymple and Lødrup (2000) and Lødrup (2002, 2012a) have argued that clausal complements can also be OBJs. We adopt this proposal here.[3] All together then we have the following options: XCOMP, an open function, and the closed functions OBJ, COMP and COMP with obligatory anaphoric control, which we will represent as COMP-OAC. This means we have three types of verbs, A,B and C, and three types of complements. Is there a correlation?

4.1 A correlation in Swedish

The subcategorization of Swedish propositional complements has not been studied in great detail (except for an early study by Ureland 1973). We base ourselves mainly on Lødrup's studies of Norwegian in the categories that we propose here. Specifically we follow him in using alternation with DPs and passivization as tests to distinguish between OBJ and COMP sentential complements. It turns out

[2]We limit our discussion to *subject control* verbs. With *object control* verbs the controller is identified as OBJ or OBJtheta of the matrix verb.

[3]But we do not always agree on the exact classification of the verbs, see Zaenen and Engdahl (to appear) for discussion.

that there is quite a good correlation between complement type and verb types in Swedish.

- OBJ-taking verbs are type A (allow OS)
- XCOMP-taking verbs are type C (don't allow OS)
- sentential COMP-taking verbs are type B
- COMP_{OAC} (*equi*) are either type A or B

We now go through the evidence, starting with type A.[4] The Swedish verb *acceptera* 'accept' takes an OBJ and behaves just like its Norwegian counterpart, *akseptere*, see Lødrup (2004, 70f.). It is an *equi* verb which takes an OBJ-OAC. The complement alternates with a DP object, it allows a personal passive and, we add, it allows OS (14d).

(14) a. De accepterade att betala högre skatt. [Sw.]
they accepted to pay higher tax
'They accepted to pay higher taxes.'

b. De accepterade chefens förslag.
they accepted boss' suggestion
'They accepted the boss' suggestion.'

c. Att betala högre skatt accepterades inte.
*to pay higher tax accepted.*PASS *not*
'To pay higher taxes was not accepted.'

d. De accepterade det inte.
they accepted it not
'They didn't accept it.' 'They didn't accept (to do so).'

The *equi* verb *sakna* 'lack, miss', which takes a COMP-OAC, is also a type A verb as shown in (15). The complement alternates with a DP which can become the subject in a passive, but the COMP-OAC argument cannot, unlike *acceptera*. OS is possible.

(15) a. Han saknar att dricka öl. [Sw.]
he misses to drink beer
'He misses drinking beer.'

b. Han saknar ölen / öldrickandet.
*he misses beer.*DEF */ beer-drinking.*DEF
'He misses the beer / the beer drinking.'

c. Ölen saknas.
*beer.*DEF *miss.*PASS
'The beer is missing.'

[4]Type A verbs of course include plain OBJ taking verbs as well, but we are here concentrating on verbs taking clausal complements.

d. *Att dricka öl saknas.
*to drink beer miss.*PASS

e. *Det saknas att dricka öl.
EXPL *miss.*PASS *to drink beer*

f. Han saknar det inte.
he miss it not
'He doesn't miss it.'

We have already seen that *tro* 'think, believe' is a type B verb. In Zaenen and Engdahl (to appear) we suggest that it sucategorizes for COMP. As evidence for this we can note that *tro* does not take a DP object that corresponds to a clausal complement and only allows impersonal passives. OS requires a special context.[5]

(16) a. Ingen trodde *(på) historien. [Sw.]
*nobody believed on story.*DEF
'Nobody believed the story.

b. *Att Northug skulle vinna troddes (av reportern).
*that Northug would win believed.*PASS *by reporter.*DEF

c. Det troddes allmänt att Northug skulle vinna.
EXPL. *believed.*PASS *generally that Northug would win*
'It was generally believed that Northug would win.'

d. #Jag tror det inte.
I believe it not

The *equi* verb *försöka* 'try' takes COMP-OAC and is also a type B verb. It does not take a DP object, does not passivize and OS is marked.[6]

(17) a. Han försökte *ölen / *öldrickande. [Sw.]
*he tried beer.*DEF */ beer-drinking*
Intended: 'He tried the beer / drinking beer.'

b. *Att dricka öl försöktes (av Olle).
*to drink beer tried.*PASS *by Olle*

[5]This verb can be construed with a personal pronoun object in which case OS is possible.

(i) Jag tror dig inte. [Sw.]
I believe you not
'I don't believe you.'

[6]The reason we classify *försöka* as a type B verb is that there are very few hits with OS in the large Swedish Language Bank (2.1 G). One example from the Finnish newspaper *Syd-Österbotten* 2011 is given in (i).

(i) Jörn Donner löser inte gåtan Mannerheim, han försöker det inte heller. [Sw.]
*Jörn Donner solves not riddle.*DEF *Mannerheim, he tries it not either*
'Jörn Donner doesn't solve the puzzle Mannerheim, he doesn't try to either.'

There are two coordinated main clauses; both verbs are negated and contrasted.

c. *Det försöktes (att) dricka öl.
EXPL *tried.*PASS *to drink beer*

d. #Han försökte det inte.
he tried it not
'He didn't try.'

Type C verbs are typical *raising* verbs and subcategorize for XCOMP. These verbs allow expletive subjects but do not take DP objects, do not passivize and OS is not possible.

(18) a. Det brukar regna här. [Sw.]
EXPL *use.to rain here*
'It usually rains here.'

b. Eva brukar sova länge på morgonen.
Eva use.to sleep long on morning
'Eva usually sleeps late in the morning.'

c. *Eva brukar sömn / sovande.
Eva use.to sleep / sleeping

d. *Sova länge brukas.
*sleep long use.to.*PASS

e. *Hon brukar det inte.
she use.to it not

4.2 Modal auxiliaries

If *equi* verbs take COMP-OAC and auxiliaries take XCOMP, what about modal auxiliaries like *kunna* 'can' and *måste* 'must'? As is well known, they can be used both as epistemic and root modals (see e.g. Teleman et al. 1999, 4:283ff. and Eide 2005) (in addition to other possible readings that we have not investigated). Lødrup (1994) for Norwegian and Thráinsson and Vikner (1995) for Danish have observed that OS is sometimes possible with modal verbs, but only on the interpretation where the subject is a thematic argument of the verb. The examples in (19) and (20) are from Lødrup (1994, 305).

(19) Kan du strikke votter nå?
'Are you able to knit mittens now?'
Nei, jeg kan det ikke ennå. [No.]
no I can that not yet
'No, I'm not able to do that yet.'

(20) Kan bussen ha kommet nå?
'Is it possible that the bus has come?'

a. Nei, den kan ikke dét. [No.]
no it can not that
'No, it can't have.'

b. ??Nei, den kan det ikke.
no, it can that not

In (19) the question is whether the addressee is able to knit mittens. The subject is hence a thematic argument of *kan* which calls for a COMP-OAC analysis; here OS is possible. In (20), the subject is not a thematic argument of *kan*, only an epistemic interpretation is possible and OS is unlikely.

The Swedish example in (21) works the same way; OS is not possible, not even with contrastive stress.[7]

(21) Kan bussen ha kommit redan?
'Is it possible that the bus has already come?'

a. Nej, den kan inte det. [Sw.]
no it can not it
'No, it can't have.'

b. *Nej, den kan det inte.
no, it can it not

c. *Nej, den KAN det inte.
no, it can it not

We thus assume that the modals are *equi* verbs that take COMP-OAC when their subject is a thematic argument of the verb whereas they are *raising* verbs that take XCOMP in other contexts, e.g. in their epistemic uses. It then comes as no surprise that some modals allow OS under the right stress conditions. The example in (22) comes from an editorial in *Dagens Nyheter*, a Swedish newspaper.

(22) Frågan är vem som kan besegra Trump. Hillary Clinton kunde det inte.
question is who that can conquer Trump Hillary Clinton could it not
'The question is who can win over Trump. Hillary Clinton wasn't able to do so.'

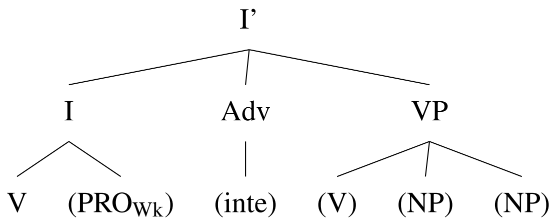
The question under discussion is who can win over Trump. The following sentence is most naturally produced with a focus accent on the subject and destressing of the verb and the pronouns. The subject *Hillary Clinton* is a thematic argument of the the modal *kunde* 'was able to'.

5 An LFG account

Under the assumptions made above, an LFG account is straightforward. First we assume, with Lødrup (2012b), that NPs can carry the specifications XCOMP and

[7]Lødrup renders the pronunciation of the shifted versions in (19) and (20b) as one phonological phrase *kan-det-ikke* whereas the *det* in situ in (20a) is accented. In Swedish too the epistemic reading is unavailable with a shifted *det*. But unlike Norwegian, *det* in situ does not require an accent and can even be cliticized onto the a sentence adverbial (Teleman et al. 1999, 2:270f., Engdahl and Lindahl 2014 and Erteschik-Shir et al. 2020).

COMP. More specifically we assume that the proform *det* is specified for the function that corresponds to the clausal subcategorization of the verb it occurs with, so it can be an OBJ, a COMP as well as an XCOMP. Second, we adopt the phrase structure rules proposed in Sells (2001) which give rise to the simplified structure below. There is a position for shifted weak pronouns under I.

(23)


Sells (2001) assumes that material under PRO is restricted to direct GFs (SUBJ, OBJ, OBJtheta). We propose instead that it is restricted to closed functions.

Since there is no such restriction on *det* occurring in situ in the VP, all types of *det* can occur there. In the shifted position, the pronoun is under I and hence restricted to complements of verbs that subcategorize for OBJ or COMP.[8]

6 *det* in Danish and Swedish

The solution above handles the Swedish facts well. We now look at the Danish facts and discuss how they fare. There is an interesting difference between Danish on the one hand and Norwegian and Swedish on the other which is relevant. All three languages have the same proform *det*, which is often referred to as a VP anaphor since it replaces a whole VP.[9] It correponds more or less to VP deletion in English, as shown in the English translations of the examples. Compare the Swedish and Danish replies to a question like *Did Peter drink beer last night?*

(24) Nej, han brukar inte det. [Sw.]
no he uses not it
'No, he usually doesn't.'

(25) a. Nej, han plejer ikke at gøre det. [Da.]
no, he uses not to do it
'No, he usually doesn't.'

b. ??/*Nej, han plejer ikke det.
no he uses not it

Whereas it is fine to have *det* in situ in Swedish, this is strongly dispreferred in Danish; instead the support verb *gøre* 'do' has to be inserted (Ørsnes (2011). This

[8] Sells (2001) actually adds a proviso for locative proforms. Under our proposal locative proforms would be allowed but we will need a restriction on the type of ADJs that are possible.

[9] See Lødrup (1994, 2012b), and Houser et al. (2007) for arguments that this *det* is a surface anaphor which requires a linguistic antecedent.

has nothing to do with OS since in both languages *det* is realized in the VP. We get the same pattern with the temporal auxiliary in replies to a question like *Have you posted the letters?*[10]

(26) Ja, jag har det. [Sw.]
yes I have done it
'Yes I have.'

(27) a. Ja, jeg har gjort det. [Da.]
yes I have done it
'Yes I have.'

b. *Ja, jeg har det.
yes, I have it

Again we see that Danish does not allow the VP anaphor in situ without *gøre* whereas this is fine in Swedish. The way Ørsnes accounts for the Danish pattern is as follows. He assumes that *det* is always an NP of category OBJ. Since *pleje* and *have* subcategorize for XCOMP, there will be a clash if we insert *det*. But *gøre* subcategorizes for an OBJ, so inserting *gøre* avoids the clash.

Ørsnes doesn't discuss Swedish. On our approach, *det* has the category of the complement that the verb subcategorizes for. Consequently having det_{XCOMP} in situ in (24) or (26) does not cause a problem.

It seems then that the difference between Swedish (and Norwegian) and Danish might lie in the difference in the categorization of *det* in the languages: in Danish it is always an OBJ, in Swedish and Norwegian it can be an OBJ, an XCOMP or a COMP. The situation is however complicated by the fact that when *det* is topicalized, which is quite common, *gøre* is optional. In this respect Danish and Swedish behave exactly the same way; both examples in (28) are natural replies to the question *Did Peter drink beer last night?*

(28) a. Nej, det plejer han ikke (at gøre). [Da.]
no it use.to he not do
'No, he usually doesn't.'

b. Nej, det brukar han inte (göra). [Sw.]
no it use.to he not do
'No, he usually doesn't.'

For Swedish we assume that det_{XCOMP} can be topicalized but this solution is not available to Ørsnes who assumes that *det* in Danish is always an NP of category OBJ. Since *pleje* in (28a) does not subcategorize for OBJ, the standard topicalization via functional uncertainty does not work. Instead Ørsnes proposes to let topicalization relax the subcategorization requirements so that a topicalized con-

[10]Example (27) supplied by Bjarne Ørsnes, e-mail, March 2020.

stituent can be of a different category than that required by the verb.[11] Constituents which appear in the 'canonical' complement position after the verb must still meet the subcategorization requirements (2013, 254). Ørsnes refers to examples like (29) from Bresnan (2001, 17).

(29) [$_{\text{CP}}$ That he was sick] we talked about [$_{\text{–NP}}$] for days.

However, as we have seen, *det* sometimes may appear post-verbally without *gøre*-support, as in the in situ version in (30), repeated from (5b).

(30) Plejer du *det ikke / ikke det? [Da.]
use.to you it not / not it
'Don't you usually do that?'

According to Ørsnes this only happens when topicalization isn't possible. The crucial difference between (25) and (27), where *gøre* is required, and (30) is that the latter is a verb initial yes/no question where topicalization is unavailable. In such cases a discourse prominent topic *det* may appear post-verbally without *gøre*-support. The reason that such a topic *det* can not appear in the shifted position in (30) is, according to Ørsnes (2011, 424f.), that it is stressed and has to appear after the negation since OS in Danish only applies to unstressed, non-topical, elements.

We have not investigated whether in situ VP anaphors in Danish are stressed. In Swedish such anaphors can cliticize onto the negation (Erteschik-Shir et al. 2020) which suggests that they are not stressed. Still an unstressed *det*$_{\text{XCOMP}}$ may not shift which we account for by a syntactic restriction on what types of weak proforms may appear under I in the tree.[12]

6.1 Polysemous verbs

Restricting the shifted position to *det*$_{\text{OBJ}}$ and *det*$_{\text{COMP}}$ has an interesting consequence for polysemous verbs; a pronoun in the shifted position forces one of the readings. We can illustrate this with the verb *ha*. So far we have only looked at examples with the temporal auxiliary *ha* but there is also a main verb *ha* 'be in possession of' which subcategorizes for OBJ. Object shift disambiguates:

[11] See Ørsnes (2011) for a detailed LFG analysis of non-finite *do*-support in Danish. On page 422 he gives a C-structure rule for CP-expansion which allows topicalized VPs and NPs to map either to XCOMP or OBJ. Mikkelsen (2015) analyzes similar VP anaphora data in a feature based Minimalist framework.

[12] The Swedish raising verb *verka* 'seem' and the phasal verbs *börja* 'begin' and *sluta* 'end' behave like the Danish auxiliaries in that they don't allow the proform *det* as complement without *göra*. These verbs, in addition, do not allow topicalization of *det* without *göra*-support. Further investigations are clearly needed. We should also point out that not all *equi* verbs allow the complement to be pronominalized by *det*. This applies to e.g. *hota* 'threaten' and *tveka* 'hesitate' which take XCOMP according to Lødrup (2004). They differ from COMP-OAC taking verbs like *försöka* and *sakna* in that they don't allow VP topicalization at all.

(31) a. Nej, jag har inte det. [Sw.]
no, I have not it
'No, I haven't'.

b. Nej, jag har det inte.
no, I have it not
'No, I don't have it'.

The unshifted order in (31a) is a possible answer to a question like *Have you been to Oslo?* whereas the shifted (31b) can only be used in reply to a question like *Har du brevet?* 'Do you have the letter?', in which case *ha* is a lexical verb. In (31b) *det* would refer to the just mentioned letter which has neuter gender in Swedish.[13]

The disambiguating effect can also be found with verbs that subcategorize for a single complement type but have more than one meaning. A case in point is the Swedish verb *tro* which translates into English either as 'think' or as 'believe'. In a corpus study, Andréasson and Engdahl (in prep.) have found that when the verb is used with the unshifted order, the example is best translated using 'think', and the shifted order is naturally translated using 'believe'.[14] The following examples are from a corpus of blog texts in *Korp*.[15]

(32) a. får se om jag hinner blogga mer senare, men jag tror inte det.
let see if I have time blog more later but I think not it
'Let's see if I have time to write more (in this blog) later, but I don't think so'.

b. man tror det inte förrän man ser det
one believes it not before one sees it
'You don't believe it until you see it'.

Andréasson and Engdahl (in prep.) investigate the correlation between the two orders and the factivity induced by the context.[16]

[13]A similar point is made by Ørsnes (2013:256) with respect to the polysemous Danish verb *agte* which translates as 'honour' when used with an NP and as 'intend' when used with a VP. The Swedish verb *bruka* 'use to', which we have shown is an XCOMP-taking verb, can also be construed with an NP denoting a substance, in which case it has the meaning 'use (a drug)'. This usage is much less common than the auxiliary use but the single example with the shifted order found in *Korp* has this meaning.

(i) jag förespråkar att cannabis ska bli lagligt å jag brukar det INTE själv idag :)
I advocate that cannabis shall become legal and I use it not self today
'I advocate legalizing cannabis (despite the fact that) I don't use it myself today.'

[14]As shown in the example in note 5.

[15]The effect of contrast noted in connection with example (8) does not affect the lexical meaning; this example is still best translated with 'think' despite the contrast induced shift.

[16]During the workshop, Helge Dyvik reported that he had found a similar difference in the Norwegian treebank *NorGramBank* and suggested that the unshifted *det* refers to an activated proposition whereas a shifted *det* is more likely to refer to a recent speech act. This distinction seems to be relevant for some of the Swedish data as well.

7 Concluding remarks

We account for syntactic constraints on OS in Swedish by distinguishing types of clausal complements, OBJ, COMP and XCOMP. We assume that *equi* verbs take COMP with obligatory anaphoric control, distinguishing them from *raising* verbs that take XCOMP with functional control. Following Lødrup (2012b), we assume that the proform *det* in Swedish is specified for the function that corresponds to the clausal subcategorization of the verb it occurs with. We thus have the following types of *det*: det_{OBJ}, $det_{\text{OBJ-OAC}}$, det_{COMP}, $det_{\text{COMP-OAC}}$ and det_{XCOMP}.

Our investigation of the distribution of *det* has revealed that det_{XCOMP} cannot appear in shifted position and we account for this by a phrase structure restriction, assuming the clause structure proposed in Sells (2001): PRO_{Wk} [under I] is restricted to closed functions. This means that det_{XCOMP} cannot appear there. This is a syntactic constraint which cannot be mitigated by information structure, e.g. contrastive stress, which has been found to affect when det_{COMP} and $det_{\text{COMP-OAC}}$ appear in shifted position.

Although we have emphasized the importance of this syntactic constraint in this paper, we are convinced that in order to get a full understanding of when object shift can, must or cannot apply, one needs to take into account information structural aspects as well as the prosodic realization of the utterances (see e.g. Josefsson 2010 and Erteschik-Shir et al. 2020). Several factors have been identified in the studies mentioned in the introduction. It has been observed that sentential anaphors shift less easily than entity anaphors and that factivity seems to play a role. It might be that what unifies these different cases is that OS is dispreferred when the anaphor is less easy to interpret, for example when more processing is required to get from the anaphor to its antecedent, either because the antecedent might not be in the center of attention of the listener or because the relation between the anaphor and the antecedent is not one of simple coreference.

It is, however, not clear how this generalization would account for the syntactic constraint we discuss in this paper. One way would be to postulate that processing an open function requires the further operation of calculating a proposition from a property by filling in the missing argument (as in *raising* with functional control). But it is not immediately clear why that should be more difficult than filling in the value of a PRO (as in *equi* with anaphoric control). We have to leave this for further study. What is clear is that many different factors play a role in determining whether OS is felicitous or not. It is thus not surprising that most recent analyses of object shift use Optimality Theory to model the interaction between different types of constraints, see e.g. Sells (2001), Andréasson (2013), Engels and Vikner (2013, 2014) and Ørsnes (2013).

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Mapping Theory and the anatomy of a verbal lexical entry

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Abstract

This paper presents a new formal framework within which to implement (Lexical) Mapping Theory. It differs from previous accounts in that it is expressed in terms of vanilla LFG+Glue, rather than relying on any additional, bolted-on formal machinery.

1 Introduction

This paper proposes a new set of tools for describing the mappings between semantic arguments and their grammatical functions, the kind of linkings that are standardly handled in LFG by (Lexical) Mapping Theory (LMT).[1] Although I make some specific theoretical assumptions here – both for the sake of concreteness, and as a contribution to one particular strand of research – it is worth highlighting that the tools I describe in this paper are compatible with a number of different versions of LMT. As such, these proposals should be of interest even to those coming from quite different theoretical backgrounds.

The theoretical assumptions I make here are of two types. Firstly, the underlying theory of LMT I will be assuming is that of Kibort (2001, 2007, 2014), with some adjustments as described in Findlay (2016). Secondly, I will follow the architectural assumptions of a strand of research originating with Asudeh & Giorgolo (2012), namely that LFG does not require a dedicated level of a(rgument)-structure, since the same results can be achieved by using Glue Semantics and a more articulated s(emantic)-structure (on which see e.g. Asudeh et al. 2014, Findlay 2016, Lowe 2014, 2015, Lovestrand 2018). That research also emphasises the use of *templates* (Dalrymple et al. 2004, Crouch et al. 2017), labelled chunks of functional description, as a means of modularising the lexicon and capturing generalisations. The present work shares this focus, whilst also highlighting the role of templates in presenting complex formalism in a more user-friendly format.

The main goal of this paper is to describe a set tools which allows LMT to be implemented using only the vanilla LFG+Glue formalism, with no additional formal machinery required. Although the modular architecture of LFG allows for different levels of representation to have their own formal properties, I believe that

[†]This work has benefitted enormously from conversations over the years with Ash Asudeh, Miriam Butt, Anna Kibort, Joey Lovestrand, and John Lowe, to whom I wish to express my thanks. They won't agree with all I have to say here, however, and of course bear no responsibility for any errors. I would also like to thank the two reviewers for their detailed comments on an earlier draft: the present paper has been incalculably improved as a result.

[1]There are various names for the theory of the mapping between arguments and grammatical functions in the LFG literature: Lexical Mapping Theory is perhaps the most widespread, although several scholars have pointed out the problems with seeing the theory as applying purely in the lexicon (e.g. Butt 1995, Alsina 1996), and so often the 'Lexical' is dropped, giving us 'Mapping Theory' *tout court* (as in e.g. Kibort & Maling 2015). Other names include Functional Mapping Theory (e.g. Alsina 1996) and Linking Theory (e.g. Butt et al. 1997). In this paper I use 'LMT' as a cover term, without taking a particular position on what the theory ought ultimately to be called.

we should prefer sparser theories, all things being equal, and so if we can do without these extra mechanisms, we should. What is more, if new objects or operations are introduced into the framework, their formal properties should be rigorously defined, and this has not always been the case with LMT proposals.

In Section 2, I discuss some preliminaries, about LMT and about the use of templates. Sections 3 and 4 give the formal details of my proposal. Section 5 shows how this can be used to represent Kibort-LMT, and then Section 6 examines argument alternations using that theory. Section 7 concludes.

2 Background

2.1 Three facets of LMT

In this section, I will discuss what I believe are the three basic components of LMT, and, in so doing, offer some concrete points of departure for my own proposals.

2.1.1 Linking

In broadly theory-neutral terms, LMT is a theory of the linking between semantic arguments and grammatical functions. But already at this very abstract level there are technical questions: how should we actually implement this linking? Most work in LMT (e.g. Bresnan & Kanerva 1989), including the most fully developed modern implementation, that of Kibort (2001, 2007, *et seq.*), leaves the mapping relation totally unanalysed, and says nothing about how it is to be integrated into the LFG architecture. This is clearly problematic from the point of view of formalisation. Butt et al. (1997) were the first to take this problem seriously, proposing that linking is codescription – specifically, a set of constraints which describe the correspondence between a-structure and f-structure. Although Asudeh & Giorgolo (2012) highlight a number of problems with the architecture proposed by Butt et al. (1997) (see Findlay 2016: 303–309 for discussion), they also agree that linking should be handled by codescription, and this is the approach I will take here as well. As mentioned earlier, I assume that a-structure has been replaced by a connected s-structure, and so the mapping equations will describe the relation between f-structure and s-structure, via the σ-projection. This means that the functional description for a given analysis will contain equations like (1), which says that the AGENT argument of a predicate is associated with the SUBJ GF:

(1) $(\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma \text{AGENT})$

Knowing what the nature of the relation between arguments and GFs is is one fundamental component of LMT. But it doesn't address the question of how we decide which GFs are linked with which arguments. There are two aspects to this. Firstly, we need an account of the *possible* GFs an argument can be associated with, incorporating a degree of flexibility to allow for argument alternations; secondly, we need a way of resolving this indeterminacy so that we arrive at the final mapping.

2.1.2 Mapping possibilities

The first of these challenges is generally met in LMT by associating each argument with a pair of GFs, via a feature decomposition which breaks GFs down into purportedly natural classes. The standard breakdown of GFs is as follows (Bresnan & Kanerva 1989: 24f.):

(2)

	$-r$	$+r$
$-o$	SUBJ	OBL_θ
$+o$	OBJ	OBJ_θ

Each argument can then be associated with a single feature, say $[-o]$, which allows it to be realised as one of the two compatible GFs, in this case SUBJ or OBL_θ. This is often done on the basis of intrinsic classifications, e.g. Agent-like arguments are intrinsically $[-o]$, Patient-like arguments are $[-r]$, etc. There is also scope for cross-linguistic variation in how different kinds of arguments are classified.

There are certain unanswered questions about the exact status of these features (see Findlay 2016: 298f. for some discussion), and about whether they have any real explanatory value (does saying an argument is $[+o]$ say anything more than that it is realised as an OBJ or OBJ_θ?). As Findlay (2016: 299) concludes, however, all that is essential is just that each argument should be associated with a pair of GFs, and we can achieve this in a more explicit way by simply defining four abbreviations:

(3) a. $\text{MINUSO} \equiv \{\text{SUBJ} \mid \text{OBL}_\theta\}$
    b. $\text{PLUSO} \equiv \{\text{OBJ} \mid \text{OBJ}_\theta\}$
    c. $\text{MINUSR} \equiv \{\text{SUBJ} \mid \text{OBJ}\}$
    d. $\text{PLUSR} \equiv \{\text{OBJ}_\theta \mid \text{OBL}_\theta\}$

Of course, insofar as the feature decompositions really do capture natural classes, this arbitrary listing is unsatisfactory. However, as a reviewer laments, the features $[\pm o/r]$ in fact describe an unnatural class (no alternation involves the two $[+r]$ GFs, OBJ_θ and OBL_θ) and also fail to describe a natural class, that of *terms* or *direct* GFs, *viz.* SUBJ, OBJ, and OBJ_θ (Alsina 1996: 29, fn. 9). Other feature decompositions are certainly possible (Alsina 1996: 19f. uses the features $[\pm\text{obl/subj}]$, for instance), and may be more satisfactory from a descriptive point of view, but using explicit disjunctions is the more conservative approach: at worst we are missing a more profound explanation for our generalisations (though we can still express such generalisations), but this is preferable to introducing new entities to our formal ontology which may not be well motivated. And although there may be issues with it, the $[\pm o/r]$ decomposition, and thus the groupings given in (3), is still very much the orthodox view (it is the one presented in textbooks/handbooks such as Bresnan et al. 2016: Ch. 14, Dalrymple et al. 2019: Ch. 9, and Börjars et al. 2019: Ch. 8, for instance), and so it is the system I will work with here.

2.1.3 Mapping resolution

Once we have associated each of a predicate's arguments with a pair of GFs, the final step in mapping is to resolve this indeterminacy and select a single GF for each. How is this done?

All versions of LMT appeal to some kind of ranking of a-structure arguments, along with a ranking of GFs. Often these take the following forms:

(4) **Thematic hierarchy** (Bresnan & Kanerva 1989: 23)
Agent > Beneficiary > Recipient/Experiencer
> Instrument > Theme/Patient > Location

(5) **Grammatical function hierarchy** (Bresnan & Zaenen 1990: 49)
$\text{SUBJ} > \text{OBJ}, \text{OBL}_\theta > \text{OBJ}_\theta$

Mapping is then a question of correctly harmonising these two hierarchies. In classical LMT (Bresnan & Kanerva 1989, Bresnan & Zaenen 1990), arguments in a-structure are ordered left-to-right according to their position in the thematic hierarchy (with the leftmost argument having the highest thematic role). Various *Mapping Principles* then assign mappings according to certain ranking properties: if the leftmost argument is $[-o]$, it is mapped to SUBJ, otherwise a $[-r]$ argument is; of the remaining arguments, the highest thematic roles are mapped to the lowest GFs compatible with their intrinsic features.[2]

The use of a thematic hierarchy for these purposes is hugely problematic, however. As has been frequently discussed, a satisfactory list of thematic roles has never been given (Dowty 1991, Davis 2011), and even when a set of roles is agreed on, different phenomena seem to call for different orderings in the hierarchy (Rappaport Hovav & Levin 2007), all of which renders the explanatory power of a purportedly universal thematic hierarchy highly suspect. For this reason, Kibort (2007) advocates a separation of a-structure argument positions from thematic roles (a return to the earlier LFG position of e.g. Bresnan 1982), with a-structures instead containing *sui generis* argument positions, drawn from a universally available set of ordered arguments, each intrinsically associated with one of the LMT mapping features (arg_1 is normally associated with $[-o]$, but $[-r]$ is used for unaccusatives):

(6)
$$\left\langle \begin{array}{cccccc} \text{arg}_1 & \text{arg}_2 & \text{arg}_3 & \text{arg}_4 & \ldots & \text{arg}_n \\ [-o]/[-r] & [-r] & [+o] & [-o] & & [-o] \end{array} \right\rangle$$

This allows Kibort to reduce the classical LMT Mapping Principles to a single principle: the highest arguments are mapped onto the *highest* compatible GFs.

However, both the classical and the modern approaches to LMT suffer from

[2] Classical LMT also requires two well-formedness principles to rule out some unwanted mappings that would otherwise be licensed by the Mapping Principles. Firstly, the *Subject Condition* ensures that there must be a SUBJ. Secondly, *Function-Argument Biuniqueness* ensures that no two arguments map to the same GF, and vice versa. Kibort's version of LMT makes the Subject Condition redundant, and the proposals in this paper also make Function-Argument Biuniqueness unnecessary.

what seems to me a critical flaw: the actual application of the Mapping Principle(s) happens ‘off stage’. There is no explanation of how the harmonisation between the two hierarchies (whichever two are used) might be achieved using the existing LFG machinery, and in fact no formal details of the implementation are usually given at all. Once again, Butt et al. (1997) are the exception here, since they give an explicit algorithm for resolving the final mapping. But their approach uses a separate system which is wholly outside of the LFG architecture. It seems to me something of an embarrassment for LMT that carrying out its very *raison d’être*, determining the linking between semantic arguments and GFs, must ultimately be outsourced. It would be far better if LFG were able to do the heavy lifting ‘in house’, and one of the goals of this paper is to show that this is indeed possible.

2.2 Modularisation of the lexicon

The other goal is to show that such a theory can be developed in a way which contributes to the ongoing project of modularising the lexicon. This refers particularly to the use of *templates* (Dalrymple et al. 2004, Crouch et al. 2017) to factor out information and allow generalisations to be expressed.

A template is just an abbreviation for a piece of functional description. It can be used to label annotations which often appear together, for example. (7) is a very simple lexical entry for the third-person singular verb form *protects* in English:

(7) protects V $(\uparrow \text{PRED}) = \text{‘protect’}$
$(\uparrow \text{TENSE}) = \text{PRESENT}$
$(\uparrow \text{SUBJ NUM}) = \text{SG}$
$(\uparrow \text{SUBJ PERS}) = 3$

Since any third-person singular verb form in English will also contain the final two lines, we can bundle them together into a template called 3SG:

(8) $3\text{SG} :=$
$(\uparrow \text{SUBJ NUM}) = \text{SG}$
$(\uparrow \text{SUBJ PERS}) = 3$

Then we can rewrite the lexical entry using this template:

(9) protects V $(\uparrow \text{PRED}) = \text{‘protect’}$
$(\uparrow \text{TENSE}) = \text{PRESENT}$
@3SG

The @ symbol is prefixed to a template name to ‘call’ it. Calling a template just replaces it with its contents. The lexical entries in (7) and (9) are therefore extensionally equivalent – they contain the same functional description – it’s just that the latter expresses a generalisation rather more transparently. Templates can also be made more flexible by parametrising them. (10) gives a very simple example:

(10) $\textsc{Tense}(X) :=$
$(\uparrow \textsc{tense}) = X$

This template can be called with an argument, and that argument will appear as the value of $\uparrow$'s TENSE feature. We can thus further modify our running example:

(11) protects V $(\uparrow \textsc{pred}) =$ 'protect'
@$\textsc{Tense}(\textsc{present})$
@3SG

There are a number of advantages, both practical and theoretical, to using templates to break down lexical entries in this way. Firstly, they make grammar engineering much more robust, since if something needs to be changed in a grammar a single template definition can be modified, rather than having to go in and change every relevant lexical entry individually, which would inevitably lead to errors. Secondly, they can make analyses more readable and make theoretical tools more user friendly, by concealing formal 'gore' but leaving the theoretically interesting claims exposed. This is akin to how modern programming languages abstract away from the machine code which ultimately implements a program. This kind of motivation has been present in LFG since the start – for example, in the use of the more readable $\uparrow$ to abbreviate the clunkier $\phi(\mathcal{M}(*))$. We can see a thoroughgoing templatic approach as offering an interface to the LFG formalism which is easier for the theorist to work with. Lastly, templates can make important empirical generalisations easier to see and easier to represent. By searching for ways to abbreviate lexical entries, we can be led to notice where they share information and where they differ from one another – and where they do differ, if they do so only in limited ways (where a template could be parametrised) or more profoundly. In this way, templates can also help mark the distinction between formalism and theory: while the LFG formalism itself places relatively weak limitations on what can be expressed, our choice of basic templates can impose strong limits.

The rest of this paper will present an analysis of verbal lexical entries whereby they can be broken down into the following parts:

(12) verb V **[core information]**
[valency information]
[argument alternations]
[other information]

The first three parts of the functional description are the focus of this paper, since they relate to mapping. Each verb must contain some core information about the relation it expresses. What exactly this encompasses is the focus of Section 3. It must also contain information about its valency: this part of the entry identifies the arguments of a predicate, what roles they play in the eventuality described by the predicate, and how they are realised syntactically; Section 4 details how this is accomplished. In addition to a verb's basic/underived valency frame, there can also be extra information realising various morphosyntactic argument alternations, like the passive. Section 6 addresses this component. Finally, there will be other information – about agreement, for example, or relating to idiosyncratic features of the particular verb. Here too it is to be hoped that sub-regularities can be found which can then be factored out into templates (as with the example of 3SG above), but this will not be my focus here.

3 Core information

There are two sides to the core information section of a verbal lexical entry. On the grammatical side, the entry must provide a PRED value for f-structure, and a REL value for s-structure. On the meaning side, it must provide a meaning constructor expressing what kind of eventuality the verb denotes.

The current status of PRED and REL is far from settled: many if not all of the important functions of PRED have been taken over by Glue Semantics (Andrews 2008), and REL really has no substantive role in the theory (Lovestrand 2018: 169ff.; although see Lowe 2014), but I include both for consistency with other work which makes use of them. Assuming that PRED and REL always have the same value (Lovestrand 2018: 170), the grammatical side of things can easily be expressed in a template PRED-REL:

(13) $\text{PRED-REL}(X) :=$
$(\uparrow \text{PRED}) = \text{`}X\text{'}$
$(\uparrow_\sigma \text{REL}) = X$

We can then combine this with the meaning constructor in a template VERB-LEXEME:[3]

(14) $\text{VERB-LEXEME}(\textit{pred-rel}, \textit{meaning}) :=$
$\textbf{@}\text{PRED-REL}(\textit{pred-rel})$
$\lambda e.\textit{meaning}(e) : (\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma$

Let us take the verb *give* as our running example going forward. Its core information would be expressed as in (15), which is equivalent to (16):

(15) give V $\textbf{@}\text{VERB-LEXEME}(\text{give}, \mathbf{give})$

(16) give V $(\uparrow \text{PRED}) = \text{`give'}$
$(\uparrow_\sigma \text{REL}) = \text{give}$
$\lambda e.\mathbf{give}(e) : (\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma$

[3] I am making a number of simplifying assumptions here. Firstly, there are well-known problems with treating verbal meanings as being of type $\langle v, t\rangle$ relating to scopal interactions (or the lack thereof), and we should instead use a higher type $\langle\langle v, t\rangle, t\rangle$, as advocated by Champollion (2015). But for the sake of simplicity I stick to the lower type here, since this is not a focus of the present paper. Secondly, the meaning constructor assumes that the verb denotes a predicate of *events*, and ignores *states* – stative verbs will require a subtly different treatment, and this distinction could easily be factored out by using further templates.

4 Valency information

The valency information of a verb has five parts, which will be presented in turn:

1. A meaning constructor which connects the arguments to the event described by the verb.
2. A set of existential constraints, requiring the presence of these arguments.
3. An expression identifying the default logical subject.
4. A set of DEFAULT-MAPPING templates, determining the default linking between the arguments and their GFs.
5. A set of PREFERRED-MAPPING templates, which implement LMT's Mapping Principle(s).

4.1 Valency meaning constructor

The valency meaning constructor consumes a verbal meaning and returns a new meaning constructor which consumes the arguments of the verb. In other words, it raises the type of the verb from the simple $\langle v, t\rangle$ to a higher type with more dependents: $\langle \tau_1, \ldots, \tau_n, \langle v, t\rangle\rangle$, where τ_1 is the type of the first argument, and τ_n the type of the last argument. For our running example, this will be (17):

(17)
$$\begin{array}{l} \lambda P \lambda x \lambda y \lambda z \lambda e. P(e) \wedge \mathbf{agent}(e, x) \wedge \mathbf{theme}(e, y) \wedge \mathbf{beneficiary}(e, z) : \\ \quad [(\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma] \multimap \\ \quad (\uparrow_\sigma \text{ AGENT}) \multimap (\uparrow_\sigma \text{ THEME}) \multimap (\uparrow_\sigma \text{ BEN}) \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma \end{array}$$

I use thematic role names to label s-structure arguments purely for readability; this choice has no theoretical significance, and I continue to assume, following e.g. Kibort (2007) and Asudeh & Giorgolo (2012), that thematic role information is best left out of the grammar itself and relegated to the meaning language (see also Findlay 2016: 314). The choice of s-structure argument labels is arbitrary, and we could as well have used ARG1, ARG2, etc. – the reason I have not done so here is in order to avoid confusion with the argument positions in Kibort's valency frame. In Findlay (2016), I took the two to be equivalent, but this is an unnecessary restriction to impose on the formalism, and one which weds it too closely to one particular theory. We will see below how that information can instead be encoded using local names if we wish to implement Kibort's theory.

4.2 Existential constraints

Once again in contrast to Findlay (2016: 320, fn. 19), I do not assume that being mentioned in a meaning constructor is sufficient for an attribute to appear at s-structure. Instead, the lexical entry for a verb also includes an existential constraint for each of the arguments mentioned in the valency meaning constructor, requiring its presence. A constraint like '$(\uparrow_\sigma$ AGENT$)$' requires there to be a positive specification somewhere in the functional description which provides the contents of the AGENT argument position at s-structure. The normal way for this to happen is for the argument to be linked to a GF – then a lexically-specified REL value can be passed on. These existential constraints therefore effectively require that the arguments they mention participate in mapping, unless some argument suppressing operation can be appealed to.

4.3 Specification of logical subject

Many mapping theories appeal to a privileged, 'most prominent', argument structure position, sometimes called the *logical subject*, and also denoted $\hat{\theta}$, for 'highest thematic argument' (Bresnan & Kanerva 1989, Alsina 1996: 36f.). By analogy with Falk's (2006) $\widehat{\text{GF}}$, I propose to call this position $\widehat{\text{ARG}}$. Part of the valency information encoded in a verbal lexical entry includes which of its arguments is, by default, the logical subject:

(18) $\text{DEFAULT-}\widehat{\text{ARG}}(arg) :=$
$\big\{(\uparrow_\sigma \widehat{\text{ARG}}) = (\uparrow_\sigma arg) \,|\, (\uparrow_\sigma \widehat{\text{ARG}})\big\}$

This uses the basic approach to defaults described by Dalrymple et al. (2004: 205f.): the left hand disjunct must be true unless something else provides the appropriate information, in which case the right-hand side can be true instead – in other words, the left-hand disjunct will hold by default. The reason we cannot specify the logical subject once and for all is that certain processes, like causativisation, can add a new logical subject, which therefore overrides the default.[4]

In most formulations of LMT, the choice of logical subject follows from other properties – usually from the ranking of arguments according to the thematic hierarchy. Here we merely stipulate it, which may seem unsatisfactory by comparison. However, recall that there is no agreed-upon/adequate thematic hierarchy, and so appeals to such a mechanism are in fact spurious. Once again, I take the conservative view that encoding this information directly in the lexical entry is not a bad thing for the time being. It may well be that this information can be made to follow from other properties, especially if the contents of s-structure is further developed, for example to include proto-role information. Until then, the direct lexical specification can be taken as a stand-in for whatever the proper mechanism is.

With that said, we can still capture certain generalisations by using templates, so that what counts as the logical subject is not precisely a matter of *lexical* stipulation; rather, it will be a property shared by certain kinds of verbs that express the same kinds of thematic roles. For example, our running example of *give* is a verb which takes an Agent, a Theme, and a Beneficiary argument, and whichever argument corresponds to the Agent will be the default $\widehat{\text{ARG}}$. *Give* will share the valency information we have described so far with other verbs like it, a fact we can capture in a template called by all such verbs:

[4]Although many complex predicates can be handled straightforwardly, along the same lines as Lowe (2015), recursive causatives will cause problems, and this is an area that needs further work.

(19) $\textsc{Agent-Theme-Benef-Verb}(\mathit{arg1}, \mathit{arg2}, \mathit{arg3}) :=$

$$\lambda P \lambda x \lambda y \lambda z \lambda e. P(e) \wedge \mathbf{agent}(e,x) \wedge \mathbf{theme}(e,y) \wedge \mathbf{beneficiary}(e,z) :$$
$$[(\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma] \multimap$$
$$(\uparrow_\sigma \mathit{arg1}) \multimap (\uparrow_\sigma \mathit{arg2}) \multimap (\uparrow_\sigma \mathit{arg3}) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$$

$$(\uparrow_\sigma \mathit{arg1}) \wedge (\uparrow_\sigma \mathit{arg2}) \wedge (\uparrow_\sigma \mathit{arg3})$$

$$@\textsc{Default-}\widehat{\textsc{arg}}(\mathit{arg1})$$

4.4 Default mapping

In Section 2.1, we identified two tasks for a mapping theory: to associate an argument with a pair of GFs, and then to decide between those GFs in different situations. In the present proposal, I divide up the task slightly differently. Instead of describing a set of possible GFs and then deciding between them, we will first describe, for each argument, a *default* mapping to a GF, and then we will describe a *preferred* mapping. This reflects the two-dimensional information present in many LMT a-structure representations, owing to the ranking of the arguments alongside their association with a pair of GFs.

For example, because Kibort's Mapping Principle links the highest arg positions to the highest GFs, each position below arg_1 in Kibort's theory is essentially in competition with some higher arg position:[5]

- arg_2 would prefer to be a SUBJ, the highest ranked $[-r]$ GF, but is generally blocked from doing so by arg_1, and so defaults to OBJ.
- arg_3 would prefer to be an OBJ, the highest ranked $[+o]$ GF, but is generally blocked from doing so by arg_2, and so defaults to OBJ_θ.
- arg_4 would prefer to be a SUBJ, the highest ranked $[-o]$ GF, but is generally blocked from doing so by arg_1, and so defaults to OBL_θ.

The next section explains how the preferred mapping is handled; in this section I show how we can achieve the default effect. In order to do this, we make use of a two-member disjunction, as we did when describing the default logical subject. The contents of this disjunction are given by the template DEFAULT-MAPPING, which takes three parameters: the default GF, the argument name, and a disjunction identifying the set of *disallowed* GFs (e.g. if the argument is assigned to the $[-r]$/MINUSR pair of GFs in the Kibort mapping theory, this parameter will be set to PLUSR):

(20) $\textsc{Default-Mapping}(\mathit{default\text{-}GF}, \mathit{arg}, \mathit{disallowed\text{-}GFs}) :=$

$$\left\{ @\textsc{Map}(\mathit{default\text{-}GF}, \mathit{arg}) \;\middle|\; \begin{array}{l} \neg @\textsc{Map}(\mathit{default\text{-}GF}, \mathit{arg}) \\ \neg @\textsc{Map}(\mathit{disallowed\text{-}GFs}, \mathit{arg}) \end{array} \right\}$$

[5] I follow Findlay (2016: 317f.) in assuming that only the first four arguments in Kibort's valency frame participate in mapping and in argument alternations, the others being treated as 'derived arguments' (Needham & Toivonen 2011) and added via various lexical or syntactic processes.

Let us look at an example to see how this works. First of all, though, we need to define the MAP template. It maps its first parameter, a grammatical function *GF*, to its second parameter, an s-structure argument *arg*.

(21) $\textsc{Map}(GF, arg) :=$
$(\uparrow GF)_\sigma = (\uparrow_\sigma arg)$

Consider the case of a Kibort arg_2, i.e. a $[-r]$ argument, and assume it is associated with a THEME argument at s-structure. Then we would call the template like this:

(22) $@\textsc{Default-Mapping}(\textsc{obj}, \textsc{theme}, \textsc{plusr})$

When expanded, this gives us the following:

(23) $$\left\{ @\textsc{Map}(\textsc{obj}, \textsc{theme}) \;\middle|\; \begin{matrix} \neg @\textsc{Map}(\textsc{obj}, \textsc{theme}) \\ \neg @\textsc{Map}(\textsc{plusr}, \textsc{theme}) \end{matrix} \right\}$$

This disjunction requires either that OBJ is mapped to the THEME argument, or alternatively that neither OBJ nor one of the $[+r]$ GFs, $\textsc{obj}_\theta$ or $\textsc{obl}_\theta$, is mapped to it – which leaves only one option for mapping: SUBJ. Crucially, though, this non-canonical mapping is only indirectly licensed: it is given in negative rather than positive terms. This is what induces the 'default' behaviour: in the absence of further information, the first disjunct must be true, since the existential constraint introduced in the verb's valency template requires that there be *some* positive specification of the mapping for the THEME argument. If we try to make the second disjunct true, we end up with a collection of negative constraints but no positive ones, and so the relevant existential constraint is not satisfied. Thus, without further specification – from an argument alternation like passive, for example – the default mapping prevails.

The DEFAULT-MAPPING template gives us a general tool for associating an argument with a pair of GFs, where one of them is identified as a default – i.e. the GF to which the argument will normally be linked, all things being equal. This can be used to implement any number of specific theories about the actual connections between arguments and GFs. In Section 5, it will be one of the tools we use to implement Kibort's version of LMT. For now, though, we need one additional tool: a means of capturing the competition between arguments for GFs.

4.5 Preferred mapping

Of course, arguments do not always surface as their default GFs. There is usually another GF which an argument will surface as if it is given the opportunity to – for example, because another argument has been suppressed or had its mapping possibilities altered by some morphosyntactic process. We call this the argument's preferred GF. For example, as I described earlier, a Kibort arg_2 will surface as a SUBJ if nothing else has a better claim to the SUBJ position, i.e. if arg_1 does not take it (because there is no arg_1 or because it is suppressed by passive, etc.). To capture this fact, we define a template PREFERRED-MAPPING, intended to be used alongside a call of the DEFAULT-MAPPING template which involves the same argument. The PREFERRED-MAPPING template takes two parameters: the preferred GF of an argument, and the name of that argument.

(24) $$\text{PREFERRED-MAPPING}(GF, arg) :=$$
$$\left\{ (\uparrow GF)_\sigma = (\uparrow_\sigma arg) \;\middle|\; \begin{array}{c} (\uparrow GF) \\ (\uparrow GF)_\sigma \neq (\uparrow_\sigma arg) \end{array} \;\middle|\; @\text{NOMAP}(\text{arg}) \right\}$$

To see how this works, let us again look at the example of an arg_2 THEME in Kibort's LMT. The appropriate template call for this situation is given in (25):

(25) $$@\text{PREFERRED-MAPPING}(\text{SUBJ}, \text{THEME})$$

When expanded, this gives the following:

(26) $$\left\{ (\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma \text{THEME}) \;\middle|\; \begin{array}{c} (\uparrow \text{SUBJ}) \\ (\uparrow \text{SUBJ})_\sigma \neq (\uparrow_\sigma \text{THEME}) \end{array} \;\middle|\; @\text{NOMAP}(\text{THEME}) \right\}$$

This disjunction offers us three possibilities:

1. The THEME argument is mapped to SUBJ (its preferred GF).
2. Something else is mapped to SUBJ (i.e. there is a SUBJ but it isn't the THEME argument).
3. The THEME argument is not mapped to any GF.

The third option is realised by a template NOMAP, defined in (27):

(27) $$\text{NOMAP}(arg) :=$$
$$(\uparrow_\sigma arg)_{\sigma^{-1}} = \varnothing$$

It describes a situation where no GF is linked to the argument in question (by stating that the inverse of the σ-projection, taking us from s-structure to f-structure, is empty when applied to it). This will only be relevant in cases of argument suppression, since otherwise the existential constraint on the argument in question introduced in the verb's valency template will require that *something* maps to it. We will discuss argument suppression in Section 6.2, but for now we can safely ignore this option, meaning our choice is between the first two disjuncts.

In the canonical mapping for a transitive verb like *kill*, which has an arg_1 and an arg_2 in Kibort-LMT terms, the arg_1 will map to SUBJ. This means that the first disjunct in (26) cannot be true, since the σ-projection is a function, and so it cannot link the same f-structure element to multiple s-structure elements.[6] That means that in the canonical/default situation, the second disjunct must be true. All this does is add yet another negative constraint to the mapping possibilities for this

[6]Note that this makes at least one component of Function-Argument Biuniqueness otiose. The other part, prohibiting multiple GFs from mapping to the same argument, is not necessary either, provided that the grammar simply never makes such possibilities available: in the present proposal, the only mapping possibilities are those explicitly introduced in the mapping templates.

argument, which once again means it is the first disjunct of the relevant DEFAULT-MAPPING template which must hold, since that remains the only positive mapping specification available for the argument in question.

The existential constraint introduced in the second disjunct ensures that the default mapping only obtains if this argument's preferred GF is not available. If nothing else maps to SUBJ, then the THEME argument should do so – that's what it means for it to be the argument's preferred GF. If that does not happen, then there will be no SUBJ, which means the second disjunct here will be rendered false because the existential constraint will not be satisfied.

Overall, the PREFERRED-MAPPING template gives us a means of associating an argument with a preferred GF – one which it will map to if given the opportunity, i.e. if nothing else is required to map to it in preference. Combined with the DEFAULT-MAPPING template, this allows us to simulate the effects of a hierarchy of arguments/GFs, commonly appealed to in LMT.

5 Kibort-LMT

In this section, I will show how we can implement (a version of) Kibort's LMT, using the tools developed in the previous section. Each of the positions in Kibort's valency frame provides a default and a preferred GF, which we now have the means to represent. What is more, each position can be referred to by other processes, e.g. locative inversion adds a $[+o]$ specification to arg_1 specifically, and so we also need a means of labelling each argument position. We achieve this using *local names* (Crouch et al. 2017). A local name, indicated by a prefixed $\%$, is essentially a variable name: it allows for a particular entity to have a name which can be used to refer to it within the same local description – here this will mean the same lexical entry. This enables other templates, e.g. those encoding morphosyntactic argument-manipulating operations, to refer to specific argument positions by name.

We define a template for each of the arg positions. These templates take a single parameter: the name of an s-structure argument. For the first position in Kibort's valency frame, arg_1, we include only a default mapping, not a preferred one, since its default is already the highest available GF. Arg_1 can have two specifications. Normally it will be $[-o]$:

(28) $\text{ARG1}(\textit{arg}) :=$
$\text{@DEFAULT-MAPPING}(\text{SUBJ}, \textit{arg}, \text{PLUSO})$
$\textit{arg} = \%\text{arg1}$

For unaccusatives, however, it is $[-r]$:

(29) $\text{ARG1-UNACCUSATIVE}(\textit{arg}) :=$
$\text{@DEFAULT-MAPPING}(\text{SUBJ}, \textit{arg}, \text{PLUSR})$
$\textit{arg} = \%\text{arg1}$

I defer discussion of arg_2 momentarily, since it involves a small additional complexity. The other two arg positions are straightforward, however:[7]

(30) $\textsc{Arg3}(\mathit{arg}) \coloneqq$
$\text{@}\textsc{Default-Mapping}(\textsc{obj}_\theta, \mathit{arg}, \textsc{minuso})$
$\text{@}\textsc{Preferred-Mapping}(\textsc{obj}, \mathit{arg})$
$\mathit{arg} = \%\text{arg3}$

(31) $\textsc{Arg4}(\mathit{arg}) \coloneqq$
$\text{@}\textsc{Default-Mapping}(\textsc{obl}_\theta, \mathit{arg}, \textsc{pluso})$
$\text{@}\textsc{Preferred-Mapping}(\textsc{subj}, \mathit{arg})$
$\mathit{arg} = \%\text{arg4}$

The arg_2 position requires one extra constraint, which is boxed in (32):

(32) $\textsc{Arg2}(\mathit{arg}) \coloneqq$
$\text{@}\textsc{Default-Mapping}(\textsc{obj}, \mathit{arg}, \textsc{plusr})$
$\text{@}\textsc{Preferred-Mapping}(\textsc{subj}, \mathit{arg})$
$\boxed{(\uparrow \textsc{subj})_\sigma \neq (\uparrow_\sigma \mathit{arg}) \Rightarrow (\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \widehat{\textsc{arg}})}$
$\mathit{arg} = \%\text{arg2}$

This conditional constraint (Bresnan et al. 2016: 60f.) says that if this argument is not mapped to SUBJ, then the argument that is must be the $\widehat{\text{ARG}}$. Since the logical subject is the highest ranked argument in a-structure, this means that the only time the arg_2 won't map to SUBJ is when the (higher ranked) arg_1 does. This gives arg_2 priority for the subject slot over arg_4, correctly capturing their hierarchical ranking.

Let us illustrate how these templates can be used via our running example. *Give* participates in the dative shift alternation, which means that in Kibort-LMT terms it has two possible argument structures and corresponding alignments of semantic arguments with arg positions:

(33) a. $\text{Odo}_{\text{arg}_1}$ gave a $\text{gift}_{\text{arg}_2}$ to $\text{Kira}_{\text{arg}_4}$.
$\langle\ \text{arg}_1\ \ \text{arg}_2\ \ \text{arg}_4\ \rangle$
$[-o]\ \ [-r]\ \ [-o]$

b. $\text{Odo}_{\text{arg}_1}$ gave $\text{Kira}_{\text{arg}_2}$ a $\text{gift}_{\text{arg}_3}$.
$\langle\ \text{arg}_1\ \ \text{arg}_2\ \ \text{arg}_3\ \rangle$
$[-o]\ \ [-r]\ \ [+o]$

Here the dative-shifted version (33b) completely replaces one argument (arg_4) with another (arg_3), and also realigns the participants – the Theme, *a gift*, is now an arg_3, and arg_2 represents the Beneficiary, *Kira*, when in (33a) it was arg_2 which corresponded to the Theme and arg_4 which represented the Beneficiary. In order to capture this in the current system, we give both options in a disjunction:[8]

[7] It is not altogether clear whether arg_3 ever actually participates in any (strictly morphosyntactic) alternations. For example, the Patient/Theme argument of the Chichewâ instrumental applicative can never trigger the appearance of an object marker on the verb, even in the passive (Alsina & Mchombo 1993), which means that even when the active-voice object is promoted to subject, the Patient/Theme argument remains an $\textsc{obj}_\theta$, and does not occupy the now vacant OBJ position. If this pattern obtains generally, then it might be sensible to simply specify arg_3 concretely as an $\textsc{obj}_\theta$, and avoid the unnecessary complexity of the mapping templates.

[8] A reviewer comments that it would be better if these possibilities followed from some semantic

(34) $\text{EN-D}{\small\text{ATIVE}}\text{-S}{\small\text{HIFT}}\text{-M}{\small\text{APPING}}(ag, th, ben) :=$
$@\text{A}{\small\text{RG}}1(ag)$
$$\left\{ \begin{array}{l|l} @\text{A}{\small\text{RG}}2(th) & @\text{A}{\small\text{RG}}2(ben) \\ @\text{A}{\small\text{RG}}4(ben) & @\text{A}{\small\text{RG}}3(th) \end{array} \right\}$$

Our running example, *give*, now has the following lexical entry:[9]

(35) give V @VERB-LEXEME(give, **give**)
@AGENT-THEME-BENEF-VERB(AGENT, THEME, BEN)
@EN-DATIVE-SHIFT-MAPPING(AGENT,THEME,BEN)

6 Argument alternations and argument suppression

In this section, we will see how argument alternations, like the locative inversion, and argument suppressing operations, like the short (agentless) passive, can be handled in the present system. The first kind involve a straightforward translation of Kibort's theory into the present formalism. However, Kibort-LMT has little to say about true argument suppression, since it simply assumes that obliques are always optional, and does not consider the semantic implications. We therefore have a little more work to do in that area.

6.1 Argument alternations

In keeping with the monotonic approach of Kibort-LMT, argument alternations involve adding further positive feature specifications to certain argument positions. We can emulate this directly, using the abbreviations PLUSO and PLUSR along with the MAP template. Let us consider the familiar locative inversion in Chichewâ to see how this works.

This alternation was one of the first given an analysis in LMT, by Bresnan & Kanerva (1989). It is illustrated in (36), taken from Bresnan & Kanerva (1989: 2):

(36) a. [Chi-tsîme]$_{\text{SUBJ}}$ chi-li [ku-mu-dzi]$_{\text{OBL}_{\text{LOC}}}$.
7-well 7SUBJ-*be 17-3-village*
'The well is in the village.'

b. [Ku-mu-dzi]$_{\text{SUBJ}}$ ku-li [chi-tsîme]$_{\text{OBJ}}$.
17-3-village 17SUBJ-*be 7-well*
'In the village is a well.'

These predicates' a-structures contain an arg_1 and an arg_4 in Kibort-LMT terms – hence in the uninverted construction, (36a), they surface as a SUBJ and an OBL_θ.

properties of the verb, rather than being lexically stipulated. Once again, they are not strcitly *lexically* stipulated, since the template in (34) will be called by all verbs of this class. And again, a more fully developed theory of s-structure, perhaps along the lines of Jackendoff (1990), might help here – for example, by giving us somewhere to encode lexical semantic properties such as aspectual class.

[9]It would likely be sensible to collapse the second and third templates into one macro-template for verbs of this type, but I leave them separate here for the sake of exposition.

Kibort (2007) models locative inversion as the adding of a $[+o]$ feature to a $[-r]$, unaccusative, arg_1, fully specifying it as an OBJ; this allows the arg_4 to take the vacant SUBJ position, giving us the arrangement in (36b). We can represent this process using the following template:

(37) LOCATIVE-INVERSION :=
@MAP(PLUSO, %arg1)

Because the template ARG1-UNACCUSATIVE gives its argument the local name %arg1, other pieces of functional description, like the template in (37), can refer to that argument without worrying about what the actual s-structure attribute name is (it might be THEME, it might be ARG1, or it might be something else altogether).

The effect of (37) is to give a positive specification to the Theme argument, stating that the GF that maps to it must be either OBJ or OBJ_θ (i.e. a $[+o]$ GF). This is now incompatible with the default mapping, which is SUBJ. The only other possibility permitted by the DEFAULT-MAPPING template called by ARG1-UNACCUSATIVE (see (29)) is for the argument to be linked to OBJ, although it does not provide this possibility directly. The template in (37) does, however, and so now the only positive mapping specification which can hold is that OBJ maps to the argument in question. Given this, the preferred GF of the Location argument, SUBJ, is now available, and so it is mapped to this argument. If it was not, then the constraints in the PREFERRED-MAPPING template called by ARG4 would not be satisifed, since the argument in question would not be linked to SUBJ (first disjunct is false), but nor would any other argument (second disjunct is also false).

The long passive in English can be given a similar analysis:[10]

(38) LONG-PASSIVE :=
@MAP(PLUSR, %arg1)

This restricts a regular, $[-o]$ arg_1 in Kibort-LMT terms so that it can only appear as a $[+r]$ GF, i.e. one of OBJ_θ or OBL_θ. This prohibits the default mapping, which is to SUBJ, and the only other possibility permitted by the relevant DEFAULT-MAPPING template is OBL_θ, hence this argument emerges as a prepositional *by*-phrase.

6.2 Argument suppression

Argument suppressing operations carry an extra challenge compared with argument alternations, since the argument being suppressed will have both grammatical and semantic dependencies which must be dealt with. On the grammatical side, we must find a way to satisfy the existential constraint which would normally ensure that the argument is mapped to a GF. On the semantic side, we must do something

[10] I follow Huddleston & Pullum (2002: 1428) in referring to the version of the passive where the active-voice subject is expressed as a *by*-phrase as the 'long' passive, and the version where it is unexpressed as the 'short' passive. A reviewer comments that this overlaps with a different usage in Romance linguistics, which is unfortunate, but I think the current usage is well enough established not to change it.

about the valency meaning constructor, which will contain a dependency on the argument – if we don't, there will be a resource deficit and no successful Glue proof will be possible for the sentence. The template SUPPRESS handles both these tasks:

(39) $\textsc{Suppress}(\textit{arg, template}) :=$
$@\textsc{NoMap}(\textit{arg})$
$(\uparrow_\sigma \textit{ arg } \textsc{rel}) = \text{var}$
$@\textit{template}(\textit{arg})$

This template takes two parameters: the argument to be suppressed, and a template name. The first line of SUPPRESS indicates that the argument in question is not mapped to any GF. The second introduces a dummy REL value 'var' for it, in order to satisfy the corresponding existential constraint by providing its s-structure with some content. The template name passed to SUPPRESS as a parameter is applied to the argument being suppressed, and describes how any semantic dependencies are to be resolved.

Perhaps the most straightforward way of resolving the dependency on an argument in the semantics is to existentially close the dependency. This is what the template CLOSURE describes:

(40) $\textsc{Closure}(\textit{arg}) :=$
$\lambda P.\exists x[P(x)] : [(\uparrow_\sigma \textit{ arg}) \multimap \uparrow_\sigma] \multimap \uparrow_\sigma$

The short passive uses this template, for example – the default SUBJ argument is not realised syntactically and is interpreted existentially in the semantics: *The cake was eaten* is truth-conditionally equivalent to *Someone ate the cake*. We can represent the short passive using the SUPPRESS template as follows:

(41) $\textsc{Short-Passive} :=$
$@\textsc{Suppress}(\%\text{arg1}, \textsc{Closure})$

A full template for the English passive will then incorporate both templates:[11]

(42) $\textsc{Passive} :=$
$(\uparrow \textsc{voice}) = \textsc{passive}$
$\{@\textsc{Short-Passive} \mid @\textsc{Long-Passive}\}$

Another way of suppressing an argument in the semantics is to bind its interpretation to another, syntactically realised argument (cf. Alsina 1996: 116ff.). This is what happens in the French reflexive. Grimshaw (1982: 112ff.) gives good reasons

[11] A reviewer complains that having this disjunction misses a generalisation, since "there is just one passive and two ways of realizing the logical subject in the passive". In fact, that is precisely what this formulation shows: there is one PASSIVE template, which contains two additional templates expressing alternative ways of realising the logical subject/more Agent-like argument. There is also a typological significance to dividing the mapping possibilities up in this way: some languages may make use of one but not the other. Although no language has only long passives, there are languages like Latvian which have only short passives (Keenan & Dryer 2007: 331f).

to believe that reflexive sentences like (43) in French are syntactically intransitive, unlike their English translations:

(43) Kira se voit.
Kira REFL *sees*
'Kira sees herself.'

But a verb like *voir* 'see' is semantically a two-place predicate, so in (43) one of its arguments has been suppressed. In this case, its second argument is interpreted as being identical to, or bound by, its first. This is what BIND describes:

(44) $\text{BIND}(arg_\beta,\ arg_\alpha) :=$
$\lambda P \lambda x. P(x)(x) : [(\uparrow_\sigma\ arg_\alpha) \multimap (\uparrow_\sigma\ arg_\beta) \multimap \uparrow_\sigma] \multimap (\uparrow_\sigma\ arg_\beta) \multimap \uparrow_\sigma$

This meaning constructor consumes a dependency on two different arguments and replaces it with a dependency on just one of them, while passing that one argument to the predicate in both of its argument positions. Assuming the clitic *se* contributes a feature $[\text{REFL}\ +]$, we can then capture Grimshaw's (1982) lexical-rule based analysis using the following template instead, which can be added to a transitive verb to turn it into a reflexive:

(45) FR-REFLEXIVE $:=$
@SUPPRESS(%arg2, BIND(%arg1))
$(\uparrow \text{REFL}) =_c +$

The first line of the template can be read as 'suppress %arg2 by binding it to %arg1'. Notice that since template parameters are just treated as strings when the template is expanded, we can include complex expressions with some parameters already filled in as the second parameter of SUPPRESS.[12]

7 Conclusion

This paper has presented a new framework for representing claims about the mapping between semantic arguments and grammatical functions, and given a few examples of its application. It differs from previous implementations of LMT in that the formalism which underlies it is vanilla LFG+Glue rather than some additional, novel mechanism. Although I have demonstrated how it can be used to encode at least one version of LMT, the framework is theory-agnostic, and could be applied to different versions of LMT, and in settings which make different architectural assumptions: for example, it is also compatible with a version of LMT which uses a dedicated level of a-structure, provided this takes the form of an AVM, as in Butt et al. (1997). It is my hope that this paper has contributed tools that can be used both to make existing theories more explicit and to enable more transparent comparisons between them, potentially revealing new insights into the data and new perspectives on existing analyses.

[12] I am assuming that @TEMPLATE$(X)(Y)$ is intepreted in the same way as @TEMPLATE(X, Y).

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Multifunctional Dutch ‘er’

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Abstract

This paper presents an LFG analysis of two aspects of the Dutch pronoun *er*: its ability to provide multiple grammatical functions within a single clause; and the constraints on the position of *er* within a clause and the combinations of functions that are allowed in a given position. The analysis rests on interactions between string ordering, c-structure, f-structure and information structure constraints. The general lexical specification for *er* comprises a core together with optional subspecifications: each instance of *er* generates its own lexical specification to satisfy other constraints in the clause. The paper introduces the proposal that a c-structure node may project a set of f-structures, each of which shares its structure with a distinct element of the overall clausal f-structure.

1 Introduction

The Dutch pronoun *er* provides a challenge to resource-based grammar theories because of its ability to introduce potentially unlimited resources. For LFG there is a further challenge because of the one-to-many mapping between an instance of *er* and grammatical functions within a clause.

In this paper I present data on the distribution of *er*, illustrating its contribution to the meaning of a sentence and the interactions between these meanings and constraints on distribution. I then propose an account that addresses these challenges with two innovations: allowing a c-structure node to project a set of f-structures rather than a single f-structure, and using a template lexical specification for *er*, which is instantiated for a particular element of the string depending on the other properties of the clause.

Er has four distinct pronominal functions. In this paper, I follow Odijk's (1993) categorisation of them:

i. existential er_X occurs with an indefinite subject or subjectless passive;

ii. locative er_L is a locative adverbial pronoun;

iii. prepositional er_P is a non-human prepositional object pronoun; and

iv. quantitative er_Q is a partitive pronoun comparable with French *en*.

There are many descriptions of the distribution of *er*, and accounts of its syntactic constraints, including Bech (1952), Bennis (1986), van Riemsdijk (1978), Odijk (1993), Neeleman and van de Koot (2006), Donaldson (2008), Grondelaers et al. (2009), Klooster (2014), Webelhuth and Bonami (2019). Distributional constraints interact with the functions expressed by an instance of *er* within a given clause. A strong constraint is that *er* generally occurs only once, and maximally

[†]My thanks go to the numerous native speakers of Dutch who advised me on example sentences, and to the anonymous reviewers, whose comments and suggestions have improved this paper.

twice, within a single clause. This means that one instance of *er* fmay carry more than one function simultaneously, and as a pronoun may refer to more than one distinct antecedent. All pairwise combinations of functions have been observed in a single instance of *er*, and combinations of three or more functions are possible.

Er is a member of the family of what have been termed “R-pronouns” (van Riemsdijk 1978), which includes *daar* ‘there’, *hier* ‘here’, and *waar* ‘where’. Some of the functions of *er* can be provided by *daar* or *hier*. However, *er* is semantically less weighty, in that it does not contribute deictic information and cannot be phonologically emphasised.

Despite the numerous accounts of *er* in different theoretical frameworks, to date a treatment in LFG is lacking. In the remainder of the paper I discuss the constraints on the distribution of the functions of *er*, and then propose and test a lexical specification that can account for the distribution.

1.1 Dutch clause structure

In describing the structure of Dutch clauses I adopt the model provided by Haeseryn et al. (1997), in which there are two “poles” around which the other elements are ordered. Only one constituent can occupy the prefield and there are constraints on the types of constituents in the postfield. A diagram of the structure is given in Figure 1.

		Pole 1		Pole 2	
MATRIX CLAUSE	prefield	inflected verb	midfield	other verbs	postfield
EMBEDDED CLAUSE		comple-mentiser	midfield	all verbs	postfield

Figure 1: Assumed Dutch clause structure (Haeseryn et al. 1997)

This topological description of phrase structure is similar to other Germanic languages, including LFG discussions of Icelandic and Swedish (e.g. Sells 2001, 2005, Booth and Schätzle 2019). At a more detailed level, there are differences between Dutch and these other languages with respect to the behaviour of expletives and the ordering constraints in the midfield, which are outside the scope of this paper. For the purposes of accounting for the constraints on *er*, I make the following assumptions.

In terms of phrase structure, I assume that Pole 1 for matrix clauses is the head of IP, which is occupied by the inflected verb. The prefield, which I assume to be the specifier of IP, Spec-IP, is reserved for a constituent that is prominent either syntactically or at information structure. Canonically it is the subject position, but information structural constraints frequently result in either the focus or topic of an utterance occupying the prefield, with the subject occurring in the midfield. The order of constituents in the midfield is determined by interactions between category, grammatical function, and information structure considerations, which are not discussed in this paper. Also, the lack of case marking on Dutch nouns means that grammatical functions may not be fully determined by the syntax. As a simplification of c-structure, I assume that the midfield is contained within a VP daughter of I′, and that midfield dependents of the verb attach at V′. All dependents of the verb, whether daughters of V′ or Spec-IP, carry the functional constraint $(\uparrow \text{GF}) = \downarrow$. For numerically quantified noun phrases, I follow the grammar for German available from INESS XLE-Web[1] (Rosén et al. 2012) in assuming that numbers project a NumP, which occupies the specifier of NP and contribute a NUM feature at f-structure via the constraint $(\uparrow \text{NUM}) = \downarrow$.

2 The distribution of *er*

In this section I describe the four core functions of *er* and their distribution in sentences where there is one instance of *er* that carries only one function. I then discuss the constraints that apply where a single instance of *er* carries more than one function.

2.1 Core functions of *er*

2.1.1 Presentative *er*$_X$

Presentative *er*$_X$ appears in the prefield of a matrix clause where the subject is indefinite (1) or as the subject of an impersonal passive sentence (2) where there is no other prominent constituent in the clause. Where the prefield is occupied by a non-subject constituent, or in embedded clauses, *er*$_X$ is optional if there is an explicit subject (3) but must appear where there is no other expressed subject (4). Grondelaers et al. (2009) identified a processing advantage for sentences with midfield *er*$_X$ where the subject is semantically unexpected in context.

(1) *Er*$_X$ *staan nog teveel mensen aan de zijlijn.*
ER stand yet too.many people on the sideline
"There are still too many people standing on the sidelines."[2]

[1]http://clarino.uib.no/iness
[2]https://www.rwm.nl/kringloop/hetgoed (all URLs accessed on 2020-10-31)

(2) *Er$_X$ werd gedanst en gedronken.*
ER became danced and drunk.
"There was dancing and drinking."[3]

(3) *...aan de haak hing (er$_X$) een peer...*
...on the hook hung (ER) a pear...
"...on the fishhook (there) hung a pear..."[4]

(4) *Waar wordt *(er$_X$) deze winter gebaggerd?*
Where PASS.PRS *(ER) this winter dredged
"Where will there be dredging this winter?"[5]

Existential *er$_X$* does not alternate with *daar/hier*. Where *daar* occupies the prefield, *er$_X$* is still possible in the midfield (5).

(5) *Daar$_{Loc}$ kwam er$_X$ al een wet in 2006.*
There came ER already a law in 2006
"A law had already been passed *there* (NL) in 2006."[6]

2.1.2 Locative *er$_L$*

Locative *er$_L$* replaces a prepositional, nominal, or adverbial locative phrase (6) whose grammatical function can be either an argument or an adjunct. It can be replaced by *daar/hier* (7). If *er$_L$* is the only function of *er*, it cannot occur in the prefield (8). However, locative *daar* is possible in the prefield (9).

(6) *Ik ben er$_L$ nooit geweest, en het trekt me ook niet.*
I am ER never been, and it attracts me also not
"I've never been there, and it doesn't attract me either."[7]

(7) *Ik ben daar nooit geweest, en het trekt me ook niet.*
I am there never been, and it attracts me also not
"I've never been there, and it doesn't attract me either."

(8) * *Er$_L$ ben ik nooit geweest, en het trekt me ook niet.*
ER am I never been, and it attracts me also not
(intended) "I've never been there, and it doesn't attract me either."

(9) *Daar ben ik nooit geweest, en het trekt me ook niet.*
there am I never been, and it attracts me also not
"I've never been *there*, and it doesn't attract me either."

[3] https://dorpskrantdeknipe.nl/vier-vijf-mei
[4] Grondelaers et al. (2009)
[5] https://www.waterschaprivierenland.nl/waar-wordt-er-deze-winter-gebaggerd
[6] https://nl.wikipedia.org/wiki/Gerechtstolk
[7] https://nl.toluna.com/opinions/2513744/Libelle-Zomerweek

2.1.3 Pronominal *er_P*

Pronominal er_P appears if the sentence requires a pronominal non-human prepositional object (10): *het* 'it' following the preposition is ungrammatical here (11). In Netherlands Dutch, the preposition associated with er_P usually appears at the end of the midfield.[8] Similarly to er_L, er_P can be replaced by *daar/hier* (12). In the prefield, er_P as the sole function of *er* is unacceptable (13), but *daar/hier* is possible here (14).

(10)	*Ja*	*soms*	*kan*	*je*	*er_P*	*trots*	*op*	*zijn.*
	Yes	sometimes	can	you	ER	proud	on	be

"Yes, sometimes you can be proud of it."[9]

(11)	*	*Ja*	*soms*	*kan*	*je*	*trots*	*op*	*het*	*zijn.*
		Yes	sometimes	can	you	proud	on	it	be

(intended) "Yes, sometimes you can be proud of it."

(12)	*Ja*	*soms*	*kan*	*je*	*daar*	*trots*	*op*	*zijn.*
	Yes	sometimes	can	you	there	proud	on	be

"Yes, sometimes you can be proud of it."

(13)	*	*Er_P*	*kan*	*je*	*trots*	*op*	*zijn.*
		ER	can	you	proud	on	be

(intended) "You can be proud of it."

(14)	*Daar*	*kan*	*je*	*trots*	*op*	*zijn.*
	There	can	you	proud	on	be

"You can be proud of that."

2.1.4 Quantitative *er_Q*

Quantitative er_Q appears with headless quantified (15) or restricted noun phrases (16). It cannot be replaced by *daar/hier* (17) and must appear in the midfield (18).

(15)	*De*	*speler*	*van*	*Veenhuizen*	*maakte*	*er_Q*	*drie.*
	The	player	of	Veenhuizen	made	ER	three

"The Veenhuizen player scored three."[10]

(16)	*Bovendien*	*zijn*	*er_Q*	*die*	*wél*	*de*	*titel*	*maar*	*geen*	*Michelinster*	*hebben.*
	Furthermore	are	ER	who	certainly	the	title	but	no	Michelin.star	have

"Then there are those who do have the title but no Michelin star."[11]

[8] https://taaladvies.net/taal/advies/vraag/1340/er_op_erop/

[9] https://uitleganimatie.studiosteenproducties.nl/blog/trots-op-je-pot

[10] https://dekrantnieuws.nl/topscorers-moes-maakt-er-drie/

[11] https://www.bndestem.nl/moerdijk/chefkok-vista-in-willemstad-krijgt-meestertitel-ik-wil-het-hoogst-haalbare~a5428451/

(17) * *De speler van Veenhuizen maakte daar drie.*
The player of Veenhuizen made there three
(intended) "The Veenhuizen player scored three."

(18) * *Daar/er$_Q$ maakte de speler van Veenhuizen drie.*
There/ER made the player of Veenhuizen three
(intended) "The Veenhuizen player scored three."

2.1.5 Summary: single-function *er*

In summary, when *er* fulfils a single function, only *er*$_X$ is possible in the prefield, but all functions are possible in the midfield. Of the four functions, only *er*$_L$ and *er*$_P$ can be substituted by *daar* or *hier*: in these cases, *daar/hier* may occupy the prefield.

2.2 Single instances of *er* serving multiple functions

Where possible, a single instance of *er* in a clause provides all the functions. However, constraints apply to the prefield such that not all function combinations are possible there.

2.2.1 *Er* in the prefield

Where *er*$_X$ occurs in the prefield, it must also provide the functions for *er*$_L$ (19) and *er*$_P$ if these are present in the clause (20). Here, a second instance of *er* in the clause is ungrammatical. However, *er*$_Q$ is not compatible with prefield *er*$_X$ and must be expressed separately (21). This the only acceptable case for prefield *er* and midfield *er* in the same clause.

(19) a. *Er$_{XL}$ woont ook vrijwel niemand.*
ER lives also almost niemand.
"Pretty much nobody lives there."[12]

b. * *Er$_X$ woont er$_L$ ook vrijwel niemand.*
ER lives ER also almost niemand.
(intended) "Pretty much nobody lives there."

(20) a. *Er$_{XP}$ heeft iemand over nagedacht voor ons.*
ER has someone over thought.about for us.
"Someone has thought that through for us."[13]

b. * *Er$_X$ heeft er$_P$ iemand over nagedacht voor ons.*
ER has ER someone over thought.about for us.
(intended) "Someone has thought that through for us."

[12]https://www.weerwoord.be/m/2582768
[13]https://gathering.tweakers.net/forum/list_messages/1894879

(21) a. * *Er_{XQ} waren twee (in de zaal)*
ER were two (in the room).
(intended) "There were two (of them in the room)."[14]

b. *Er_X wonen er_Q 53 in Kortrijk.*
ER live ER 53 in Kortrijk
"53 (of them) live in Kortrijk."[15]

2.2.2 Midfield *er* carrying two functions

In clauses where *er* occurs only in the midfield, it carries all the functions required by the clause. Bennis (1986) demonstrates this using lexical substitutions and valency constraints for the combinations er_{XL}, er_{XP}, and er_{XQ}, where *er* has only one pronominal antecedent. However, clauses where a single midfield *er* has two or more distinct antecedents are also possible, and the corresponding clauses with multiple instances of *er* in the midfield are almost always rejected (22). Corpus evidence suggests that a second midfield *er* is observed infrequently where it provides er_P for a subsequent clausal antecedent, and where the *er* is written as a single word with its governing preposition. This phenomenon is the subject of ongoing research and for the purposes of this paper, it is assumed that a second midfield *er* is ungrammatical.

(22) a. *Er_L* and *er_P*

*De student wacht er (*er) nu (*er=)op*
The student waits ER (*ER) now (*ER=)on

"The student is waiting there for it now."

b. *Er_L* and *er_Q*

*Merel heeft er (*er) vijf gegeten*
Merel has ER (*ER) five eaten

"Merel ate five there."

c. *Er_P* and *er_Q*

*Suus heeft er (*er) drie (*er=)op neergezet*
Suus has ER (*ER) three (*ER=)on put.down

"Suus put three down on it."

It is also possible for a single instance *er* to provide multiple instances of the same function with different antecedents (23).

(23) a. *Jan heeft de sleutel met een tang$_i$ uit het slot$_j$ gehaald.*
Jan has the key with a tongs$_i$ out the lock$_j$ taken
"Jan took the key out of the lock with pliers"

[14] Odijk (1993)
[15] https://www.standaard.be/cnt/g0lsk35f

b. *Jan heeft* $er_{ij:PP}$ *de sleutel* mee_i uit_j *gehaald.*
Jan has ER_{ij} the key $with_i$ out taken.
"Jan took the key out of it with them."[16]

Sentences with a single *er* providing four functions with three distinct antecedents are also possible (24).

(24) a. *... dat er twee* $studenten_i$ *drie* $boeken_j$ *uit de* $boekenkast_k$ *gehaald hebben.*
... that ER two students three books out the bookcase fetched have.
"... that two students fetched three books out of the bookcase."

b. *... dat* $er_{ijk:XQQP}$ $twee_i$ $drie_j$ uit_k *gehaald hebben.*
... COMP ER_{ijk} two_i $three_j$ out_k fetched have.
"... that two (of them) fetched three (of them) out of it."[17]

2.2.3 Summary: multifunctional *er*

All functions of *er* are compatible with each other in the midfield. While er_L and er_P cannot occupy the prefield if they provide the sole function of *er*, they must be provided by prefield *er* if this is licensed by er_X. However, any instances of er_Q can never be provided by prefield *er*, instead requiring an instance of *er* in the midfield.

3 Accounting for multifunctionality

Most other accounts rely on syntactic deletion rules (e.g. Bennis 1986, Neeleman and van de Koot 2006). Webelhuth and Bonami (2019) propose an account within HPSG which relies on the optional non-expression of *er* in phrase-structure, the expression being determined by interactions of constraints that relate specifically to the prefield and the midfield. Again, information is contributed to the analysis by an element that is invisible in the string. Phonological deletion is another possible cause, but as Dutch allows the repetition of other unstressed pronouns (25) this explanation is also unsatisfactory, and is also rejected by Neeleman and van de Koot (2006).

(25) a. *Opdat je je bruiloft keer op keer opnieuw kunt beleven.*
so.that 2 2.POSS wedding time on time again can experience
"So that you can relive your wedding time and time again."[18]

[16]Webelhuth and Bonami (2019, exx. 6a,6d)
[17]Webelhuth and Bonami (2019, exx. 8a,c)
[18]weddingreport.nl

b. *Herinner je je je verjaardag?*
remember 2 2.REFL 2.POSS birthday
"Do you remember your birthday?"[19]

However, accounts based on deletion are unsatisfactory: the required deletion of c-structure elements means that an analysis is no longer monotonic. This causes problems computationally and, for LFG, contravenes one of the underpinning assumptions of the theory. It is also unclear how empirical psycholinguistic evidence in support of a deletion-based account might be gathered.

The proposal here is based on interactions between positional and functional constraints, builds on Asudeh (2009) in relating f-structure to the string. Rather than remove elements from c-structure by deletion, the account assumes that the lexical specification for *er* includes optional resources that can be included as required to satisfy constraints introduced elsewhere in the string. Similar to Webelhuth and Bonami (2019), the c-structure constraints distinguish between the prefield and the midfield. The finer-grained constraints on the position of *er* within the midfield are left for future work.

3.1 Constraints and interactions

A lexical specification for *er* must reflect constraints at both f-structure and c-structure. At f-structure, a single instance of *er* must correspond to a single f-structure via the correspondence function ϕ, whilst potentially providing content, including distinct PRED values, to multiple f-structures. At c-structure, the functions expressed by a single instance of *er* constrain its distribution.

3.1.1 C-structure distributional constraints

A sole *er* in the midfield is grammatical whatever the combination of functions it carries. This provides evidence that *er* is a single lexical item that can provide more than one PRED value into f-structure. It also demonstrates that the four functions er_X, er_L, er_P, and er_Q are not intrinsically incompatible, and that the constraints on particular combinations of function associated with specific c-structure positions arise from interactions between constraints within the lexical specification and constraints within phrase structure rules.

A sole *er* in the prefield is only grammatical when er_X is present, and is never grammatical where the clause has an instance of er_Q. This requires the specification for er_X to satisfy c-structural constraints on the Spec-IP position, and the specification for er_Q to be incompatible with those constraints. It further suggests that er_L and er_P are underspecified with regard to the Spec-IP constraints, allowing them to occupy Spec-IP where er_X is present, but preventing them appearing in Spec-IP without er_X.

[19] taalthuis.com/theory/pronouns

Two *er* in the string are ungrammatical if the clause has er_X and either er_L or er_P. This suggests that there is a string ordering constraint on er_L and er_P such that they must be carried by the leftmost instance of *er*.

3.1.2 Functional assumptions

Existential er_X does not contribute a semantic form to f-structure. If it is present together with an indefinite subject, that provides the PRED value. If it is present in the impersonal passive construction, the subject is athematic and therefore a value of SUBJ PRED would result in an incoherent f-structure.

However, each instance of the functions er_L, er_P, and er_Q contributes the constraint PRED = 'pro' to an f-structure within the clause, and these pronouns may have different antecedents. Except in cases such as (21b), these multiple PRED values are provided by one instance of *er* in the string and therefore must correspond to a single f-structure through the ϕ-function. This is problematic because of the PRED uniqueness constraint on f-structures.

To resolve this problem, I propose to amend the definition of the ϕ-function such that it is possible to project a single set of f-structures. For *er* this set is defined as E. Each f-structure within the set E then shares its structure with a grammatical function in the clause. These individual f-structures have specific constraints, not only functionally but also relating to c-structure, linear precedence in the string, and information structure.

As a result, the lexical specification for *er* must be described in general terms, with a specific instantiation for each appearance of *er* in a string. These instantiations must include the constraints relating to at least one function of *er*, but the exact composition is dependent on the content of the whole clause.

The question then arises as to where in f-structure the set E sits. The structure shared by the individual f-structures within E relating to er_P, er_Q, and non-passive er_X, must also contain material contributed by other c-structure elements, which may be non-adjacent to *er* in the string. This can be seen as a dislocation within the clause, but because an instance of *er* is not necessarily associated with a prominent element of information structure such as topic or focus, it is not appropriate to use the f-structural discourse functions TOPIC or FOCUS (Bresnan and Mchombo 1987, and others). Instead, I follow Dalrymple et al. (2019, p. 38), who propose the overlay function DIS to represent dislocation or long distance dependency, and who include the discourse functions TOPIC and FOCUS in the separate i-structure level of representation. Accordingly, I propose that the set E is the value of the overlay function DIS.

3.2 Building a lexical specification

The lexical specification for *er* consists of a core specification together with four subspecifications that each relate to one of the functions of *er*. The specification results in a set of f-structures, each of which shares structure with another f-structure or grammatical function in the clause. The subspecifications each follow a similar template, including functional constraints, any constraints on the number of f-structures of a given ERTYPE that may be present, the path constraint for structure sharing, and a c-structure precedence condition that constrains the number of instances of *er* in the s-string. The feature ERTYPE is used for er_X and er_L to preclude situations where an infinitely large set E could be generated. Er_P and er_Q are not specified for the feature because their presence is constrained by completeness and coherence constraints dependent on other words in the sentence. The subspecifications relating to er_X and er_Q also reflect the relationship of these functions to the c-structure Spec-IP position.

For a particular instance of *er*, the core specification is always present, and copies of the subspecifications are added to satisfy the requirements of the sentence. Thus the exact composition of the set E depends on the presence of other elements in the clause (e.g. an indefinite subject for er_X, an objectless preposition for er_P, a number without a specific noun for er_Q, a location required by valency or context for er_L) to satisfy constraints.[20] If it is not possible to build a lexical specification for a particular instance of *er*, or if the generated specification results in feature clashes, the sentence is ungrammatical.

3.2.1 The core specification

The core specification for *er* is given at (26).

(26) *er* N (DIS ↑)
$\{E\text{: }\%\text{ER}_1, ..., \%\text{ER}_n\}, |E| \geq 1$
$\%\text{ER}_i = \{\text{ER}_X \mid \text{ER}_L \mid \text{ER}_P \mid \text{ER}_Q\}$
$\%\text{ER}_i = ((\text{DIS} \uparrow)\ \text{ERPATH}_i)$

The first line constrains the information from *er* to be added to the value of the clause's overlay function. The second and third lines define this information as a non-zero set of f-structures, each represented by indexed local variable $\%\text{ER}_i$. Each instance of $\%\text{ER}_i$ is further constrained to be one of four subspecifications ER_X, ER_L, ER_P, ER_Q which correspond to the four functions of *er*. There may be more than one instance of er_P or er_Q in a clause, and so it is assumed that there is no upper limit on the size of set E. The fourth line specifies that each instance of $\%\text{ER}_i$ shares its structure with an f-structure along the path ERPATH_i, which is also further defined in the subspecifications.

3.2.2 Subspecification ER_X

The subspecification ER_X is given at (27).

[20] The specification cannot determine whether or not a locative adjunct is contributed by *er* in a given context: the factors that govern native speakers' intuitions about whether a location is contributed by *er* in a given context are left for future research.

(27) $\text{ER}_X \equiv$ $(\%\text{ER}_i\ \text{DEF}) \neq +$
$(\%\text{ER}_i\ \text{ERTYPE}) = \text{X}$
$\neg(\%\text{ER}_j \in E).\%\text{ER}_j \neq \%\text{ER}_i \ \wedge\ (\%\text{ER}_j\ \text{ERTYPE})=\text{X}$
$\text{ERPATH}_i = \text{SUBJ}$
$\neg *_n .*_n < \hat{*} \ \wedge\ \pi^{-1}(*_n) = er$

The first line prevents an instance of ER_X from contributing to an f-structure from a definite DP or NP. The second line sets the value of the instance's ERTYPE feature to be X, and the third line uses the ERTYPE feature to ensure that there is only one f-structure specified by ER_X in set E. The fourth line constrains the f-structure to share structure with the SUBJ of the clause. This licenses *er* to occupy Spec-IP. The fifth line is a c-structure precedence constraint relating the terminal c-structure node for this instance of *er* ($\hat{*}$) to other nodes in c-structure. It says that there is no other node $*_n$ that precedes this instance of *er*, for which the associated word in the string, $\pi^{-1}(*_n)$, is *er*. The effect of this is that any f-structure specified by ER_X is constrained to be contributed by the leftmost instance of *er* in the string.

3.2.3 Subspecification ER_L

The subspecifiation ER_L is given at (28).

(28) $\text{ER}_L \equiv$ $(\%\text{ER}_i\ \text{PRED}) =$ 'pro'
$(\%\text{ER}_i\ \text{ERTYPE}) = \text{L}$
$\neg(f \in ((\text{DIS} \uparrow)\ \text{ADJ})).f \neq \%\text{ER}_i \ \wedge\ (f\ \text{ERTYPE})=\text{L}$
$\text{ERPATH}_i = \{\text{OBL}_{Loc} \mid \text{ADJ} \in\}$
$\neg *_n .*_n < \hat{*} \ \wedge\ \pi^{-1}(*_n) = er$

The first line contributes the value PRED = 'pro' to an f-structure which is an instance of ER_L. The second line sets the value of that f-structure's ERTYPE feature to be L. The third line uses the ERTYPE feature to ensure that there is only one f-structure specified by ER_L within the adjunct set of the clause. The fourth line constrains the f-structure to share structure with either the clause's OBL_{Loc} grammatical function or a member of the clause's adjunct set. And the fifth line again constrains any f-structure specified by ER_L to be contributed by the leftmost instance of *er* in the string.

3.2.4 Subspecification ER_P

The subspecification ER_P is given at (29).

(29) $\text{ER}_P \equiv$ $(\%\text{ER}_i\ \text{PRED}) =$ 'pro'
$\text{ERPATH}_i = \{\text{OBL}_\theta \mid \text{ADJ} \in\}\ \text{OBJ}$
$\neg *_n .*_n < \hat{*} \ \wedge\ \pi^{-1}(*_n) = er$

The first line again contributes the value PRED = 'pro' to an f-structure that is an instance of ER_P. The second line constrains the f-structure to share structure with the object of either an oblique grammatical function or a member of the clause's adjunct set. The presence of an ER_P f-structure requires there to be an available OBJ, and so it is not necessary to further constrain the number of f-structures with ERTYPE = P. The third line again constrains any f-structure specified by ER_P to be contributed by the leftmost instance of *er* in the string.

3.2.5 Subspecification ER_Q

The subspecification ER_Q is given at (30).

(30) $$\begin{array}{lll} \text{ER}_Q & \equiv & (\%\text{ER}_i\ \text{PRED}) = \text{‘pro’} \\ & & (\%\text{ER}_i\ \text{DEF}) = - \\ & & (\%\text{ER}_i\ \{\text{COMP}|\text{NUM}\}) \\ & & \text{ERPATH}_i = \{\text{SUBJ} \mid \text{OBJ} \mid \text{OBJ}_\theta\} \\ & & \neg *_n .\hat{*} < *_n \ \wedge\ \pi^{-1}(*_n) = er \\ & & (\uparrow_{\sigma\iota}\ \text{PROM}) = - \end{array}$$

Similarly to the subspecifications ER_L and ER_P, the first line contributes the value PRED = 'pro' to an f-structure that is an instance of ER_P. The second line constrains the DEF feature of that f-structure to be negative. The third line requires the f-structure to have either a NUM or a COMP attribute, in line with the requirement discussed in Section 2.1.4 that the nominal antecedent of er_Q is restricted in some way. The fourth line constrains the f-structure to share structure with one of the term grammatical functions of the clause. In the fifth line, the precedence constraint is reversed so that there is no other terminal node projected by an instance of *er* that is preceded by this instance of *er*. Thus any f-structure specified by ER_Q to be contributed by the rightmost instance of *er* in the string. The sixth line specifies the information structure feature PROM to be negative.[21] This clashes with constraints on Spec-IP, discussed below, and thus prevents an f-structure specified by ER_Q from being contributed by *er* in Spec-IP.

4 Analysis

The analysis follows the phrase-structure assumptions in Section 1.1. For phrases where *er* may appear, the constraint $(\uparrow \text{SUBJ}) = \downarrow$ on dependents of the verb is replaced by the disjunction $\{(\uparrow \text{SUBJ}) = \downarrow \mid (\uparrow \text{DIS}) = \downarrow\}$.[22] Further constraints apply to Spec-IP, shown in (31).[23]

[21] I follow the treatment of information structure in Chapter 10 of Dalrymple et al. (2019). In summary, $\uparrow_{\sigma\iota}$ and $\downarrow_{\sigma\iota}$ represent the i-structures projected by the f-structures $\uparrow$ and $\downarrow$ respectively. Within i-structure, PROM is a feature representing the notion of prominence.

[22] The detail of constraints on *er* within the midfield is left for future work. This paper makes the simplifying assumption that *er* occurs either in the prefield or the start of the midfield.

[23] DF is an i-structure feature representing discourse functions, allowing sentential content to be associated with TOPIC or FOCUS.

(31)
$$\begin{array}{c} \text{XP} \\ \{(\uparrow \textsc{gf}) = \downarrow \mid (\uparrow \textsc{dis}) = \downarrow\} \\ \uparrow_{\sigma\iota} = \downarrow_{\sigma\iota} \\ (\downarrow_{\sigma\iota}\ \textsc{prom}) \neq - \\ \left\{ \begin{array}{c} (\downarrow_{\sigma\iota}\ \textsc{df}) = \textsc{topic} \mid \\ (\downarrow_{\sigma\iota}\ \textsc{df}) = \textsc{focus} \mid \\ (\uparrow \textsc{subj}) = \downarrow\ \mid \\ \%\textsc{er} \in \downarrow\ \wedge\ \%\textsc{er} = (\uparrow \textsc{subj}) \end{array} \right\} \end{array}$$

The constraint $(\downarrow_{\sigma\iota}$ PROM$) \neq -$ means that the constituent occupying Spec-IP must not be intrinsically non-prominent (a characteristic assumed for er_Q). The disjunction means that the constituent must provide either topic or focus of the sentence (represented by the value TOPIC or FOCUS for the clause's DF feature at i-structure), or the subject. The final line of the constraint covers the case where *er* occupies Spec-IP. In this case, there must be an f-structure in the set which is equal to ($\uparrow$ SUBJ). This constraint is the set equivalent of the previous element of the disjunction ($\uparrow$ SUBJ) $= \downarrow$; it can be satisfied by the presence in the set of ER$_X$, by equation (27), or of ER$_Q$, by equation (30). However, ER$_Q$ is incompatible with Spec-IP because of the prominence constraint mentioned above.

In the c-structure diagrams that follow the constraint $\uparrow=\downarrow$ is omitted for clarity, dependents of the verb show only the applicable element of the disjunction $\{(\uparrow \textsc{gf}) = \downarrow \mid (\uparrow \textsc{dis}) = \downarrow\}$, and only the relevant constraints on Spec-IP from (31) are shown.

4.1 *Er$_P$* in the prefield with and without *er$_X$*

Example (32) is ungrammatical. Only *er$_X$* licenses *er* in the prefield, through the c-structure constraint ($\uparrow$ SUBJ) $\in \downarrow$. The set E contains two f-structures, one specified by ER$_X$ and one by ER$_P$. The resulting lexical specification for *er* is given in (33). Because *er$_X$* carries the constraint (ER$_1$ DEF) $\neq +$, there is a feature clash with the definite subject *de student* 'the student' (34).

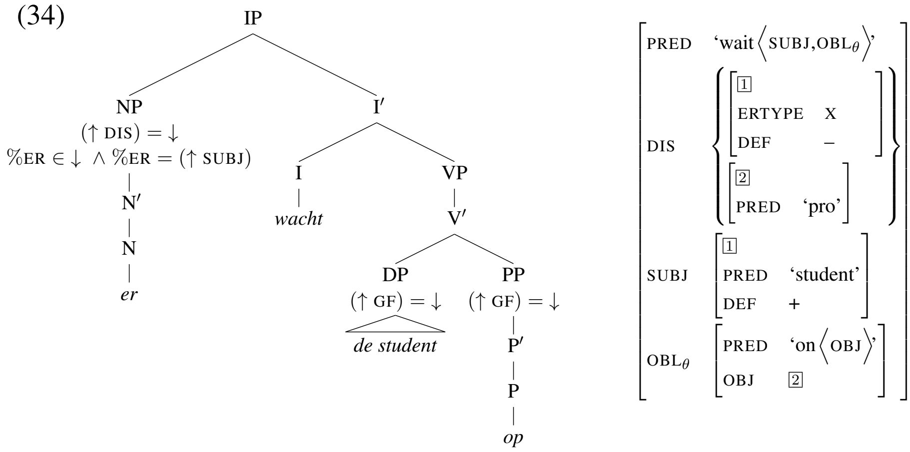
(32) * *Er wacht de student op*
ER waits the student on
(intended) "The student is waiting for it."

(33) *er* N (DIS $\uparrow$)
$\neg *_n .*_n < \hat{*}\ \wedge\ \pi^{-1}(*_n) = er$
$\{E$: ER$_1$, ER$_2\}$

(ER$_1$ DEF) $\neq\ +$
(ER$_1$ ERTYPE) = X
$\neg(\%\textsc{er}_j \in E).\%\textsc{er}_j \neq \%\textsc{er}_1\ \wedge\ (\%\textsc{er}_j$ ERTYPE)=X
ER$_1$ = ((DIS $\uparrow$) SUBJ)

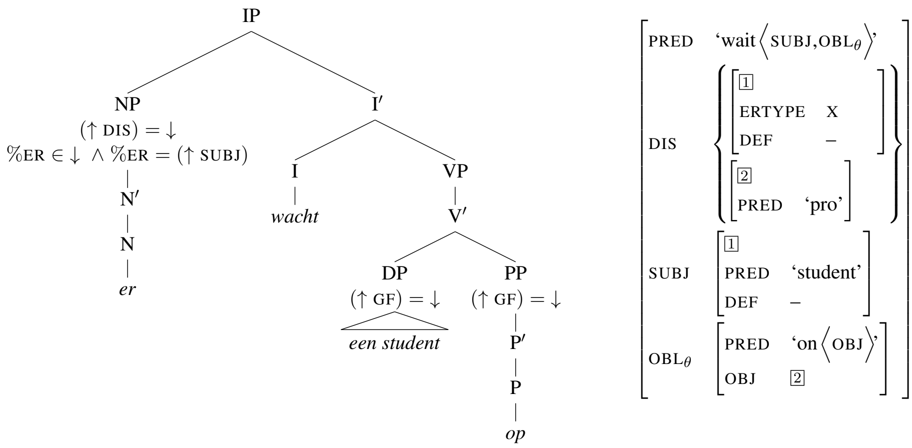
(ER$_2$ PRED) = 'pro'
ER$_2$ = ((DIS $\uparrow$) {OBL$_\theta$ | ADJ $\in$} OBJ)

(34)



Replacing the definite subject with the corresponding indefinite *een student* 'a student' removes the feature clash and the sentence becomes grammatical (35).

(35) *Er wacht een student op*
ER waits a student on
"A student is waiting for it."



4.2 *Er$_L$* and *er$_P$* in the midfield: one *er* or two?

Example (36), repeated from (22a), is grammatical. Spec-IP is occupied by the subject *de student* 'the student', with *er* at the start of the midfield. The sentence contains *er*$_L$ and *er*$_P$, and as a result the set E has two f-structures, one specified by ER$_L$ and one by ER$_P$. The lexical specification generated for *er* in this case is given at (37), and the c- and f-structure pair is shown at (38).

(36) *De student wacht er$_{LP}$ nu op*
The student waits ER now on
"The student is waiting there for it now."

(37) *er* N (DIS $\uparrow$)

$\neg *_n . *_n < \hat{*} \;\wedge\; \pi^{-1}(*_n) = er$

$\{E\text{: ER}_1\text{, ER}_2\}$

(ER$_1$ PRED) = 'pro'

(ER$_1$ ERTYPE) = L

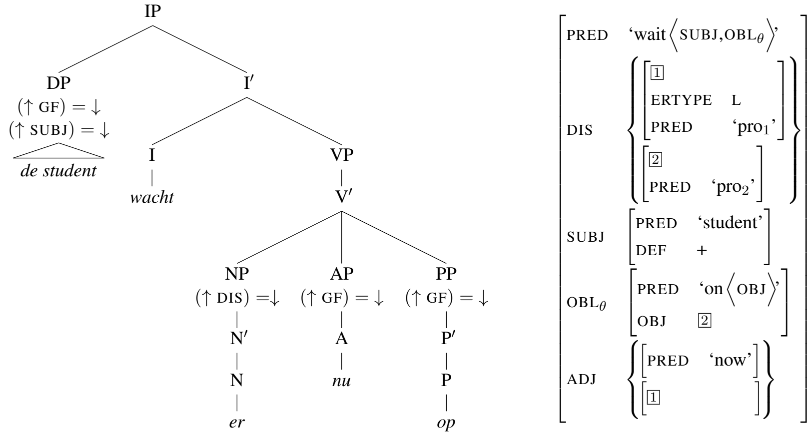
$\neg(f \in ((\text{DIS} \uparrow) \text{ ADJ})).f \neq \%\text{ER}_1 \;\wedge\; (f \text{ ERTYPE})\text{=L}$

$\text{ER}_1 = ((\text{DIS } \uparrow) \{\text{OBL}_{Loc} \mid \text{ADJ} \in\})$

(ER$_2$ PRED) = 'pro'

$\text{ER}_2 = ((\text{DIS } \uparrow) \{\text{OBL}_\theta \mid \text{ADJ} \in\} \text{ OBJ})$

(38)



Attempting to add a second instance of *er* in the sentence, so that each of er_L and er_P has a separate word contributing a PRED value, results in ungrammaticality. The clause again requires two functions of *er* to be present, er_L and er_P, but this time two lexical specifications for *er* are generated, one for each instance. The lexical specification from (37) is still valid, because the subspecifications ER$_L$ and ER$_P$ must both be part of the specification for the leftmost instance of *er*. The attempt to generate a specification for the second instance of *er* fails (39): there are no other functions of *er* required by the clause and so the constraint that er_2 projects a non-empty set cannot be satisfied.

(39) er_2 N (DIS $\uparrow$)

$\{E\text{: \%ER}_1\text{, ..., \%ER}_n\}, |E| \geq 1$

$\%\text{ER}_i = \{\text{ER}_X \mid \text{ER}_L \mid \text{ER}_P \mid \text{ER}_Q\}$

$\%\text{ER}_i$ = ((DIS $\uparrow$) ERPATH$_i$)

4.3 Sentences with *er*$_\mathbf{Q}$

Example (40), repeated from (21b), shows the case where two instances of *er* in a clause are grammatical. Each instance of *er* generates a lexical specification. The specification for the first instance (41a) holds the constraints for er_X and that for the second instance (41b) holds the constraints for er_Q.

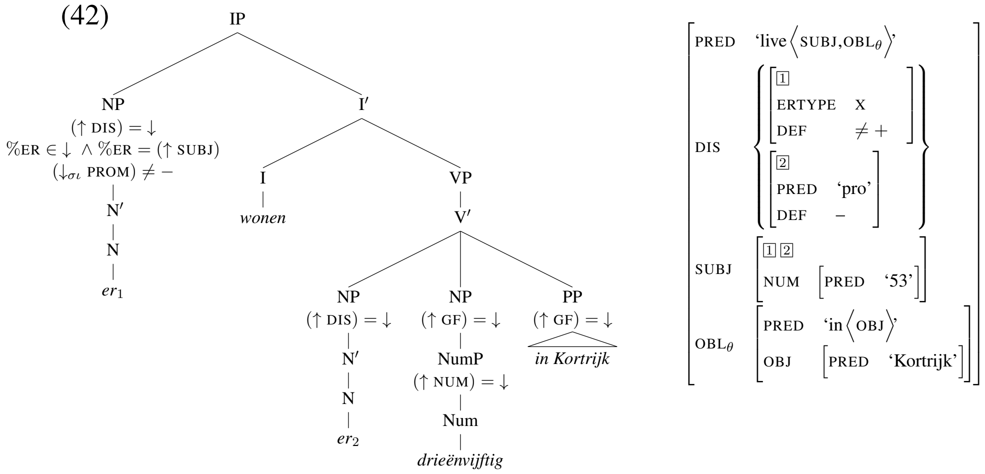
(40) *Er_X wonen er_Q drieënvijftig in Kortrijk*
ER live ER fifty-three in Kortrijk
"There are fifty-three living in Kortrijk."

(41) a. er_1 N (DIS $\uparrow$)
$\neg *_n .*_n < \hat{*} \;\wedge\; \pi^{-1}(*_n) = er$

$\{E$: ER$_1\}$
(ER$_1$ DEF) $\neq +$
(ER$_1$ ERTYPE) = X
$\neg(\%\text{ER}_j \in E).\%\text{ER}_j \neq \%\text{ER}_1 \;\wedge\; (\%\text{ER}_j$ ERTYPE)=X
ER$_1$ = ((DIS $\uparrow$) SUBJ)

b. er_2 N (DIS $\uparrow$)
$\neg *_n .\hat{*} < *_n \;\wedge\; \pi^{-1}(*_n) = er$
$(\uparrow_{\sigma\iota}$ PROM) $= -$
$\{E$: ER$_2\}$

(ER$_2$ PRED) = 'pro'
(ER$_2$ DEF) $= -$
(ER$_2$ {COMP|NUM})
ER$_2$ = ((DIS $\uparrow$) {SUBJ | OBJ | OBJ$_\theta$})

(42)


If the second instance of *er* is deleted, the sentence becomes ungrammatical (43).

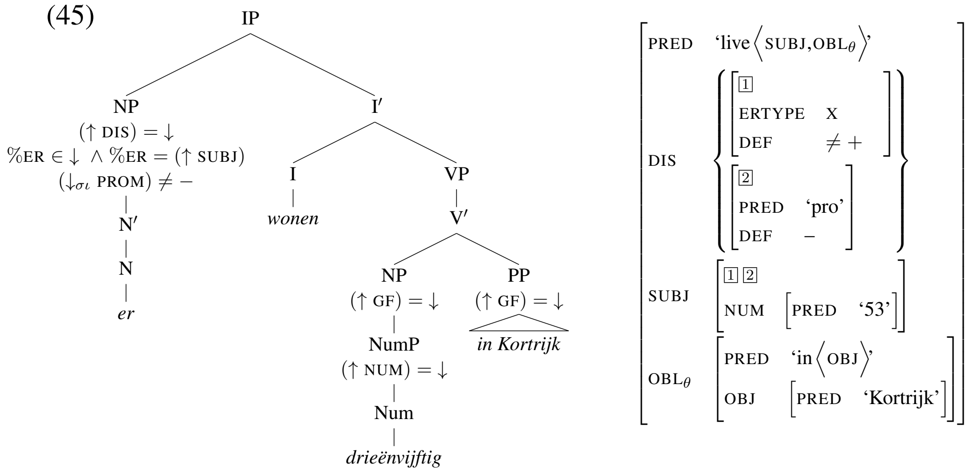
(43) * *Er_{XQ} wonen drieënvijftig in Kortrijk*
ER live fifty-three in Kortrijk
(intended) "There are fifty-three living in Kortrijk."

The lexical specification for the single instance of *er* must now hold the constraints for both er_X and er_Q (44). Although the f-structure is well-formed, ungrammaticality arises at information structure because the constraint $(\uparrow_{\sigma\iota}$ PROM$) = -$ contributed by ER$_Q$ is incompatible with the constraint $(\downarrow_{\sigma\iota}$ PROM$) \neq -$ associated with Spec-IP (45).

(44) *er* N $(\text{DIS} \uparrow)$

$$\begin{array}{l}
(\uparrow_{\sigma\iota}\ \text{PROM}) = \ - \\
\neg *_n .*_n < \hat{*} \ \wedge \ \pi^{-1}(*_n) = er \\
\neg *_n .\hat{*} < *_n \ \wedge \ \pi^{-1}(*_n) = er \\
\\
\{E\text{: ER}_1\text{, ER}_2\} \\
(\text{ER}_1\ \text{DEF}) \neq \ + \\
(\text{ER}_1\ \text{ERTYPE}) = \text{X} \\
\neg(\%\text{ER}_j \in E).\%\text{ER}_j \neq \%\text{ER}_1 \ \wedge \ (\%\text{ER}_j\ \text{ERTYPE})\text{=X} \\
\text{ER}_1 = ((\text{DIS} \ \uparrow)\ \text{SUBJ}) \\
\\
(\text{ER}_2\ \text{PRED}) = \text{`pro'} \\
(\text{ER}_2\ \text{DEF}) = \ - \\
(\text{ER}_2\ \{\text{COMP}|\text{NUM}\}) \\
\text{ER}_2 = ((\text{DIS} \ \uparrow)\ \{\text{SUBJ} \mid \text{OBJ} \mid \text{OBJ}_\theta\})
\end{array}$$

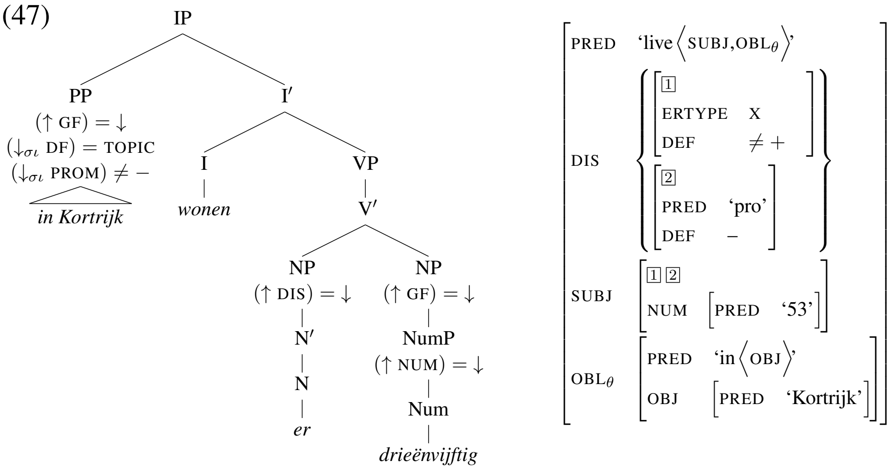
(45)



However, if the first instance of *er* is deleted and the PP *in Kortrijk* ‘in Kortrijk’ occupies Spec-IP as the topic, the resulting sentence is grammatical (46). The single instance of *er* no longer occupies a position that has an information structure constraint (47).

(46) *In Kortrijk wonen* er_{XQ} *drieënvijftig*
In Kortrijk live ER fifty-three
“There are 53 living in Kortrijk”

(47)



5 Conclusion

The above account demonstrates how the LFG architecture can account for the complex distribution of *er*, including its ability to refer to multiple distinct antecedents. Rather than assume unexpressed or deleted elements of c-structure, the account assumes that optional resources can be added to meet the constraints introduced by other elements of the string.

The role of sets in f-structure is long established. The innovation in this paper is the ability for a set to be generated by a single lexical item. The choice of a set rather than a disjunction is motivated by the assumption that there is no upper syntactic constraint on the number of antecedents to *er*, but that pragmatic or processing constraints may introduce an effective upper limit to acceptability: compare the syntactically correct English sentence It_i *put* it_j *next to* it_k *on* it_l *using* it_l. Work to investigate this assumption is ongoing.

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Zipper-driven Parsing for LFG Grammars

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Abstract

We describe an approach to LFG parsing that is optimized for c-structure discontinuities that are established through "zipper" unification. These are characterized by parallel c-structure paths that carry the same function assignments. Wedekind and Kaplan (2020) demonstrated that LFG grammars giving rise to discontinuities with finitely bounded zipper paths can express only mildly context-sensitive dependencies and thus can be converted to equivalent linear context-free rewriting systems (LCFRSs). In principle, parsing with LCFRS grammars can be accomplished in polynomial time, but that may not be the most effective way of parsing with mildly context-sensitive dependencies. In this paper we propose a hybrid strategy for LFG parsing that is tuned to the common case of bounded zippers but still allows for putatively rare constructions that do not conform to the formal restrictions that guarantee finite boundedness. This strategy automatically takes advantage of mildly context-sensitive dependencies in addition to the context-free dependencies that the XLE parsing system has focused on (Maxwell and Kaplan 1996).

1 Introduction

The prohibition against c-structures with nonbranching dominance (NBD) chains ensures the decidability of the recognition/parsing problem for LFG grammars (Kaplan and Bresnan 1982) but still that problem is known to be NP-complete (Berwick 1982, Trautwein 1995) and thus intractable in the worst case. However, grammars for actual languages seem not to exploit all the mathematical power that the LFG formalism makes available, as witnessed by the fact that parsing and generation systems, for example, the XLE system, have been constructed that are practical for broad coverage grammars and naturally occurring sentences (Crouch et al. 2008, Maxwell and Kaplan 1996).

The implementations of these systems must be taking advantage implicitly of certain patterns of dependencies that are characteristic of linguistic grammars even if those properties have not been clearly articulated and explicitly coded. XLE in particular is optimized for context-free structures in sentences for which disjunctions arising from words and phrases that are distant from each other in the string are not incompatible. This optimization is based on the disjunctive constraint and lazy contexted constraint satisfaction algorithms developed by Maxwell and Kaplan (1991, 1996) (henceforth the MK algorithms). The XLE experience has shown these algorithms to be effective for a large majority of sentences in many languages, even though performance may—and does—degrade for constructions with dependencies that are more sensitive to context.

Recent papers (Wedekind and Kaplan 2020, Kaplan and Wedekind 2019) have identified a class of dependencies that are more sensitive to context

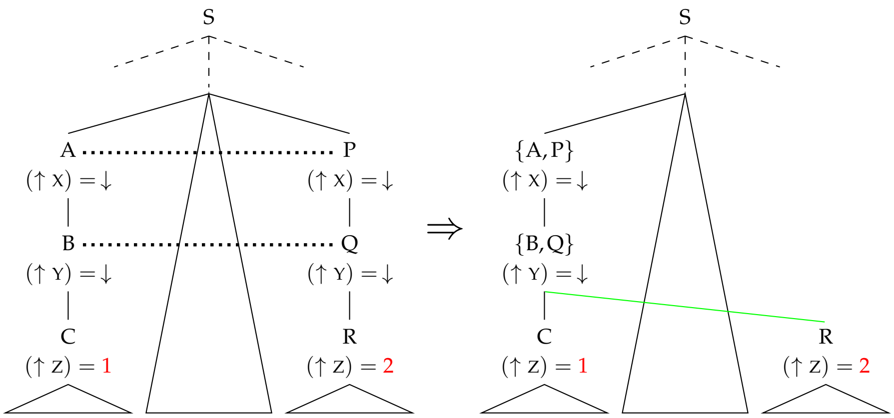


Figure 1: Zipping of discontinuous constituents.

but may still allow for efficient processing of a broader range of commonly occurring sentences. These dependencies allow information carried by distant c-structure nodes of discontinuous constituents to interact as long as those nodes map to f-structure through c-structure paths that are annotated with the same function assignments. This pattern has been described as "zipper" unification (Maxwell and Kaplan 1996) and is illustrated in Figure 1. The paths from the common mother of A and P to B and Q in the left tree are labeled in parallel by the $(\uparrow \text{X}) = \downarrow$ and $(\uparrow \text{Y}) = \downarrow$ function assignments and they can therefore be zipped into the structure on the right. This represents how information from the separate paths can be systematically combined. In particular it reveals the inconsistency between the $(\uparrow \text{Z}) = 1$ and $(\uparrow \text{Z}) = 2$ annotations even though the B and Q nodes dominate substrings that are not adjacent.

The key formal property of two nodes n and n' that zip together is that they map to the same f-structure (i.e., $\phi(n) = \phi(n')$) or, equivalently, that n and n' both belong to $\phi^{-1}(f)$ for some unit of f-structure f. If it can be established for an LFG grammar G that discontinuities are exclusively captured through zipper unification and the size of $\phi^{-1}(f)$ is bounded by a constant for all f-structure units for all sentences, then that grammar can be converted to a grammar G' in the formalism of linear context-free rewriting systems (LCFRSs) (Seki et al. 1991, Kallmeyer 2010), a grammatical formalism that can encode mildly context-sensitive dependencies. The LCFRS grammar G' is equivalent to G in that it produces the same f-structures for the same sentences (Wedekind and Kaplan 2020). Wedekind and Kaplan describe notational and derivational restrictions, here summarized in Section 2, that G must meet in order to determine whether G is convertible. They observe that grammars in this subclass, the finitely bounded LFG grammars, are still likely suitable for natural language description (see also Kaplan and Wedekind 2019).

The LCFRS conversion identifies and combines the information from all possible zippers, precomputing and eliminating from G' the effect of any combinations that would give rise to unsatisfiable f-descriptions. On its face, the advantage is that LCFRS parsing algorithms applied to G' will simulate the recognition of all and only the c-structures whose f-descriptions are guaranteed to be satisfiable. This crucially differs from the two-stage process of typical LFG parsing algorithms, including XLE, of context-free chart parsing that produces a representation of many candidate c-structures whose f-descriptions are then checked for satisfiability. The two-stage process is exponential and intractable in the worst case, because of the many candidate c-structure constituents that must be evaluated, while one-stage LCFRS parsing is known to take time that is polynomial in the length of the input string.

Realizing the advantages of direct LCFRS parsing for a given finitely-bounded G depends on the feasibility of carrying out the conversion and also on the size of the resulting G'. The conversion process for an arbitrary G may be too expensive and the equivalent LCFRS grammar too large for practical use. However, following Wedekind and Kaplan (2020) we point out in Section 3 that the grammar expansion is likely to be limited for LFG grammars describing natural languages and it may be feasible to apply direct LCFRS parsing to such languages. But that may not be the most effective way of exploiting the zipper configurations implicit in G's derivations.

Thus in Section 4 we consider a strategy that applies not to the given grammar G but to a specialization of G containing only the annotated rules that define the f-structures for a particular input string. The specialized grammar is likely to be finitely bounded even if the entire G is not, and the LCFRS for the specialized grammar is likely to be much smaller and to operate more efficiently than the LCFRS for the larger grammar. In Section 5 we sketch an alternative strategy for propagating zipper information that works even if the specialized grammar lies outside the finitely bounded class. This involves identifying and eliminating the zipper-entailed inconsistencies of the specialized grammar and then using MK bottom-up satisfiability algorithms to interpret any residual annotations. Performance for this zipper-driven strategy is proportionately as good as XLE in the context-free-equivalent case that XLE does particularly well at, is proportionately better than XLE if the particular sentence has only zipper dependencies, and is proportionately no worse than XLE if the sentence involves more complex annotations that interact in more intricate ways.

2 Finitely bounded LFG grammars

Seki et al. (1993) first established the connection between a restricted subclass of LFG grammars and formal systems that can describe only mildly context-sensitive dependencies. Their *finite copying grammars* permit rules with the very limited functional annotations in (1a) and that also satisfy the bounding condition (1b).

(1) a. Each category on the right-side of a rule can be annotated with at most one function assignment of the form $(\uparrow \textsc{f}) = \downarrow$ and any number of atom-value assignments only of the form $(\uparrow \textsc{a}) = \textsc{v}$.

b. There is a constant k such that no more than k nodes map to the same f-structure element f in any derivation. That is $|\phi^{-1}(f)| \leq k$.

It is decidable whether the bounding condition holds for such a notationally restricted grammar, and such a bounded grammar can be converted to an equivalent LCFRS. A grammar with these annotations is expressive enough to specify zipper paths as in Figure 1, but these restrictions are obviously too severe for linguistic description. This notation disallows, for example, the trivial $\uparrow = \downarrow$ annotations that mark the heads and coheads in the functional domain of a predicate, reentrancies such as $(\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{obj})$ that represent functional control, multi-attribute value specifications, such as $(\uparrow \textsc{subj num}) = \textsc{sg}$, that encode agreement requirements, and any direct specification of feature values on daughter nodes, as in $(\downarrow \textsc{case}) = \textsc{nom}$.

The finitely bounded grammars of Wedekind and Kaplan (2020) allow the linguistically more suitable annotations in (2), but they must also satisfy other conditions whose effect is to limit their expressive power and endow them with the same mathematical and computational properties, including LCFRS equivalence, as Seki et. al's finite copying grammars.

(2) Basic annotations

$(\uparrow/\downarrow \textsc{a b c} \cdots) = \textsc{v}$	general atom-value annotations
$(\uparrow \textsc{f}) = \downarrow$	function assignment
$\uparrow = \downarrow$	trivial (co)head identity

Reentrancies

$(\uparrow \textsc{f g}) = (\uparrow \textsc{h})$	functional control
$(\uparrow \textsc{f}) = (\uparrow \textsc{h})$	local-topic link
$(\downarrow \textsc{g}) = (\uparrow \textsc{h})$	daughter-mother control
$(\downarrow \textsc{g}) = (\downarrow \textsc{h})$	daughter sharing
$(\downarrow \textsc{g}) = \uparrow$	promotion
$(\uparrow \textsc{f}) = \uparrow$	mother cycle
$(\downarrow \textsc{g}) = \downarrow$	daughter cycle

The additional conditions that a finitely bounded grammar G must meet are listed in (3) (Wedekind and Kaplan 2020).

(3) a. Each right-side category is annotated with at most one function assignment $(\uparrow \text{F}) = \downarrow$ and trivial (co)head identities $\uparrow = \downarrow$ and function assignments always appear in complementary distribution (to keep separate the properties of a head and its complements).

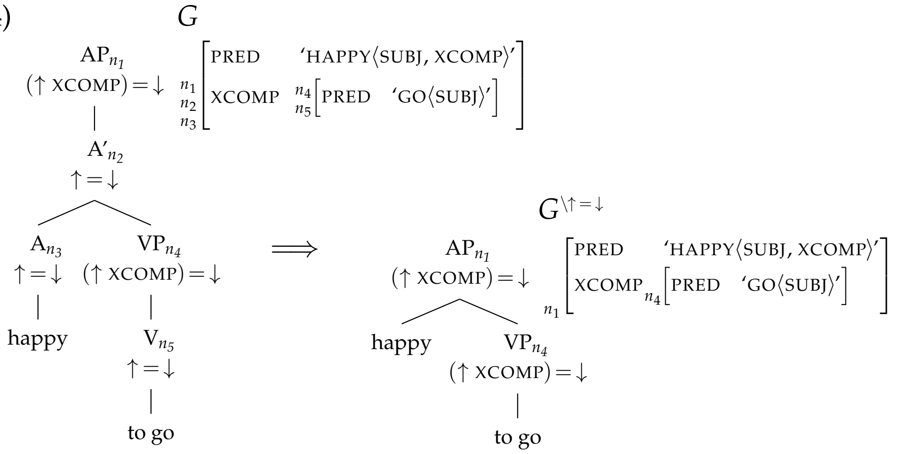
b. The *functional domains* of G (the collections of $\uparrow = \downarrow$-annotated nodes that map to the same f-structure) are height-bounded.

c. The *reentrancy-free kernel* of G (the grammar formed by removing all reentrancies from G) is bounded as in (1b).

d. Reentrancies are nonconstructive.

There is a simple transformation of a grammar G with height-bounded functional domains into a strongly equivalent LFG grammar $G^{\backslash\uparrow=\downarrow}$ that no longer contains $\uparrow = \downarrow$ annotations. The transformation is accomplished by recursively replacing a category annotated with $\uparrow = \downarrow$ in the right side of one rule by the right sides of all the rules expanding that category, and making the appropriate replacements of $\uparrow$ for $\downarrow$ to preserve the f-structure mappings. The effect of this transformation is illustrated in (4).

(4)



Although the grammar $G^{\backslash\uparrow=\downarrow}$ resulting from this simple transformation may be substantially larger than G, the transformation makes it unnecessary to give further consideration to $\uparrow = \downarrow$ annotations. And of relevance to present purposes, it exposes any zipper paths that trivial annotations may otherwise obscure, as pictured in Figure 2.

The nonconstructivity condition (3d) ensures that only function assignments (the zipper-forming annotations of finite copying grammars), can cause two nodes to map to the same f-structure.[1] The difference between constructive and nonconstructive reentrancies is illustrated in Figure 3. On the left side the reentrancies are constructive because they cause the nodes

[1]This condition has appeared implicitly in LFG grammars and has also been mentioned in the LFG literature (Crouch et al. 2008, Zaenen and Kaplan 1995).

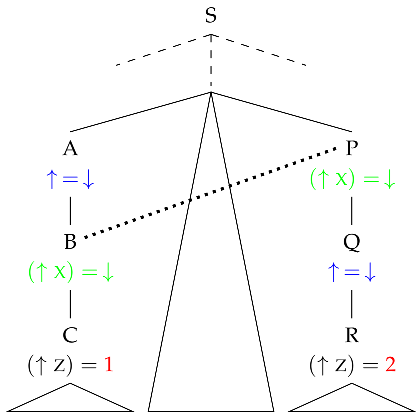


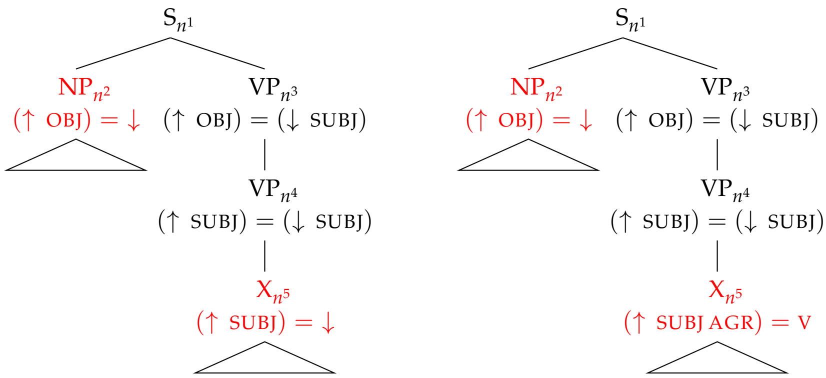
Figure 2: Head identities obscure zippers.

n^2 and n^5 to map to the same f-structure element. If reentrancies are nonconstructive, as in the derivation on the right side, they can only propagate atom-value information across the f-structure elements. Nonconstructive reentrancies do not introduce new node-to-f-structure mappings and thus do not affect the bounds on the ϕ^{-1} node classes.

The nonconstructivity of reentrancies is undecidable for grammars with functional control annotations (Wedekind and Kaplan 2020). However, in derivations that meet the requirements of the Coherence Condition, annotations such as $(\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{obj})$ can always be reduced to daughter-mother control annotations. This is because the controllee (SUBJ) is a governable function in an open (XCOMP) complement and therefore must be licensed by the complement's semantic form. These licensing semantic forms are always introduced by simple PRED equations associated with individual lexical entries, such as $(\uparrow \textsc{pred}) = \text{`}\textsc{walk}\langle\textsc{subj}\rangle\text{'}$. Therefore, $(\uparrow \textsc{pred}) = \text{`}\textsc{walk}\langle\textsc{subj}\rangle\text{'}$ must instantiate to the equation $(\phi(n')\ \textsc{pred}) = \text{`}\textsc{walk}\langle\textsc{subj}\rangle\text{'}$ at some node n', and the f-description must also entail an equation $(\phi(n)\ \textsc{xcomp}) = \phi(n')$ that links the complement to a higher clause and is also available to shorten the control equation. Wedekind and Kaplan (2020) provide a formal specification of nonconstructivity, this expected consequence of Coherence, and of other technical requirements that are sufficient to decide whether an arbitrary LFG grammar belongs to the finitely bounded subclass and therefore has an LCFRS equivalent.

3 Direct LCFRS parsing

For a k-bounded LFG G the equivalent LCFRS G' is constructed by precomputing the zipper interactions in G. Because trivial annotations obscure zippers, as depicted in Figure 2, the LCFRS is constructed from $G^{\backslash\uparrow=\downarrow}$ rules



Constructive

$\phi(n^2) = \phi(n^5)$

Nonconstructive

$(\phi(n^2)\ \textsc{obj agr}) = \textsc{v}$

Figure 3: Constructive and nonconstructive reentrancies.

rather than G rules. Thus the LCFRS for G is constructed in two stages. In the first stage a $\uparrow = \downarrow$-free LFG grammar $G^{\setminus\uparrow=\downarrow}$ is created by eliminating the $\uparrow = \downarrow$-annotated categories in favor of equivalent collections of flattened LFG rules. The second stage of the construction produces LCFRS rules for $G^{\setminus\uparrow=\downarrow}$. The LCFRS rule construction is based on locally disclosing structure sharing through zipper unification, as illustrated in Figure 1. The construction hypothesizes finite sequences of $G^{\setminus\uparrow=\downarrow}$ rules that might expand the categories realizing a k-bounded zipper, and it builds an LCFRS rule if the sequence gives rise to satisfiable f-descriptions. The LCFRS rule categories are refined by atom-value decorations containing the atomic-valued information that could be associated with the corresponding f-structure element in any valid LFG derivation (see Wedekind and Kaplan (2020) for more details on the construction and the parsing complexity for the LCFRSs G' that result from linguistically motivated k-bounded LFG grammars.)

The LCFRS G' can be used to parse sentences from $L(G)$, provided the LFG grammar G is finitely bounded. (XLE or some other LFG parser must be used if G is not finitely bounded.) LCFRS parsing complexity is $\mathcal{O}(|G'| \cdot n^{k(r+1)})$ (Seki et al. 1991) where n is the length of the input string, $|G'|$ is the number of rules in G', k is the fan-out of G' (the degree of discontinuity of G), and r is the rank of G' (the maximum number of phrasal categories in any G' rule). Parsing complexity is polynomial in the length of the input string (n) but, without further restrictions, parsing with the equivalent grammar may be impractical because the LCFRS G' can be exponentially larger than G (Wedekind and Kaplan 2020).

For linguistically motivated grammars, however, the potential growth is limited by conventions and principles of LFG theory and the properties of natural languages. In LFG, the distribution of trivial annotations is regulated by the principles of X-bar theory and its structure-function mapping principles (Bresnan 2001, Dalrymple 2001). In this (epsilon-free) framework the height of a functional domain is effectively bounded by the maximum number of coheads that can associate to a single predicate plus 1 for the head (denoted by c), the maximum number k of discontinuous c-structure phrases that can realize a particular function, and the maximum number g of different grammatical functions that an individual predicate can govern. Thus parsing complexity for a linguistically motivated grammar G is proportional to $|G^{\setminus\uparrow=\downarrow}| \leq |G|^{kg+c+1}$, where k, g, and c are typically rather small.[2] (In the broad-coverage, commercial-grade ParGram grammars, for example, no word in either lexicon governs more than four functions, and very few words allow even that many (in English only the word *bet*)).

In the second phase of the LCFRS construction, sequences of $G^{\setminus\uparrow=\downarrow}$ rules are converted into LCFRS rules with decorated categories. From the observations above, we can assume that for a linguistically motivated LFG G the rank of G' is bounded by $g + c$, the LCFRS categories for the grammatical functions are at most k-ary, and the categories for the coheads are unary. Thus the size bound on $G^{\setminus\uparrow=\downarrow}$ accounts for rule sequences of length up to k and therefore the number of LCFRS rules before they are decorated with agreement features. Those skeletal rules are refined by the combinations of agreement features that are associated with particular syntactic categories and grammatical functions, and the number of these combinations is limited by morphosyntactic constraints (nouns carry PERS and NUM but not TNS). Thus, with a denoting the maximum number of attested agreement feature combinations, the size of G' is bounded by $a^{g+c+1}|G|^{kg+c+1}$. (For instance, for English NP f-structures the number of (fully-specified) agreement feature combinations would be $24 = 3(\text{PERS}) \cdot 2(\text{NUM}) \cdot 4(\text{CASE})$; as shown in Wedekind and Kaplan (2020), the predicate values (semantic forms) do not have to be distinguished.)

4 Grammar specialization

Even if it is feasible to construct the LCFRS for a linguistically motivated grammar in its entirety, that may not be the best way of taking advantage of the mildly context-sensitive dependencies of natural language. As alternatives that may be more effective, we consider parsing strategies that avoid constructing the LCFRS for the whole grammar and instead only operate on the typically much smaller subset of annotated c-structure rules that participate in the analysis of a given input string. Such a specialized grammar may be finitely bounded even if the entire grammar is not, and the corresponding LCFRS may be much more manageable. Grammar specialization is also the first stage of a zipper-driven parsing strategy that may

[2]The exponent is increased by 1 to account for trivial-free rules obtained from functional domains smaller than $kg + c$.

be helpful for broad-coverage grammars that do not meet all the conditions of finite bounding.

We first apply a context-free chart parser to a given input string s, as does XLE, but we do not then execute the bottom-up traversal of chart edges (Maxwell and Kaplan 1996) to check for f-description satisfiability. Instead, we extract from the resulting parse-chart an LFG grammar G_s that has all and only the rules and annotations that are specialized to the particular input s. Grammar specialization depends on the fact that context-free languages are closed under intersection with regular languages (Bar-Hillel et al. 1961). As Lang (1992) and others have pointed out, a context-free grammar specialized to a particular s can be extracted in cubic time by any number of context-free parsing algorithms, and such an algorithm can easily be modified to record the annotations associated with the categories even though those are not evaluated during the context-free parse. The size of the resulting grammar G_s is proportional to $|s|^3$ (and G_s is k-bounded if G is k-bounded).

We illustrate grammar specialization with an analysis of the Dutch double infinitive construction in (5).

(5) ... (dat) hij het boek heeft kunnen lezen
... (that) he the book has able read
... (that) he has been able to read the book

This sentence is assigned the annotated c-structure and f-structure depicted in Figure 4.[3] For sentence (5) and the grammar G of Bresnan et al. (1982) we obtain the specialized grammar G_s that includes the rules in (6).

[3]Johnson (1986) used this example to demonstrate that the natural extension for these sentences of the Dutch grammar of Bresnan et al. (1982) violates the Nonbranching Dominance Constraint, and thus calls into question the linguistic suitability of the Kaplan and Bresnan (1982) formulation. In fact, this particular sentence does not violate the later refinement of the NBD constraint described by Kaplan and Maxwell (1996) and Dalrymple (2001) wherein functional annotations are also taken into account in determining whether a category has repeated. The recursive VPs in this sentence have different annotations, but sentences with more intransitive verbs and deeper XCOMP embeddings would still be disallowed. We return to this point below.

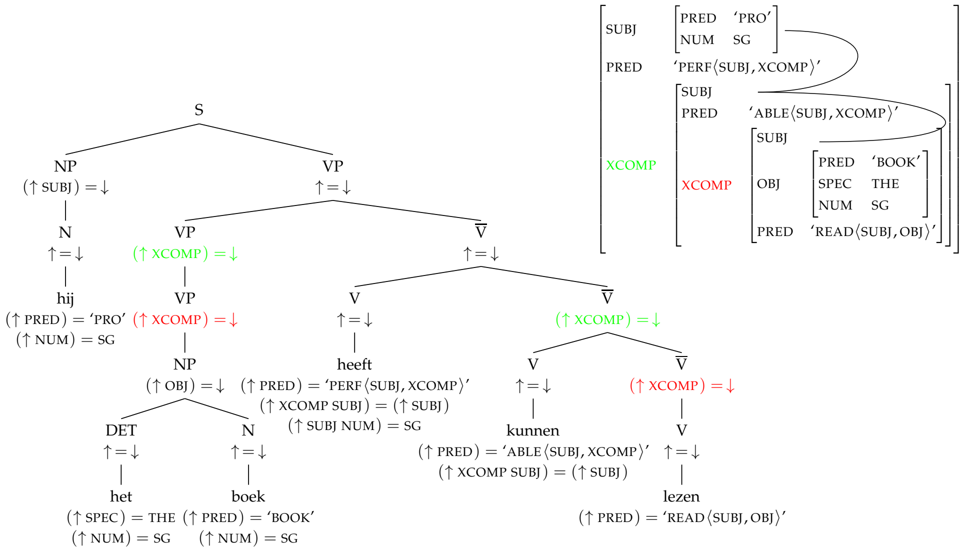


Figure 4: The Bresnan et al. (1982) analysis of sentence (5). The zipped functions are indicated in green and red.

(6)

$$
{}_0\mathrm{S}_6 \rightarrow \underset{(\uparrow \text{SUBJ}) = \downarrow}{{}_0\mathrm{NP}_1} \quad \underset{\uparrow = \downarrow}{{}_1\mathrm{VP}_6}
\qquad
{}_1\mathrm{VP}_6 \rightarrow \underset{(\uparrow \text{XCOMP}) = \downarrow}{{}_1\mathrm{VP}_3} \quad \underset{\uparrow = \downarrow}{{}_3\overline{\mathrm{V}}_6}
$$

$$
{}_1\mathrm{VP}_3 \rightarrow \underset{(\uparrow \text{XCOMP}) = \downarrow}{{}_1\mathrm{VP}_3}
\qquad
{}_1\mathrm{VP}_3 \rightarrow \underset{(\uparrow \text{OBJ}) = \downarrow}{{}_1\mathrm{NP}_3}
$$

$$
{}_3\overline{\mathrm{V}}_6 \rightarrow \underset{\uparrow = \downarrow}{{}_3\mathrm{V}_4} \quad \underset{(\uparrow \text{XCOMP}) = \downarrow}{{}_4\overline{\mathrm{V}}_6}
\qquad
{}_4\overline{\mathrm{V}}_6 \rightarrow \underset{\uparrow = \downarrow}{{}_4\mathrm{V}_5} \quad \underset{(\uparrow \text{XCOMP}) = \downarrow}{{}_5\overline{\mathrm{V}}_6}
$$

$$
{}_0\mathrm{NP}_1 \rightarrow \underset{\uparrow = \downarrow}{{}_0\mathrm{N}_1}
\qquad
{}_1\mathrm{NP}_3 \rightarrow \underset{\uparrow = \downarrow}{{}_1\mathrm{DET}_2} \quad \underset{\uparrow = \downarrow}{{}_2\mathrm{N}_3}
$$

$$
{}_5\overline{\mathrm{V}}_6 \rightarrow \underset{\uparrow = \downarrow}{{}_5\mathrm{V}_6}
\qquad
{}_0\mathrm{N}_1 \rightarrow \begin{array}{c} {}_0\mathrm{hij}_1 \\ (\uparrow \text{PRED}) = \text{'PRO'} \\ (\uparrow \text{NUM}) = \text{SG} \end{array}
$$

$$
{}_1\mathrm{DET}_2 \rightarrow \begin{array}{c} {}_1\mathrm{het}_2 \\ (\uparrow \text{SPEC}) = \text{THE} \\ (\uparrow \text{NUM}) = \text{SG} \end{array}
\qquad
{}_2\mathrm{N}_3 \rightarrow \begin{array}{c} {}_2\mathrm{boek}_3 \\ (\uparrow \text{PRED}) = \text{'BOOK'} \\ (\uparrow \text{NUM}) = \text{SG} \end{array}
$$

$$
{}_3\mathrm{V}_4 \rightarrow \begin{array}{c} {}_3\mathrm{heeft}_4 \\ (\uparrow \text{PRED}) = \text{'PERF}\langle\text{SUBJ, XCOMP}\rangle\text{'} \\ (\uparrow \text{XCOMP SUBJ}) = (\uparrow \text{SUBJ}) \\ (\uparrow \text{SUBJ NUM}) = \text{SG} \end{array}
\qquad
{}_4\mathrm{V}_5 \rightarrow \begin{array}{c} {}_4\mathrm{kunnen}_5 \\ (\uparrow \text{PRED}) = \text{'ABLE}\langle\text{SUBJ, XCOMP}\rangle\text{'} \\ (\uparrow \text{XCOMP SUBJ}) = (\uparrow \text{SUBJ}) \end{array}
$$

$$
{}_5\mathrm{V}_6 \rightarrow \begin{array}{c} {}_5\mathrm{lezen}_6 \\ (\uparrow \text{PRED}) = \text{'READ}\langle\text{SUBJ, OBJ}\rangle\text{'} \end{array}
$$

The specialized grammar G_s contains refinements of all and only the G rules that describe the c-structures of (5). The categories of those rules are elaborated with indexes that record the beginning and ending positions of the substrings of s that they dominate. Thus the category ${}_0\mathrm{S}_6$ is the refinement of S that covers the entire sentence and the category ${}_1\mathrm{NP}_3$ covers the words of the second NP. The terminals are also refined with their particular string positions, so grammar G_s derives the specialized string in (7)

(7) ${}_0\mathrm{hij}_1$ ${}_1\mathrm{het}_2$ ${}_2\mathrm{boek}_3$ ${}_3\mathrm{heeft}_4$ ${}_4\mathrm{kunnen}_5$ ${}_5\mathrm{lezen}_6$

if and only if G derives the original input (5) and both are assigned the same f-structures. Note that there are infinitely many annotated c-structures for the specialized input sentence because the VP rule

$$
{}_1\mathrm{VP}_3 \;\rightarrow\; \begin{array}{c} {}_1\mathrm{VP}_3 \\ (\uparrow \textsc{xcomp}) = \downarrow \end{array}
$$

is recursive and thus allows for derivations that violate the Nonbranching Dominance Condition.

If the emptiness algorithm for context-free languages establishes that $L(G_s) = \emptyset$, we know that s is ungrammatical with respect to G. Otherwise, s has at least one annotated c-structure and further analysis is necessary to determine whether any G_s derivations also meet the functional well-formedness requirements of LFG theory. As Wedekind and Kaplan (2020) have demonstrated, it is decidable whether G_s is finitely bounded and thus whether an equivalent LCFRS G'_s can be constructed to resolve the functional annotations for s. As noted, the complexity of LCFRS parsing for the entire grammar G (if in fact it is finitely bounded) is $\mathcal{O}(|G'| \cdot n^{k(r+1)})$ where G' is bounded by $a^{g+c+1}|G|^{kg+c+1}$. This formula applies to the specialized LCFRS G'_s but with parameters a_s, k_s, g_s, c_s, r_s that are typically much smaller and more likely to be practical than a, k, g, c, r (for our Dutch example sentence, for example, k_s is 2, g_s is 2, and r_s is 2).

The construction of G'_s begins with a top-down traversal of G_s that evaluates the annotations for c-structure paths with parallel function assignments to determine whether the zippers are bounded. If the zippers are bounded, this is followed by a bottom-up pass to detect constructive reentrancies and to test compatibility of any atom-valued features that might be promoted upwards by (nonconstructive) reentrancies. All this effort would be wasted for the (putatively rare) sentences for which G_s fails to meet the bounding conditions and parsing reverts to an MK bottom-up execution sequence. An alternative is to perform only the top-down zipper traversal in every case and use the information it uncovers to guide the operation of the bottom-up algorithms. The overall process will approach LCFRS efficiency automatically for specialized grammars that happen to be finitely bounded. This is the zipper-driven strategy that we illustrate below.

5 Zipper-driven parsing

We start as above by extracting the specialized grammar G_s from the context-free parser-chart for s. We then transform the rules of that grammar to produce a zipper-free grammar G^z_s whose annotations are free of zipper-entailed inconsistencies but continue to define all the f-structures of G_s and thus also of G. The rules of G^z_s are subsequently interpreted as a parse-chart that MK algorithms can operate on to check for inconsistencies that escaped the top-down zipper identification (for example, those arising from constructive reentrancies), if any. If there are no such inconsistencies, the bottom-up satisfiability check will quickly verify that the language of the annotated context-free grammar G_s^z is not empty. Otherwise, zipper-driven parsing may degrade to the performance of XLE for constructions that can only be described by more intricate annotations. In the following we describe these steps in more detail.

The construction of G_s^z from G_s involves several operations the first of which is to eliminate trivial $\uparrow = \downarrow$ annotations by promoting the daughter category strings of the rules that expand a trivially-annotated category. The trivial-free grammar $G_s^{\backslash\uparrow=\downarrow}$ that we obtain from G_s through trivial elimination is shown in (8).

(8) a. $${}_0\mathrm{S}_6 \rightarrow \begin{array}{cccc} {}_0\mathrm{NP}_1 & {}_1\mathrm{VP}_3 & {}_3\mathrm{heeft}_4 & {}_4\overline{\mathrm{V}}_6 \\ (\uparrow \textsc{subj}) = \downarrow & (\uparrow \textsc{xcomp}) = \downarrow & (\uparrow \textsc{pred}) = \text{‘}\textsc{perf}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & (\uparrow \textsc{xcomp}) = \downarrow \\ & & (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \\ & & (\uparrow \textsc{subj num}) = \textsc{sg} & \end{array}$$

b. $${}_1\mathrm{VP}_3 \rightarrow \begin{array}{c} {}_1\mathrm{VP}_3 \\ (\uparrow \textsc{xcomp}) = \downarrow \end{array}$$

c. $${}_1\mathrm{VP}_3 \rightarrow \begin{array}{c} {}_1\mathrm{NP}_3 \\ (\uparrow \textsc{obj}) = \downarrow \end{array}$$

d. $${}_4\overline{\mathrm{V}}_6 \rightarrow \begin{array}{cc} {}_4\mathrm{kunnen}_5 & {}_5\overline{\mathrm{V}}_6 \\ (\uparrow \textsc{pred}) = \text{‘}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & (\uparrow \textsc{xcomp}) = \downarrow \\ (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \end{array}$$

e. $${}_5\overline{\mathrm{V}}_6 \rightarrow \begin{array}{c} {}_5\mathrm{lezen}_6 \\ (\uparrow \textsc{pred}) = \text{‘}\textsc{read}\langle \textsc{subj}, \textsc{obj}\rangle\text{’} \end{array}$$

f. $${}_0\mathrm{NP}_1 \rightarrow \begin{array}{c} {}_0\mathrm{hij}_1 \\ (\uparrow \textsc{pred}) = \text{‘}\textsc{pro}\text{’} \\ (\uparrow \textsc{num}) = \textsc{sg} \end{array}$$

g. $${}_1\mathrm{NP}_3 \rightarrow \begin{array}{cc} {}_1\mathrm{het}_2 & {}_2\mathrm{boek}_3 \\ (\uparrow \textsc{spec}) = \textsc{the} & (\uparrow \textsc{pred}) = \text{‘}\textsc{book}\text{’} \\ (\uparrow \textsc{num}) = \textsc{sg} & (\uparrow \textsc{num}) = \textsc{sg} \end{array}$$

We then execute a simple top-down strategy for identifying zippers and solving their functional constraints. The zippers in this process are represented as those annotated subsets of specialized terminals and nonterminals that result from expanding categories top-down from the zipper-root $\{{}_0\mathrm{S}_6\}$ and grouping together daughter categories that are annotated with the same function assignment. Thus the root is expanded with rule (8a), and the instantiated description of the derived annotated categories is tested for well-formedness. This test eliminates as ill-formed zipper rules with inconsistent descriptions and rules that cannot be rendered complete and coherent through bottom-up propagation. In our example, the description is consistent and the subcategorization requirements of the local predicate are satisfied. Moreover, the XCOMP function assignment common to ${}_1\mathrm{VP}_3$ and ${}_4\overline{\mathrm{V}}_6$, depicted in green, gives rise to a two-element set for the discontinuous zipper constituent $\{{}_1\mathrm{VP}_3, {}_4\overline{\mathrm{V}}_6\}$. This reflects the fact that the discontinuity bound for this construction (and for Dutch as a whole) is two. The zipper conversion of (8a) is illustrated in (9).

(9)
$$\begin{array}{cccccc}
{}_0\mathrm{S}_6 \rightarrow & {}_0\mathrm{NP}_1 & {}_1\mathrm{VP}_3 & {}_3\mathrm{heeft}_4 & {}_4\overline{\mathrm{V}}_6 \\
& (\uparrow \textsc{subj}) = \downarrow & (\uparrow \textsc{xcomp}) = \downarrow & (\uparrow \textsc{pred}) = \text{‘}\textsc{perf}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & (\uparrow \textsc{xcomp}) = \downarrow \\
& & & (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \\
& & & (\uparrow \textsc{subj num}) = \textsc{sg} &
\end{array}$$

$$\Downarrow$$

$$\begin{array}{ccccc}
\{{}_0\mathrm{S}_6\} \rightarrow & \{{}_0\mathrm{NP}_1\} & \{{}_1\mathrm{VP}_3, {}_4\overline{\mathrm{V}}_6\} & \{{}_3\mathrm{heeft}_4\} \\
& (\downarrow \textsc{num}) = \textsc{sg} & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{‘}\textsc{perf}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} \\
& (\uparrow \textsc{subj}) = \downarrow & (\uparrow \textsc{xcomp}) = \downarrow & \\
& & (\downarrow \textsc{subj}) = (\uparrow \textsc{subj}) &
\end{array}$$

The shared assignment also allows the functional control equation to be shortened to a mother-daughter control that specifies the identity of the matrix and embedded clause subjects. Because of the SUBJ assignment to the initial NP, the agreement requirement of the verb migrates to the $\{{}_0\mathrm{NP}_1\}$ so that it can propagate top-down and eventually come into contact with the singular pronoun. The number agreement feature also transfers to $\{{}_1\mathrm{VP}_3, {}_4\overline{\mathrm{V}}_6\}$ against the possibility left open by $(\downarrow \textsc{subj}) = (\uparrow \textsc{subj})$ that the subject is realized in the embedded clause.

Now consider the decorated zipped ${}_1\mathrm{VP}_3, {}_4\overline{\mathrm{V}}_6$ daughters of the zipper rule in (9) depicted in (10).

(10)
$$\begin{array}{c}
\{{}_1\mathrm{VP}_3, {}_4\overline{\mathrm{V}}_6\} \\
(\downarrow \textsc{subj num}) = \textsc{sg}
\end{array}$$

$G_s^{\backslash\uparrow=\downarrow}$ has the two alternative expansions (11a,b) for ${}_1\mathrm{VP}_3$ but only a single rule for ${}_4\overline{\mathrm{V}}_6$ (11c).

(11) a. $\begin{array}{cc} {}_1\mathrm{VP}_3 \rightarrow & {}_1\mathrm{NP}_3 \\ & (\uparrow \textsc{obj}) = \downarrow \end{array}$

b. $\begin{array}{cc} {}_1\mathrm{VP}_3 \rightarrow & {}_1\mathrm{VP}_3 \\ & (\uparrow \textsc{xcomp}) = \downarrow \end{array}$

c. $\begin{array}{ccc} {}_4\overline{\mathrm{V}}_6 \rightarrow & {}_4\mathrm{kunnen}_5 & {}_5\overline{\mathrm{V}}_6 \\ & (\uparrow \textsc{pred}) = \text{‘}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & (\uparrow \textsc{xcomp}) = \downarrow \\ & (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \end{array}$

Here, the expansion with (11a,c) yields the daughter combinations in (12a) and the one with (11b,c) the combinations in (12b). The atom-value information that is inherited from the decoration of the mother (10) is shown in blue. (By convention, we assume that this information is inherited to the leftmost daughter.)

(12) a. $\begin{array}{ccc} {}_1\mathrm{NP}_3 & {}_4\mathrm{kunnen}_5 & {}_5\overline{\mathrm{V}}_6 \\ (\uparrow \textsc{obj}) = \downarrow & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{xcomp}) = \downarrow \\ (\uparrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{‘}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & \\ & (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \end{array}$

b. $\begin{array}{ccc} {}_1\mathrm{VP}_3 & {}_4\mathrm{kunnen}_5 & {}_5\overline{\mathrm{V}}_6 \\ (\uparrow \textsc{xcomp}) = \downarrow & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{xcomp}) = \downarrow \\ (\uparrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{‘}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{’} & \\ & (\uparrow \textsc{xcomp subj}) = (\uparrow \textsc{subj}) & \end{array}$

Because the daughter combination in (12a) cannot be rendered coherent through bottom-up propagation (the object is not subcategorized by the predicate ABLE) the expansion with (11a,c) does not result in a well-formed zipper rule. For the expansion with (11b,c) on the other hand we obtain the zipper rule in (13).

(13)
$$\begin{array}{cccc}
\{_1\mathrm{VP}_{3,4}\overline{\mathrm{V}}_6\} & \rightarrow & \{_1\mathrm{VP}_{3,5}\overline{\mathrm{V}}_6\} & \{_4\mathrm{kunnen}_5\} \\
(\downarrow \textsc{subj num}) = \textsc{sg} & & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{'}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{'} \\
 & & (\uparrow \textsc{xcomp}) = \downarrow & \\
 & & (\downarrow \textsc{subj}) = (\uparrow \textsc{subj}) &
\end{array}$$

The entire zipper grammar G_s^z is shown in (14).

(14)
$$\begin{array}{ccccc}
\{_0\mathrm{S}_6\} & \rightarrow & \{_0\mathrm{NP}_1\} & \{_1\mathrm{VP}_{3,4}\overline{\mathrm{V}}_6\} & \{_3\mathrm{heeft}_4\} \\
 & & (\downarrow \textsc{num}) = \textsc{sg} & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{'}\textsc{perf}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{'} \\
 & & (\uparrow \textsc{subj}) = \downarrow & (\uparrow \textsc{xcomp}) = \downarrow & \\
 & & & (\downarrow \textsc{subj}) = (\uparrow \textsc{subj}) &
\end{array}$$

$$\begin{array}{cccc}
\{_1\mathrm{VP}_{3,4}\overline{\mathrm{V}}_6\} & \rightarrow & \{_1\mathrm{VP}_{3,5}\overline{\mathrm{V}}_6\} & \{_4\mathrm{kunnen}_5\} \\
(\downarrow \textsc{subj num}) = \textsc{sg} & & (\downarrow \textsc{subj num}) = \textsc{sg} & (\uparrow \textsc{pred}) = \text{'}\textsc{able}\langle \textsc{subj}, \textsc{xcomp}\rangle\text{'} \\
 & & (\uparrow \textsc{xcomp}) = \downarrow & \\
 & & (\downarrow \textsc{subj}) = (\uparrow \textsc{subj}) &
\end{array}$$

$$\begin{array}{cccc}
\{_1\mathrm{VP}_{3,5}\overline{\mathrm{V}}_6\} & \rightarrow & \{_1\mathrm{NP}_3\} & \{_5\mathrm{lezen}_6\} \\
(\downarrow \textsc{subj num}) = \textsc{sg} & & (\uparrow \textsc{obj}) = \downarrow & (\uparrow \textsc{pred}) = \text{'}\textsc{read}\langle \textsc{subj}, \textsc{obj}\rangle\text{'}
\end{array}$$

$$\begin{array}{ccc}
\{_0\mathrm{NP}_1\} & \rightarrow & \{_0\mathrm{hij}_1\} \\
(\downarrow \textsc{num}) = \textsc{sg} & & (\uparrow \textsc{pred}) = \text{'}\textsc{pro}\text{'} \\
 & & (\uparrow \textsc{num}) = \textsc{sg}
\end{array}$$

$$\begin{array}{cccc}
\{_1\mathrm{NP}_3\} & \rightarrow & \{_1\mathrm{het}_2\} & \{_2\mathrm{boek}_3\} \\
 & & (\uparrow \textsc{spec}) = \textsc{the} & (\uparrow \textsc{pred}) = \text{'}\textsc{book}\text{'} \\
 & & (\uparrow \textsc{num}) = \textsc{sg} & (\uparrow \textsc{num}) = \textsc{sg}
\end{array}$$

The analysis of sentence (5) provided by the zipper grammar (14) appears in Figure 5.

For our Dutch grammar the top-down strategy for G_s^z is certainly sufficient to ensure that G_s^z will be a finite encoding of all and only the derivations of s in G. But that is not always the case even for finitely bounded LFGs. The top-down pass is insufficient if completeness and coherence depend on predicates or governable functions that propagate bottom-up. Moreover, the top-down construction may also fail to detect all inconsistencies. The top-down process creates a single descending branch for all daughter categories that share the same function assignment $(\uparrow \textsc{f}) = \downarrow$ and separate zipper branches for daughters with other assignments $(\uparrow \textsc{g}) = \downarrow$. Those branches are typically independent with respect to agreement features, but that is not necessarily the case if the separate branches have annotations that lift agreement features from daughter nodes. For example, if the F and G branches have promotions $(\downarrow \textsc{x}) = \uparrow$ and $(\downarrow \textsc{y}) = \uparrow$, then the X and Y values of the separate branches come into contact at the common mother and therefore must be consistent. Similarly, if the separate

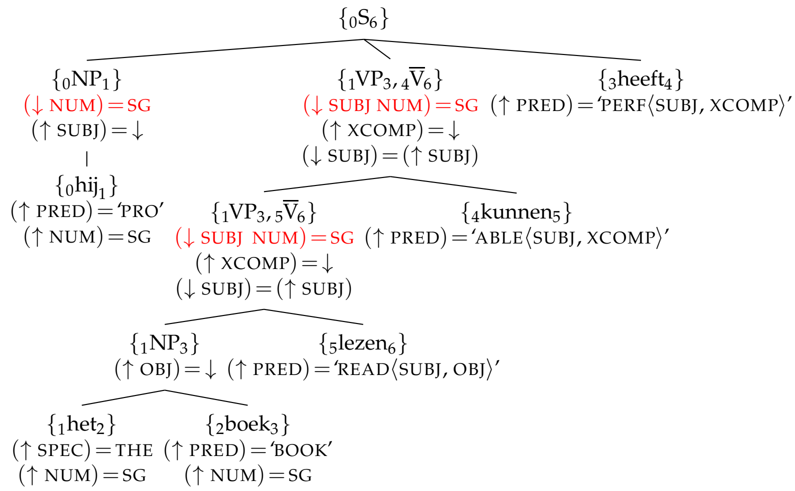


Figure 5: The zipper grammar analysis of sentence (5).

branches are annotated with control equations of the form $(\downarrow \text{X}) = (\uparrow \text{Z})$ and $(\downarrow \text{Y}) = (\uparrow \text{Z})$, then the lower X and Y values must be consistent as values of the common $(\uparrow \text{Z})$. Annotation combinations such as these may not be typical of linguistically motivated grammars, but additional tests through bottom-up propagation are necessary if they are encountered as the top-down process unfolds (as described in Wedekind and Kaplan (2020)).

Thus suppose that G_s happens to be *top-down complete* in the sense that the top-down traversal is sufficient to guarantee that G_s^z encodes all and only the valid derivations of s in G. Then the bottom-up MK algorithms will quickly check that there is at least one derivation of s in G_s^z and arrange it so that all of its f-structures can be read out each in linear time.

In sum, the incremental zipper-driven parsing algorithm performs the following steps:

1. Specialize G to an LFG grammar G_s characterizing all/only annotated c-structures for s in G. If $L(G_s) \neq \emptyset$, move to step 2. Otherwise, stop and report that there is no parse for s.
2. Construct LFG rules for zipper grammar G_s^z of G_s:

   Step 2a: Eliminate identity annotations to produce $G_s^{\backslash\uparrow=\downarrow}$.

   Step 2b: Create G_s^z from candidate subsets of $G_s^{\backslash\uparrow=\downarrow}$ rules.[4]
3. Use MK algorithms to test $L(G_s^z) \neq \emptyset$ and prepare for the enumeration of the f-structures assigned to s.

[4] It is also possible to interleave $\uparrow=\downarrow$-elimination (Step 2a) with zipper identification (Step 2b) for epsilon-free grammars, but the process would have been more difficult to illustrate. The interleaved elimination process will terminate even without an explicit bound on the height of functional domains if rules that would obviously generate nonbranching dominance chains in G_s^z are discarded.

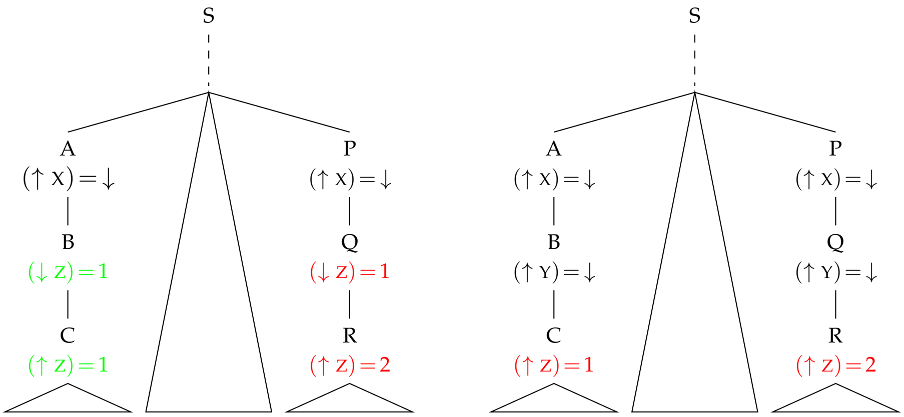


Figure 6: Illustration of the dependencies locally captured by XLE (left) and zipper parsing (right).

In Step 3 we apply to G_s^z the MK algorithms that XLE in essence applies to G_s to determine whether there are any derivations with satisfiable functional descriptions. These algorithms are particularly efficient for disjunctive systems with inconsistencies that are relatively few in number and arise from combinations of nearby constituents. Thus the optimal situation for XLE is illustrated by the schematic derivation on the left side of Figure 6. Here the derivation will fail quickly when the mother-daughter inconsistencies are encountered, and there is no need to evaluate the constituents that make up the large triangle (unless they also belong to an alternative derivation).

The situation illustrated on the right is much less optimal because the inconsistency is not discovered until bottom-up processing reaches the common mother of A and P. Significantly, the entire intermediate subderivation will also be processed before the failure is detected. In contrast, the top-down zipper traversal identifies the A and P subtrees as two branches of the discontinuous X–Y functional unit, as shown earlier in Figure 1. The inconsistency of the C and R annotations becomes apparent when those nodes are brought together by the expansion of the zipped category $\{B, Q\}$ in G_s^z. The failure is discovered immediately, before any computation is wasted in the evaluation of the intermediate subtree.

The improved performance for discontinuous constituents at Step 3 is purchased with the additional expense of the top-down traversal and zipper grammar construction of Step 2. This depends on the degree of discontinuity of G_s, the number of different rules for each specialized category, and the way the annotations of those rules interact when they are combined to form candidate expansions for a zipper set-category. It can be shown that the overall Step 2 effort is bounded by a polynomial in the length of the input.

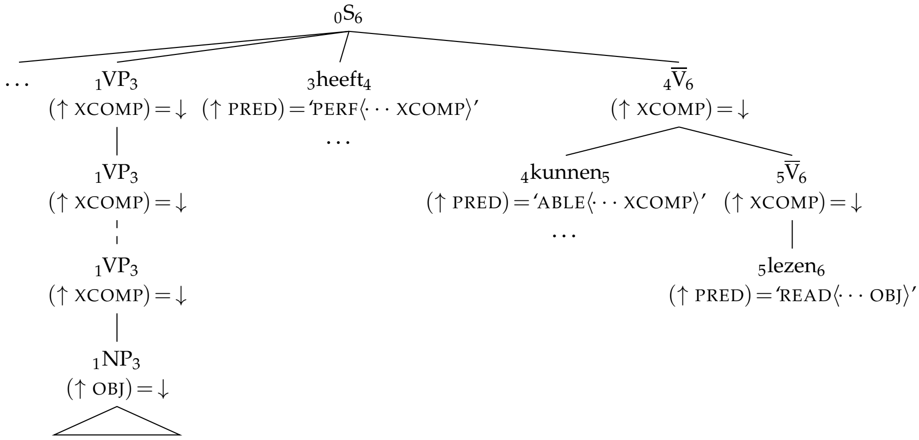


Figure 7: Recursive expansion of the $_1\mathrm{VP}_3$ rule.

We close this section with a remark on the nature of the NBD constraint in LFG theory. Formally, this constraint guarantees (for epsilon-free grammars) the decidability of the recognition problem because it bounds as a function of the length of an input string s the number of annotated c-structures and thus the number of f-structures assigned by the specialized grammar G_s. The refined NBD constraint (Kaplan and Maxwell 1996) and Dalrymple (2001) that takes category annotations into account does not eliminate the intended analysis of sentence (5). This is because only one expansion by the recursive rule (11b) is required to match the depth of the governable function OBJ on the left branch with its governing predicate READ on the right. But this rule can apply without limit to produce arbitrarily many nonbranching G_s derivations for this sentence, as indicated by the dashed line in Figure 7. The NBD condition removes those additional derivations from further consideration so that they do not have to be evaluated one by one to discover that the OBJ is ungoverned in each of them.

For this example the NBD condition only suppresses derivations with incoherent and incomplete f-structures, but that would not be the case for longer sentences with more subject-controlled intransitives appearing in the verb sequence on the right. As an example, the sentence (15) is admitted by the Bresnan et al. (1982) grammar.

(15) ... (dat) hij het boek moet hebben kunnen lezen
... (that) he the book must have able read
... (that) he must have been able to read the book

Nonbranching chains would be required to match the level of the OBJ in this and longer sentences with the level of its governing predicate. Unfortunately those derivations would be marked as inadmissible by the NBD condition on G_s, and s would not be accepted as a sentence of G. The problem is that NBD decisions are made separately on each branch of an annotated c-structure with no awareness of relevant information, for example subcategorization requirements, carried by parallel branches. The NBD condition for G (effectively narrowed to a condition on G_s derivations) does not correctly differentiate between all intended and unintended analyses.

We note, however, that the zipper grammar G_s^z in (14) does not contain a nonbranching rule corresponding to the recursive (11b) in G_s. The top-down traversal of the XCOMP zipper components matches each of the specialized VPs on the left with the corresponding predicate on the right, resulting in an internally well-formed zipper rule that necessarily branches. Thus the zipper derivation in Figure 5 has no nonbranching dominance chains. Importantly, by the same reasoning neither would the zipper derivations for sentences with more intransitive verbs: they would be admitted to the language even though all their derivations in G_s violate the NBD condition. These observations lead us to propose a revision to the LFG formalism whereby the original (annotation-insensitive) restriction against nonbranching dominance chains is displaced from derivations of G/G_s to derivations of the zipper grammar G_s^z. This makes a larger set of derivations available for bottom-up validation, but it still guarantees a bounded number of derivations for a given input string and thus the decidability of the recognition problem for arbitrary LFG grammars.

6 Conclusion

In this paper we have explored parsing strategies that follow from the strong equivalence between mildly context-sensitive grammatical formalisms and restricted subclasses of Lexical-Functional Grammar. That connection was first recognized by Seki et al. (1993) and characterized in the definition of finite copying grammars (1), but this key result went largely unnoticed because its notational constraints were so severe. Here we build on the recent work of Wedekind and Kaplan (2020) that demonstrates the same formal equivalence for the subclass of finitely bounded LFG grammars. These are defined with functional annotations and derivational conventions that are much more appropriate for linguistic description.

An LFG grammar that meets all the conditions of finite boundedness can be converted to a linear context-free rewriting system that provides exactly the same f-structures for exactly the same sentences. This enables what we have called the direct LCFRS parsing strategy wherein an LCFRS parser applies the converted grammar to individual input sentences. The LCFRS computation is polynomial in the length of the input and thus tractable in a technical sense. But the computation is likely dominated by another factor that enters into the complexity formula, the size of the converted grammar. While it may be feasible to construct an LCFRS for a finitely-bounded broad-coverage LFG grammars, given natural limits on the parameters of expansion, this may not be the most effective way of parsing with mildly context-sensitive dependencies.

We therefore consider alternative strategies that avoid constructing the LCFRS for all rules and features of an entire grammar and instead only operate on the LFG rules that participate in the context-free analyses for a given input. The specialized grammar is more likely to meet all the bounding conditions even if the entire grammar does not, and the most straightforward approach in that case is to build the LCFRS at parse-time only for the specialized grammar. This approach will typically increase performance because parsing complexity still conforms to the general polynomial formula for LCFRS parsing but with parameters that pertain only to individual inputs and not to the language as a whole. We must revert to conventional parsing algorithms, however, for the (putatively rare) sentences for which the specialized grammar is not bounded.

As another alternative, we propose a more heuristic zipper-driven strategy that incrementally resolves only those mildly context-sensitive zippers that can be identified through a top-down traversal of the rules of that specialized grammar. Zipper-driven parsing is particularly efficient for the majority of inputs with only mildly context-sensitive dependencies because it limits the complexity of subsequent f-structure consistency checking after the polynomial top-down phase is complete. Performance will likely degrade for inputs with more intricate dependencies, but zipper driving offers the benefit of eliminating many candidate f-descriptions before they are subjected to full-scale LFG equation solving.

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Are there arguments for the subject analysis of Mainland Scandinavian presentational sentences?

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Abstract
The Mainland Scandinavian languages have a productive presentational construction with an expletive and an indefinite "logical subject". The topic of this paper is the syntactic function of the logical subject. In traditional grammar, it was considered a (kind of) grammatical subject. Askedal (1982) and Platzack (1983) argued that it is a grammatical object, and this is a common view in Scandinavian grammar. The purpose of the paper is to defend this analysis against attacks, and argue that there are no acceptable arguments that the logical subject is a grammatical subject.

1. Introduction[1]

The Mainland Scandinavian languages – Norwegian, Swedish and Danish – have a productive presentational construction. This construction includes an expletive, and an indefinite "logical subject" (which is a pre-theoretical term for the noun phrase following the verb in active and passive sentences). The verb can be unaccusative, unergative or passive. Examples (1)–(3) are Bokmål Norwegian, like many examples here.

(1) Det har arbeidet en mann i hagen.
EXPL has worked a man in garden.DEF
'A man has worked in the garden.'
(2) Det har forsvunnet en katt.
EXPL has disappeared a cat
'A cat has disappeared.'
(3) Det ble spist pølser.
EXPL was eaten sausages
'Sausages were eaten.'

This construction has a number of fascinating properties that have been discussed within different frameworks through the years. The focus of this paper is the syntactic function of the logical subject – is it a grammatical subject or a grammatical object? There is no new account of the construction. My main goal is to defend the analysis of the logical subject as a grammatical object, which was proposed by Askedal (1982) and Platzack (1983). I will discuss some important arguments for the subject and the object analyses, argue that the arguments for the subject analysis do not work, and defend some arguments for the object analysis.

One could ask if it is important what syntactic function is assumed for the logical subject. In LFG, it must be important, because of the role that syntactic functions play in the framework – rules for e.g. binding and unbounded dependencies make direct reference to syntactic functions.

[1] For input and discussion, I would like to thank the audience at the LFG20 conference, especially Elisabet Engdahl and Annie Zaenen. Thanks are also due to the proceedings reviewers, and to Lars Hellan.

Mainland Scandinavian presentational sentences are sometimes discussed in the context of Icelandic presentational sentences, such as (4) from Thráinsson (2007:310).

(4) það komu fjórir nemendur í tímann í gær.
EXPL came.3PLUR four.NOM students.NOM in class.DEF in yesterday
'Four students came to the class yesterday.'

There is a number of important grammatical differences between Icelandic and Mainland Scandinavian presentational sentences (see e.g. Platzack 1983). The standard analysis of the Icelandic construction takes the logical subject to be the grammatical subject (see Booth (2018) for an LFG perspective). The expletive is often seen as a kind of expletive topic, e.g. in Zaenen (1983) (but see Sells (2005) for a different view).

Section 2 presents the state of the art for the status of the logical subject. The grammatical properties of the expletive are discussed briefly in section 3. Section 4 goes deeper into the discussion of the logical subject, and argues for the object analysis. Section 5 discusses the question if all presentational sentences should have the same analysis. Presentational sentences in other languages are mentioned briefly in section 6. Section 7 discusses the problem of assuming agentive objects with unergative verbs, and section 8 gives a conclusion.

2. Subject or object?

For Mainland Scandinavian presentational sentences, a subject analysis is the older assumption. In traditional grammar, the logical subject has been called the "real" (*egentlig, reelt*) or "potential" (*potensielt*) subject (see e.g. Næs 1972:255, Vinje 1977:125).

A subject analysis is argued for in the Norwegian reference grammar, Faarlund et al. (1997:833–35) (for active sentences only), and the Swedish reference grammar, Teleman et al. (1999:384-406). There are also articles that argue for a subject analysis and/or against an object analysis within LFG: Börjars and Vincent (2005), Zaenen et al. (2017), and Hellan and Beermann (2020).

Börjars and Vincent (2005) assume that the expletive and the logical subject both map to subject in f-structure. The expletive has no PRED, and no other features that cannot unify with those of the logical subject. Its only reflex in f-structure is then a feature such as [EXPL +]. (Sells (2005) gives this kind of analysis for Icelandic.)

Zaenen et al. (2017) and Hellan and Beermann (2020) argue that both the expletive and the logical subject have subject properties. They are agnostic concerning the syntactic function of the logical subject, which they refer to as "pivot" and "presented" respectively.

The first object analysis of Norwegian presentational sentences was given by Askedal (1982, 1986), working within a typologically oriented framework. Platzack (1983) takes the same position for Swedish within a Government and Binding framework. He does not say directly that the logical subject is an object, but his analysis treats it as one. He shows that it is in the canonical object position in surface structure – this is a point that has not been challenged. He then argues that it has the same position in deep structure, where it gets an internal role from the verb. Platzack's analysis is reflected in several publications within Scandinavian Chomskyan grammar (e.g. Hestvik 1986, Christensen 1991, Åfarli 1992, Sveen 1996:116–26, Mikkelsen 2002, Åfarli and Eide 2003:226–37, Faarlund 2019:83).

Within LFG, an object analysis is assumed in Lødrup (1999, 2000) and Egebakken (2005). This is also the analysis that is implemented in the Norwegian XLE grammar (http://clarino.uib.no/iness/xle-web).

An object analysis can also be found in the Danish reference grammar, Hansen and Heltoft (2011). Applying the European structuralist distinction between content and expression, they say that the logical subject is at the same time a "content subject" and an "expression object" (Danish *indholdssubjekt* and *udtryksobjekt*) – see Hansen and Heltoft (2011:124, 304–306).

The question of a subject analysis or an object analysis might be more complicated than it seems. The presentational construction is possible with many unergative and unaccusative verbs, and with all relevant passive verbs. The question is then if all presentational sentences have the same syntactic structure, independently of their verb type, or if there are different structures for different verb classes. In traditional grammar, the underlying assumption seems to be that the structure is the same for all verb types. This is also the position taken here (see the discussion in section 5). When the syntactic function of the logical subject is discussed in section 4, possible differences between the verb classes will be mentioned. It turns out, however, that this difference is only directly relevant to one or two arguments discussed.

3. Properties of the expletive

Some arguments from Askedal (1982, 1986) and Platzack (1983) that the expletive has subject properties will be mentioned briefly.

It is uncontroversial that the expletive has c-structure properties of subjects. It has the same positions as other subjects in c-structure, preceding or following the finite verb, as in the Norwegian (1) and (5).

(5) I hele dag har det arbeidet en mann i hagen.
in whole day has EXPL worked a man in garden.DEF
'A man has worked in the garden the whole day.'

The expletive has one clear f-structure property of subjects: It allows subject raising to subject and object, as in the Norwegian (6)–(7). This is a strong argument that the expletive must be an f-structure subject.

(6) Så pleier det å komme en nabo innom med julesnop. (www)
then uses EXPL to come a neighbor by with christmas.candy
'Then a neighbor usually drops by with Christmas candy.'

(7) Vi anser det å være en risiko for rømning. (www)
we assume EXPL to be a risk for escape
'We assume there to be a risk of escape.'

There is also another phenomenon that is relevant – even if the last word on its treatment has not been said – namely the so-called surface anaphor *det* 'it/that' with auxiliaries, as in the Norwegian (8)–(9).

(8) (Har mynten forsvunnet i vannet?) Ja, den har det.
has coin.DEF disappeared in water.DEF yes it has that
'(Has the coin disappeared in the water?) Yes, it has.'

(9) (Har det forsvunnet en mynt i vannet?) Ja, det har det.
has EXPL disappeared a coin in water.DEF yes EXPL has that
'(Has a coin disappeared in the water?) Yes, it has.'

The interpretation of the surface anaphor generally includes the verb and its selected arguments, except the subject (see example (8)). When a presentational sentence is pronominalized this way, the logical subject is included in the interpretation of the surface anaphor, while the expletive is the subject (see example (9)).

In Danish and some Norwegian and Swedish dialects, the expletive is *der* 'there'. In other varieties of Norwegian and Swedish, the expletive is the 3. person singular neutral pronoun *det*. In varieties with agreeing participles, *det* can trigger the expected agreement, as in the Nynorsk Norwegian (10).

(10) Det er kome nokre lokale regnbygar. (www)
EXPL is come.SG.NEUT some local showers
'Some local showers have occurred.'

This could be an argument that the expletive is an f-structure subject. There is, however, some variation in Mainland Scandinavian concerning agreement in presentational sentences. Some varieties allow agreement with the logical subject (Teleman et al. 1999:385, Börjars and Vincent 2005, Engdahl 2017). The singular neuter form triggered by the expletive could be seen as a default form, which is used when there is no agreement (Börjars and Vincent 2005). There seems to be no argument based on agreement, then, or at least no argument that applies to Mainland Scandinavian as a whole.

4. Properties of the logical subject

Transitivity restriction An important argument for the object analysis is the fact that the presentational construction is never possible with a transitive verb – or to be more exact: it is impossible to realize a logical object in a presentational sentence. This argument was discussed already by Askedal (1982) and Platzack (1983).[2] However, Börjars and Vincent (2005) dismiss this argument, saying ".. for verbs which are optionally transitive, the presentational focus construction is ruled out even when there is no object." However, this is not correct. Optionally transitive verbs behave as unergatives when they are without an object, and they can be used in presentational sentences, as expected. An example is the Swedish (11) (from Teleman et al.1999:400)

(11) Det äter många tjänstemän (..) på det här matstället.
EXPL eats many civil.servants at this here restaurant.DEF
'Many civil servants eat at this restaurant.'

Benefactive objects A fact that was mentioned already by Askedal (1982) and Platzack (1983) is that a presentational sentence can take a benefactive object in addition to the logical subject. Relevant verbs are two-place unaccusatives and passives of ditransitives, cf. the Norwegian examples (12) (from Hellan and Beermann 2020:82) and (13).

(12) Det ventet ministeren dårlige nyheter.
EXPL awaited minister.DEF bad news
'Bad news awaited the minister.'

(13) Det ble overrakt meg en medalje.
EXPL became presented me a medal
'I was presented with a medal.'

Some papers mention this kind of sentences as a semantically conditioned exception from the generalization that transitive verbs cannot occur in presentational sentences, and/or as a problem for the object analysis (Maling 1988:3, Bjerre and Bjerre 2008a:50, Zaenen et al. 2017:275–76, Engdahl et al. 2018, Hellan and Beermann 2020). However, there seems to be no kind of exception or problem here. A common assumption in Scandinavian grammar is that sentences such as (12) and (13) are double object constructions, with

[2] Mainland Scandinavian actually has a transitive expletive construction – or rather had, because it is archaic in most varieties today (Christensen 1991, Håkansson 2017). This construction is grammatically different from the construction discussed in this paper, and shares properties with the Icelandic construction shown in (4) above. An important fact is that the expletive does not have subject properties – it is an expletive topic that can only occur in the first position of the sentence.

the benefactive object as what is called an indirect object in Scandinavian grammar, or OBJ_θ in LFG (e.g. Åfarli 1992:chap 6, Lødrup 1995, Mikkelsen 2002:12–15, Faarlund 2019:141–42). Note that the benefactive object is not affected by the definiteness restriction in (12) and (13), while the logical subject is indefinite, and couldn't be definite.

Presentational sentences with benefactive objects thus raise no problems for the object analysis. On the contrary, they provide an argument for this analysis, which gives the same syntactic pattern in active and passive presentational and non-presentational sentences: an indirect benefactive object (OBJ_θ) followed by a direct patient object (OBJ).

Börjars and Vincent (2005) dismiss this argument, pointing to information structural constraints on word order. It is clear, however, that the order indirect object (OBJ_θ) – direct object (OBJ) is normally fixed, independently of the sentence being active or passive, presentational or non-presentational (see e.g. Teleman 1999:304-307, 392).

Sentences with reflexives Hellan and Beermann (2020) argue against the object analysis on the basis of sentences in which the logical subject cooccurs with a simple reflexive. Their idea is that this reflexive is the object, which means that the logical subject cannot be. They give Norwegian examples such as (14)-(16) (Hellan and Beermann 2020:79, 81). In these sentences, the logical subject is preceded by a simple reflexive; in (15)-(16) there are also a particle and an adjectival resultative.

(14) Det setter seg en katt på trappen.
EXPL sets REFL a cat on stairs.DEF
'A cat sits down on the stairs.'
(15) Det drakk seg i hjel et eksternt styremedlem.
EXPL drank REFL to death an external board.member
'An external board member drank himself to death.'
(16) Det hadde drukket seg full en nordlending.
EXPL had drunk REFL drunk a northerner
'A northerner had drunk himself drunk.'

The idea that the simple reflexive is the object in (14)-(16) is problematic. The reflexive in (14) cannot be replaced by a non-reflexive; this is illustrated in (17) (from Hellan and Beermann 2020:80, note 18). On the other hand, the reflexive is in a position where an "empty" lexical reflexive can be realized, as shown in (18) with the inherently reflexive verb *smyge seg* 'sneak' (from Hellan and Beermann 2020:79, note 16).

(17) *Det setter meg en venn på trappen.
EXPL sets me a friend on stairs.DEF
'A friend places me on the stairs.' [intended]

(18) Det smyger seg en mann ut.
EXPL sneaks REFL a man out
'A man sneaks out.'

The assumption that non-substitutable reflexives can be objects is untraditional. Hellan and Beermann (2020) sketch a semantic approach. The traditional analysis of sentences such as (14) seems to be a more satisfactory alternative (Hellan 1988:108-113): The verb is detransitivized by an empty non-argument reflexive, which can be realized in a presentational sentence without creating a situation with two instances of OBJ.

Examples (15) and (16) require a separate discussion. Example (16) with an adjectival resultative does not seem to represent an existing pattern – it is unacceptable to me and other linguists I have asked. Example (15) is special. The expression *i hjel* 'to death' is not an adjectival resultative like *full* 'drunk' in (16). It is a particle – a category whose properties are not really understood (Stensrud 2009:133–34). Again, the alternative traditional analysis is that the reflexive in (15) is an empty non-argument reflexive. Hellan (1988:121) gives the rather parallel presentational sentence in (19), saying that it is possible because the reflexive is not an argument.

(19) Det ligger seg ihjel mange pasienter på det sykehuset.
EXPL lie REFL to.death many patients on that hospital.DEF
'Many patients lie themselves to death at that hospital.'

Binders An argument that has been used by several proponents of a subject analysis is based upon the fact that the logical subject can bind a reflexive (Faarlund et al. 1997:847, Börjars and Vincent 2005, Zaenen et al. 2017). Example (20) is Swedish (from Börjars and Vincent 2005).

(20) Det kom en man med sin /*hans fru.
EXPL came a man with REFL.POSS / his wife
'There came a man with his (own) wife.'

Börjars and Vincent (2005) say: "Swedish has a reflexive determiner *sin*, which can only be bound by a subject and not by a direct object".

However, objects can also bind reflexives in Scandinavian in some cases (not only when they are subjects in secondary predications). Teleman et al. (1999:340) give some acceptable Swedish examples, such as (21).

(21) Jag såg Per tillsammans med sin fru.
I saw Per together with REFL.POSS wife
'I saw Per together with his wife.'

The option of object binders seems to be restricted in various ways, and intuitions vary. However, it is seen as a rather general option in e.g. Platzack (1998:222–23) on Swedish, Diderichsen (1937) on Danish, and Lødrup (2008) on Norwegian.

If the binding facts should make the basis of an argument for the subject analysis, the argument would have to be that the use of reflexives is obligatory with logical subjects, but not with regular objects. It would be difficult, however, to argue that reflexives are obligatory with logical subjects. Faarlund et al. (1997:847) say that logical subjects cannot bind reflexives in passive clauses. They compare the Nynorsk Norwegian (22) and (23).

(22) I dag kom det nokre studentar til meg pga. karakterane sine/ *deira.
in day came EXPL some students to me because.of grades.DEF their.REFL/their
'Some students came to me today because of their grades.'

(23) Det vart stroki nokre studentar pga. karakterane *sine/deira.
EXPL was flunked some students because.of grades.DEF their.REFL/their
'Some students were flunked because of their grades.'

Other speakers find the contrast (22)–(23) less sharp. Even so, it would be difficult to base an analysis upon the assumption that the reflexive is obligatory in (23). We see, then, that obligatory reflexives do not constitute an argument for a subject analysis – at least if the subject analysis applies to both active and passive sentences.

It must be admitted that an account of the difference between (22) and (23) is still missing when all presentational sentences are assumed to have the same analysis (see section 5). This is a part of a larger question – the general conditions for object binders are not known (see discussion in Lødrup (2008)).

(Pseudo)coordination Another argument that has been used by proponents of a subject analysis concerns subject ellipsis in coordination. The [correct] generalization is that subject ellipsis in the second sentence is possible only when the subject is identical to the subject of the first sentence (as in *He sings and dance*s). The idea is then that sentences with ellipsis such as the Swedish (24) (from Börjars and Vincent 2005) show that the logical subject is a grammatical subject.

(24) Det kom en man och *pro* pratade med mig.
EXPL came a man and talked with me
'There came a man and talked to me.'

Sentences similar to (24) have been used to argue for the subject analysis in Faarlund et al. (1997:834, 847), Börjars and Vincent (2005), Engdahl (2006:40–41), and Zaenen et al. (2017:274).

If accepted, this argument would only work for active sentences (Faarlund et al. 1997:847, Zaenen et al. 2017:277). Ellipsis is always impossible if the presentational sentence is passive, such as the Norwegian (25).

(25) Det ble utnevnt en mann *og *pro* begynte straks arbeidet.
EXPL became appointed a man and started immediately work.DEF
'A man was appointed and started his work immediately.'

The fact that passive sentences behave differently creates a problem for Börjars and Vincent (2005), who use the coordination argument, while (at least implicitly) assuming the subject analysis for both actives and passives.

However, the real problem with the argument based on (24) is that it and similar examples used in the literature are not real coordinations. They are so-called pseudocoordinations, with rather different properties than real coordinations. Pseudocoordination is a construction that has fascinated Scandinavian grammarians for generations, from Jespersen (1895) to Lødrup (2019). Only a small number of verbs allow pseudocoordination. There are different analyses, but it is uncontroversial that pseudocoordination cannot be regular coordination. Many grammarians follow Jespersen (1895) and see it as a subordinating construction in which the second verb is 'an infinitive in disguise' (Jespersen's Danish original: *en forklædt infinitiv*). What (24) really shows is then control of a verbal complement. Most verbs that allow the presentational focus construction do not allow pseudocoordination, and they would be ungrammatical in sentences such as the Norwegian (26).

(26) Det manglet en lyspære *og *pro* var umulig å finne.
EXPL lacked a light.bulb and was impossible to find
'A light bulb was missing, and it was impossible to find.'

The pseudocoordination facts thus give an argument against a subject analysis – because it predicts that (25) and (26) should be grammatical.[3]

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[3] Elisabet Engdahl tells me that she finds the Swedish example (i) "pretty good" (pc).
(i) Det spelade några svenska ishockeyspelare i NHL och gjorde karriär.
EXPL played some Swedish hockey players in NHL and made career
'Some Swedish hockey players played in NHL and had a career.'
The verb in its first part does not allow pseudocoordination, so (i) must have the same structure as the unacceptable (26). Its Norwegian equivalent is somewhat better than (26), but not really acceptable to me and other linguists I have asked. What causes this difference from (26) is not known.

A new argument: Islandhood A subject is generally a strong syntactic island for unbounded dependencies, as shown in the Norwegian (27). A logical subject is like an object in not being an island, cf. (28).

(27) *Hvem tror du et bilde av _ står på presidentens bord?
who think you a picture of stands on president.DEF.GEN table
'Who do you think there is a picture of on the president's table?' [intended]

(28) Hvem tror du det står et bilde av _ på presidentens bord?
who think you EXPL stands a picture of on president.DEF.GEN table
'Who do you think there is a picture of on the president's table?'

This argument is important in LFG, where restrictions on unbounded dependencies are accounted for using syntactic functions.

A non–argument: Case Mainland Scandinavian – except some archaic dialects – has morphological case on personal pronouns only. Personal pronouns are usually not logical subjects, but it is possible to construct acceptable sentences. A Norwegian example is (29).

(29) Det var bare meg der.
EXPL was only me there
'Only I was there.'

In Norwegian and Danish, a personal pronoun gets the accusative form when it is a logical subject. This has been used as an argument for object status from Askedal (1982). In Swedish, however, the personal pronoun gets the nominative form. The best analysis of these facts seems to be the one given in Mikkelsen (2002:11, note 14): A pronoun that is a logical subject has the default form, which is accusative in Norwegian and Danish, and nominative in Swedish. Morphological case gives no argument, then, or at least no argument that applies to Mainland Scandinavian as a whole.

Conclusion for part 4 I have tried to show that there are no acceptable arguments that the logical subject is a grammatical subject in presentational sentences. The subject function is taken by the expletive, which has to be the one and only f-structure subject to account for the fact that it allows subject raising to subject and object position (examples (6) and (7) above). There are several arguments that the logical subject is the f-structure object, including:

-This analysis accounts for the fact that a transitive verb can never realize its logical object argument in a presentational sentence.

-This analysis accounts for the fact that active and passive presentational sentences can show the same double object pattern as non-presentational sentences (see examples (12) and (13) above).

-This analysis accounts for the fact that the logical subject does not behave as a syntactic subject wrt subject ellipsis in coordinated sentences (see examples (25) and (26) above).
-This analysis accounts for the fact that the logical subject is not an island for unbounded dependencies (see example (28) above).

It must be admitted that some of the data used in the discussion are less than clear, especially the binding data. The data problems are not decisive for the argument, however.

5. Alternative analyses

The discussion above was based upon the assumption that all presentational sentences have the same analysis, with the logical subject as either a grammatical subject or a grammatical object. However, these are not the only possibilities. We will now have a look at a couple of alternative options.

Stensrud (2006) proposes that unergative presentationals are grammatically different from unaccusative and passive presentationals. Her point of departure is a difference between the groups: Unergative presentationals must normally contain a locative, while this is not necessary in unaccusative and passive presentationals (see examples (1)–(3) above). Building upon Hoekstra and Mulder (1990), she sees this locative as the predicate in a small clause with the logical subject as the small clause subject.

This is an interesting proposal. However, it does not seem to have any direct consequences for the syntactic function of the logical subject. In LFG, the small clause would have to be an XCOMP. The XCOMP subject would be functionally controlled by the logical subject of the presentational sentence – and the question if the logical subject is a grammatical subject or a grammatical object would still remain.

The picture becomes different if it is assumed that all presentational sentences with a PP have a small clause analysis.[4] This kind of analysis would have consequences for the treatment of reflexives bound by the logical subject, as in example (20) above (Elisabet Engdahl pc). If it is the small clause subject that is the binder of the reflexive, one could assume both that the logical subject is a grammatical object and that reflexives can only be bound by subjects.

Problems would remain, however. First, this account would require some strange small clauses. Consider the Nynorsk Norwegian (30), which is similar to example (22) above, but without the locative argument of 'come'.

[4] Faarlund (2019:132–34) could be understood this way, but it is not clear to me if he wants to consider all PPs small clause predicates, and if not, which PPs.

(30) I dag kom det nokre studentar pga. karakterane sine/*deira.
in day came EXPL some students because.of grades.DEF
their.REFL/their
'Some students came today because of their grades.'

To account for the reflexive in the PP, it would be necessary to assume that the PP is the predicate of a small clause. This would be a strange small clause, however – it seems more natural to say that the PP is an adjunct in the main clause. Second, the small clause analysis would give the wrong result in passive sentences, such as (23) above, repeated as (31).

(31) Det vart stroki nokre studentar pga. karakterane *sine/deira.
EXPL was flunked some students because.of grades.DEF
their.REFL/their
'Some students were flunked because of their grades.'

The logical subject 'some students' would be a small clause subject. Subjects are normally obligatory binders, but this alleged small clause subject cannot bind a reflexive in (31), at least for many speakers.

This problem with (31) raises a more general question, independently of small clauses. Proponents of a subject analysis take different positions concerning the treatment of passive presentational sentences. Some proponents of a subject analysis apply it to active sentences only, while passive sentences get an object analysis. It is not always clear in the literature what position is taken. Faarlund et al. (1997:846–47) argue explicitly that only active presentationals have a subject analysis. A difference between actives and passives is also claimed in Zaenen et al. (2017:277–78), and hinted at in Teleman et al. (1999:389).

An argument against different analyses for active and passive sentences is given by examples such as the Norwegian (32). When an active and a passive verb are coordinated, a logical subject can be an argument for both verbs at the same time.

(32) Det kommer og sendes nye e-poster hele tiden. (www)
EXPL comes and send.PASS new e-mails whole time.DEF
'New e-mails arrive and are sent all the time.'

There is also a more theoretical argument against assuming different analyses for actives and passives. It has been observed that there are no passive sentence types – passive verbs use the same syntactic patterns as active verbs (see e.g. Müller and Wechsler 2014). From a lexicalist point of view, it would be strange if there should be a pattern *expletive – verb – subject* limited to active sentences, and a pattern *expletive – verb – object* limited to passive sentences.

When one assumes that both active and passive sentences have the logical subject as a grammatical object, passive sentences do not seem to raise problems – apart from the unexplained fact that their objects are reluctant to act as binders for reflexives (cf. example (23)/(31) above).

6. Other languages

Some languages have a construction that could be compared to the Mainland Scandinavian presentational construction. However, they tend to be less productive, and they don't usually allow unergatives.

A case of a logical subject that is clearly a grammatical object can be found in German. In existential sentences with *es gibt* 'there is' (literally 'it gives'), the verb agrees with the expletive, and the logical subject takes the accusative case. These properties are shown in examples (33)–(34) (from Czinglar 2002:87, 88).

(33) In meinem Garten gibt es viele Gänseblümchen.
in my garden gives.3P.SG EXPL many daisies
'There are many daisies in my garden.'

(34) Es gibt einen Apfelbaum in meinem Garten.
EXPL gives an.ACC apple.tree in my garden
'There is an apple tree in my garden.'

In other cases, the analysis of presentational sentences raises problems (see e.g. Lødrup 1999). An example is the English *there* construction, which is given an object analysis in Bresnan (1982:72–80) (but this is not the focus of her discussion).

Impersonal passives can be found in many languages. What seems to be less common is the Mainland Scandinavian option of an impersonal passive with a direct object, as shown in examples (3), (13) and (23) above. Cases can be found, however, e.g. in Ukrainian (Lavine 2005).

It is especially difficult to find languages that have sentences with unergative verbs and agentive objects. The Bantu languages Sesotho and Setswana have a construction that seems to be relevant (Demuth and Mmusi 1997), as in (34). What is glossed "17.SUBJ" in (35) is the agreement morpheme for locative subjects. When there is no locative subject, it could be seen as an empty expletive.

(35) gó -lema ba-ñina. (Setswana, Demuth and Mmusi 1997)
17.SUBJ-plough 2 -men
There are men ploughing.'

Demuth and Mmusi (1997) never explicitly state that the nominal argument is an object. However, their Lexical Mapping Theory (LMT) analysis is designed to give the logical subject as a grammatical object for the languages they discuss; they even modify LMT to get this result.

An interesting parallel to Mainland Scandinavian is French, which to some extent allows unergatives (as well as unaccusatives and passives) in a presentational construction with an expletive subject. An example is (36) (from Cummins 2000:238).

(36) Il courait deux enfants dans la salle.
EXPL ran.3P.SG two children in the room
'Two children were running in the room.'

The discussion of this construction in French linguistics has been strikingly parallel to the corresponding Scandinavian discussion – without Scandinavian being mentioned. There are object analyses of the French construction, see e.g. Hulk (1989), Cummins (2000), and Creissels (2008) – the latter says that this is an old idea in French linguistics.

Alsina and Yang (2018) argue that Catalan also allows both unergatives and unaccusatives to realize their argument as an object.[5]

7. Theoretical challenges

Presentational sentences have been a traditional favorite in Scandinavian linguistics in various frameworks. Especially the nineteen eighties saw a lot of work on this topic. We will now give an overview of issues and possible solutions. There is nothing original here, and no new analysis.

One issue with presentational sentences is that an expletive subject is chosen over a referring subject. From a technical point of view, this can be implemented in LMT using a feature that requires realization as an object (called object preservation in Kibort (2007)), and/or a special rule that inserts an expletive subject (Lødrup 2011:151).

The motivation for object realization is obviously related to information structure. An old insight is that Mainland Scandinavian has strong topicality requirements on subjects, so indefinite arguments are better realized as objects. An attempt to implement this insight using Optimality Theory is Mikkelsen (2002), who says (simplified) that an expletive subject is better than an indefinite subject (see also Lødrup (1999), and Alsina and Yang (2018) on Catalan).

A difficult theoretical challenge is the fact that the presentational construction is allowed with most unergative verbs. This situation creates

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[5] The English locative inversion construction, as in (i), also allows unergatives to some extent (Bresnan 1994, Levin and Rappaport Hovav 1995:chap 6). It is controversial, however, if the nominal argument is a subject or an object.
(i) On the third floor worked two young women called Maryanne Thomson and Ava Brent (Levin and Rappaport Hovav 1995:224)

problems for all theories of thematic roles and syntactic functions. One of the most robust generalizations of linking theories is that agents are realized as subjects, and not as objects. In LMT, an agent gets the syntactic feature [-object].

The subject analysis of presentational sentences makes the linking problem disappear. This could be seen as an argument for the subject analysis, as in Börjars and Vincent (2005). However, the subject analysis has a corresponding problem: what is seen as a subject is uncontroversially in the canonical object position in a configurational language.

The object analysis has a real problem concerning the realization of an agent as an object. This has been discussed several times in Scandinavian grammar, as will be seen below.

It is of course easy to stipulate that unergatives can realize their agent role as an object. Some researchers simply say that unergatives have alternative lexical entries for realizing the agent as a subject and an object (e.g. Åfarli 1992:105, Åfarli and Eide 2003:235–36, Faarlund 2019:133).

It has been proposed that presentational sentences could be seen as a case of ergativity – in the classical, typological sense of the word – because the single argument of a one-place verb is treated in the same way as the patient argument of a two place verb (Askedal 1986, Creissels 2007 on French). This is an interesting idea, but it raises a question that has not been answered: how to integrate this ergative subpart into the grammar as a whole.

A traditional explanation that unergatives can realize their argument as an object is that there is deagentivization: their argument is not really an agent in the presentational construction, but rather a theme in some sense. (See e.g. Anward (1981), Platzack (1983:93–94), Maling (1987), Ekberg 1990 and Bjerre and Bjerre (2008b). Stensrud (2006) could also be placed in this group, as well as the treatment of unergatives in locative inversion in Bresnan (1994:90–92).)

Even if the deagentivization analysis has some intuitive appeal, it is not clear what deagentivization is. It would be more natural to see deagentivization as an effect of, and not as the cause of, the agent's object position. (For criticism, see Faarlund (1993), Levin and Rappaport Hovav (1995:259).)

An explanation based upon deagentivization also suffers from a more general problem: There is no connection to other properties of Mainland Scandinavian. The explanation opens up a general option for unergatives to realize their argument as an object – it cannot account for the fact that this is exceptional in the world's languages. The same problem is found with other explanations that have been proposed.

Related to deagentivization are proposals that there is underspecification or neutralization between agent and patient when there is only one nominal argument in the sentence. This approach has been implemented in different ways in Falk (1989) and Lødrup (2000). This is also the approach to French in Hulk (1989), and to Sesotho and Setswana in Demuth and Mmusi (1997). The account of Catalan in Alsina and Yang (2018) could also be placed in this group.

It has also been proposed that the linking of thematic roles and syntactic functions takes place unrestricted, with semantic interpretation taking place "afterwards". This is the approach to Norwegian in Faarlund (1993), Sveen (1996) and Jordet (2016), and to French in Cummings (2000).

Again, explanations in terms of underspecification or unrestricted linking open up a general option for agentive objects – they cannot explain their exceptionality. Optimality Theory could give a way of accounting for this. Lødrup (1999) and Mikkelsen (2002) give OT analyses of Scandinavian presentational sentences in which information structure has a part to play. Unfortunately, they are not satisfactory in this context. Lødrup's analysis has several weaknesses, which will not be discussed here. Mikkelsen's account of presentational sentences has nothing to say about agentive objects, because she does not really accept that they exist (Mikkelsen 2002:5, 65–67).[6]

An OT account of unergatives with objects would have to rank a constraint against agentive objects below a constraint against indefinite subjects (a modification of the proposal in Lødrup (1999)). This kind of approach would have the advantage that it establishes a connection between the option of unergatives with objects and another fact of the language. It would overgenerate, however, and additional machinery would be needed.

There seems to be no ideal solution to the problem of unergative verbs realizing their argument as an object. This problem came with the object analysis of presentational sentences. It was discussed intensively some time ago. We seem to have run of out of new ideas and new approaches, however, and there is not much written about this in the present millennium. What is clear is that there is a marked linking pattern, and this is maybe as far as we come for the time being.

8. Conclusion

The goal of this paper was to show that there are no acceptable arguments for the subject analysis of presentational sentences. Their logical subjects are grammatical objects. We have to live with the option of agentive objects – while a new and better account is overdue.

[6] Alsina and Yang (2018) give a partly OT-based account of argument alternation with one-place verbs in Catalan, which cannot be transferred to Scandinavian in a simple way.

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On control and binding in Hungarian complex event nominals

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Abstract

Laczkó & Rákosi (2019) analyze the binding relations of Hungarian anaphors occurring within possessive DPs. They introduce a new feature: BDD "binding domain delimiter" associated with the lexical form of the definite article. Furthermore, they assume that within Hungarian possessive DPs there are two [–r] grammatical functions available to arguments of complex event nominals: SUBJ and POSS. In this paper we will show that their analysis is on the right LFG-theoretic lines, because it handles the crucial binding facts appropriately. However, we will also demonstrate that it cannot capture some further related phenomena; therefore, we will propose an important modification of their account that will also cover these further cases. In addition to adopting their SUBJ PRO analysis of the external argument of a "transitive" derived nominal, we will subscribe to the view that the by-phrase realizing such an external argument bears the OBL_{ag} grammatical function, which is more feasible than a suppression account. Finally, we will explore the treatment of obligatory control into Hungarian DPs from an LFG perspective. We will argue for the anaphoric control approach as opposed the functional control alternative.

1 Introduction

Laczkó & Rákosi (2019), henceforth: L&R19, develop an LFG analysis of the binding relations of Hungarian anaphors when they occur within possessive DPs. Their starting point is the empirical generalization Rákosi (2017, 2020) reports: when either the reflexive or the reciprocal pronoun occurs within a possessive DP, neither of them can be anaphorically bound from outside if this DP contains the definite article. The LFG account of L&R19 has two crucial aspects to it. On the one hand, L&R19 introduce a new feature: BDD "binding domain delimiter" associated with the lexical form of the definite article. On the other hand, following Laczkó (2004, 2009), they assume that within Hungarian possessive DPs there are two [–r] grammatical functions available to arguments of complex event nominals: SUBJ and POSS. Both can be overtly realized by either the nominative or the dative possessor constituent, and, in addition, SUBJ can also be an LFG-style PRO, which can be controlled in the usual way. Our paper will have the following three interrelated objectives.

First of all, as a point of departure, we will show that L&R19's analysis is on the right LFG-theoretic lines, because it handles the crucial binding facts in the possessive DP domain appropriately. This subsumes the treatment of reflexives, and the majority of the uses of the reciprocal in a variety of case-forms, including the nominative possessor use. However, we will also demonstrate that this approach, as it stands, cannot capture the behaviour of the reciprocal functioning as the dative possessor. We will propose an important modification of L&R19's analysis that will also cover this additional case.

Secondly, we will emphasize the fact that the SUBJ PRO analysis of the external argument of a "transitive" derived nominal is indispensable for the treatment of binding and control. As regards its expression by a *by*-phrase, we will claim that the postulation of its mapping onto the OBL_{ag} grammatical function is more feasible than a suppression account.

Thirdly, we will explore the treatment of obligatory control into Hungarian DPs from an LFG perspective, a less studied area, see Szűcs (2019). After discussing the pros and cons for functional vs. anaphoric control, we will argue for the latter.

The structure of the paper is as follows. In section 2 we present the basic facts. In section 3 we give a critical overview of L&R19's analysis. In section 4 we propose a modification of their approach. In section 5 we claim that *by*-phrases in Hungarian DPs are obliques and not suppressed arguments with an adjunct function. In section 6 we argue for anaphoric (as opposed to functional) control into Hungarian event nominal. In section 7 we conclude.

2 The definite article and anaphoric possessors (Rákosi 2017, 2020)

The Hungarian possessive noun phrase may include the definite article. It has a complex distribution, but in general, whether it is present or not has no direct influence on the semantics of the possessive noun phrase. If the (unmarked) nominative possessor, for example, is a personal name, then the definite article is largely optional (subject to dialectal variation):

(1)	Szeretem	[$_{\text{DP}}$	(a)	Kati	süti-jé-t].
	like.1SG		the	Kate	cake-POSS.3SG-ACC
	'I like Kate's cake.'				

In other possessive constructions, the article may be obligatory or ungrammatical.[1]

Building on the work of Despić (2011, 2015) and Reuland (2011), Rákosi (2017, 2020) argues that this variation in article use has a so far unrecognized binding theoretic dimension in Hungarian. In fact, the definite article plays a syntactically active role in licensing anaphoric possessors in Hungarian: no article can intervene between the possessor and its antecedent if the possessor is a true anaphor. We illustrate this with reciprocal anaphors, our focus in this paper. Consider the following three examples, each containing a reciprocal anaphor acting as the possessor within the object noun phrase:

(2)	a.	Mi	ismerjük [$_{\text{DP}}$	($^{*/??}$az)	egymás	baj-á-t].
		we	know.1PL	the	each_other	problem-POSS.3SG-ACC
		'We know each other's problem.'				

[1] We refer the reader to Szabolcsi (1994), Laczkó (1995), and Alberti & Laczkó (2018), among others, for rich overviews of the syntax of the Hungarian possessive noun phrase.

b. Mi ismerjük [DP egymás-nak *(a) baj-á-t].
we know.1PL each_other-DAT the problem-POSS.3SG-ACC
'We know each other's problem.'

c. Mi díjaztuk [DP (az) egymás lefest-és-é-t].
we appreciated.1PL the each_other painting-DEV-POSS.3SG-ACC
'We appreciated the painting of each other.'

While the article is more or less unacceptable in (2a), an example including the unmarked nominative possessor, it is obligatory in (2b) with the dative-marked possessor.[2] In this latter case, the possessor occupies a peripheral position in the possessive noun phrase, preceding the definite article. Thus in neither of these two examples is there an article intervening between the reciprocal possessor and the matrix subject antecedent. The definite article is largely optional in (2c), where the head of the possessive noun phrase is a deverbal nominal. Since it is plausible to assume that such nominalizations include a grammatically active subject (see below), the search for an antecedent does not have to cross the boundaries of the possessive noun phrase, and many speakers tolerate the insertion of the definite article in this case.[3]

Rákosi (2017, 2020) develops a Minimalist account that captures the above data, and which covers anaphoric possessor strategies in Hungarian in general. In particular, he argues that the possessive noun phrase is a binding domain, with a left edge that is directly accessible from the matrix clause (see Despić 2015 for detailed arguments for a cross-linguistic approach along these lines). Thus the dependency between the reciprocal anaphor and the matrix antecedent is local in the syntactic sense in both (2a) and (2b). The use of the article in the nominalization example in (2c) is not constrained by such factors

[2] One of the reviewers notes that while we report absolute judgements for (2b), we suggest that there may be some variation in (2a). The article is indeed obligatory in contemporary Hungarian in (2b), and while the judgements concerning (2a) are somewhat less unequivocal, speakers strongly disprefer the article there, and most cannot accept it at all. An examples similar to (2a) was rated at 4.61 without the article in the survey Rákosi (2020: 128-131) conducted, whereas with the article the average rating was 1.87 (on a 5-point Likert-scale, 5: fully acceptable, 1: non-acceptable, N=141).

[3] In the questionnaire survey that Rákosi (2020: 128-131) reports, an example analogous to (2c) received the average rating of 4.52 with the article, and 3.12 without it (on a 5-point Likert-scale, 5: fully acceptable, 1: non-acceptable). 35 participants found the version without the article fully acceptable, while 29 rejected it (N=141). Rákosi also notes that the majority of the corpus examples wherein a reciprocal possessor is preceded by the definite article are such that the possessum is a nominalized verbal head. Thus the emerging picture is that the article becomes a more or less acceptable option in the construction that (2c) represents, except for a minority of speakers. One of the reviewers asks whether this variation in article use is related to the variation in (1). At this point, we do not see a clear connection, but we intend to investigate this issue in future work.

since the direct, local antecedent for the reciprocal is within the nominalization itself.

L&R19 put forward an LFG-based account of these phenomena, which describes the grammar of (2a) and other anaphoric possessor constructions not discussed here, under the assumption that the definite article introduces a binding domain delimiting (BDD) feature in Hungarian. One of our main goals in this paper is to augment this analysis to cover the dative construction in (2b), as well as to develop a deeper understanding of the nominalization construction in (2c) and to propose an LFG-theoretic analysis.

3 On L&R19's analysis

Consider (2a) and (2c) repeated here for convenience.

(2) a. Mi ismerjük [$_{DP}$ ($^{*/??}$az) egymás baj-á-t].
we know.1PL the each_other problem-POSS.3SG-ACC
'We know each other's problem.'

c. Mi díjaztuk [$_{DP}$ (az) egymás lefest-és-é-t].
we appreciated.1PL the each_other painting-DEV-POSS.3SG-ACC
'We appreciated the painting of each other.'

L&R19 capture the ungrammaticality of (2a) in the presence of the definite article by assuming that the article has a blocking effect: it prevents binding from outside the DP that it heads. They encode this blocking function by employing a special feature: "binding domain delimiter": BDD.[4] They associate it with the lexical form of the article in case it occurs in a possessive DP, see (3), the simplified lexical form representation, which only shows the two crucial aspects of the analysis. The first annotation checks for the possessive DP environment, and the second introduces the new BDD feature.

(3) *a(z):* …
(↑CHECK _POSS-MORPH)$=_c$ +
(↑BDD)= +

L&R19 assume that the Hungarian reciprocal, *egymás* 'each other, one another', which can have the whole range of nominal case suffixes, is subject to the Minimal Finite Domain Condition, which is to be encoded in its lexical form. This encoding is combined with the BDD feature as a negative off-path

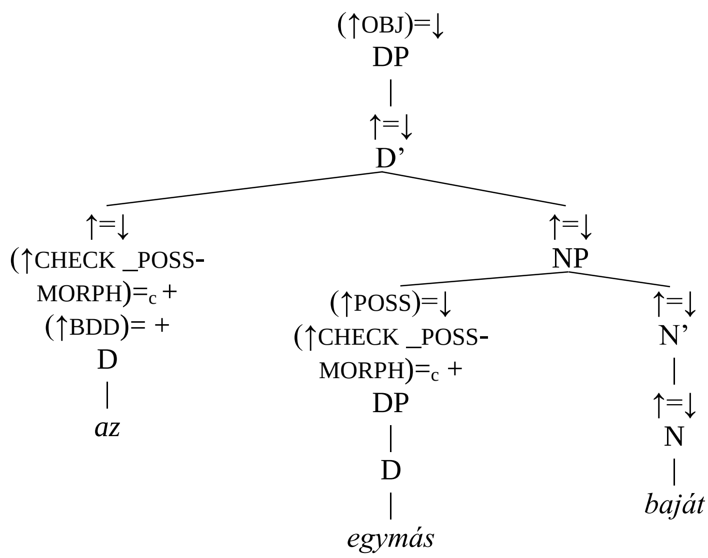
[4] One of our anonymous reviewer asks the following question. "How is the Binding Domain Delimiter more than a simple description of the facts?" Our answer is that at this stage it is not more. It serves as an adequate device to formally encode the relevant facts in LFG. In the future we may find other languages exhibiting similar phenomena. Then we may be in a position to make broader generalizations.

constraint: ~(→ TENSE), see (4), the simplified lexical form of the nominative reciprocal. The BDD feature is added as a negative off-path constraint on possessive DP domains: the path leading to the anaphor cannot contain this feature. For instance, this results in the ungrammaticality of (2a) in the presence of the article, and the construction is grammatical in the absence of the article.

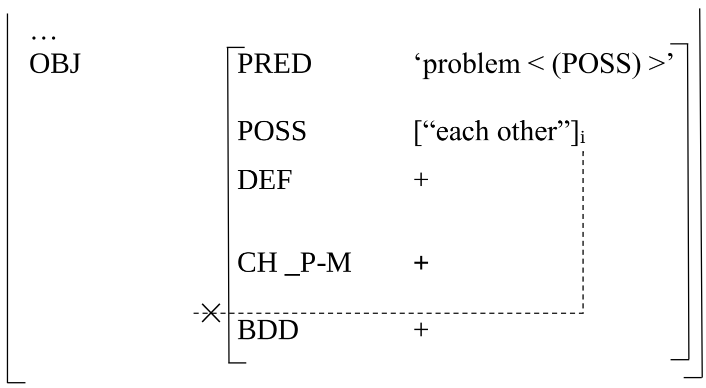
(4) *egymás:* (GF* GF_{pro})
~(→ TENSE)
~(→ BDD)

Consider L&R19's c-structure and f-structure representation of the possessive DP in (2a).

(5) a.

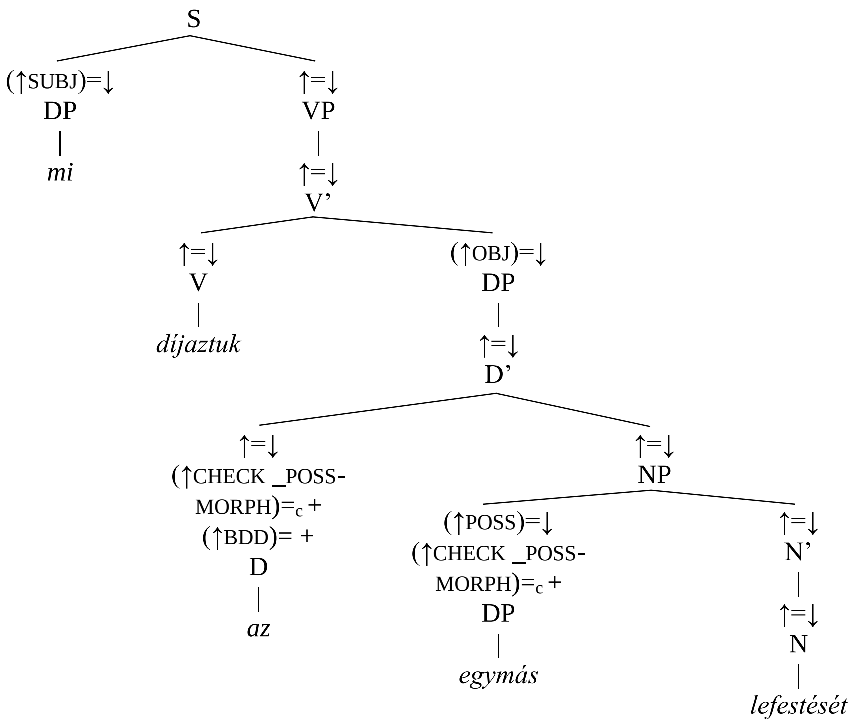


b.



As (2c) demonstrates, the reciprocal can be coreferential with the matrix subject when the DP contains a complex event nominal even in the presence of the definite article. L&R19 assume that in this case, too, the definite article has the same binding domain delimiting function; however, the reciprocal DP is bound within the possessive DP by an LFG-style SUBJ PRO, and in turn this PRO is controlled by the matrix subject from outside the DP. Thus, here the coreference is along the control and binding lines, that is, the reciprocal is not bound from outside the DP. For such an analysis to work, L&R19 subscribe to Laczkó's (2004, 2009) approach, in which the crucial assumption is that within Hungarian possessive DPs there are two [–r] grammatical functions available to arguments of complex event nominals: SUBJ and POSS. Both can be overtly realized by either the nominative or the dative possessor constituent, and, in addition, SUBJ can also be an LFG-style PRO, which can be controlled in the usual way.[5] Consider the analysis of (2c) in this approach.

(6)



[5] See the argument structure of *lefestés* 'painting' in (7). Laczkó (2004) develops an LMT analysis involving these functions. He also adopts the Subject Condition from the verbal (clausal) domain.

When the definite article is not present in the possessive DP in (2c), the f-structure is the same as in (7), the only difference being that it does not contain the (BDD) feature.

(7)
$$\left[\begin{array}{ll} \text{PRED} & \text{‘appreciate < (SUBJ) (OBJ) >’} \\ \text{TENSE} & \text{past} \\ \text{SUBJ} & [\text{“we”}]_i \\ \text{OBJ} & \left[\begin{array}{ll} \text{PRED} & \text{‘painting < (SUBJ) (POSS) >’} \\ \text{SUBJ} & [\text{“pro”}]_i \\ \text{POSS} & [\text{“each other”}]_i \\ \text{CH \_P-M} & + \\ \text{BDD} & + \end{array}\right] \end{array}\right]$$

We believe that fundamentally L&R19’s approach is appropriate in an LFG framework, because it handles the crucial binding facts in the possessive DP domain satisfactorily. This includes the treatment of reflexives, which we do not discuss here, and the majority of the uses of the reciprocal in a variety of case-forms, including the nominative possessor use. However, the approach as it stands has a significant shortcoming. It cannot fully capture the behaviour of the reciprocal as the dative possessor. Consider (2b), repeated here as (8a) for convenience (with a minor representational adjustment for the sake of ease of minimal pair comparison in (8)), and (8b), by also comparing the latter with (2c).

(8) a. Mi ismerjük [$_{DP}$ egymás-nak a baj-á-t].
we know.1PL each_other-DAT the problem-POSS.3SG-ACC
‘We know each other’s problem.’

b. Mi díjaztuk [$_{DP}$ egymás-nak a lefest-és-é-t].
we appreciated.1PL each_other-DAT the painting-DEV-POSS.3SG-ACC
‘We appreciated the painting of each other.’

(8b) does not pose a problem for L&R19’s system, because in the case of complex event nominal heads the presence of the definite article does not make coreference from outside the possessive DP ungrammatical. In this case the reciprocal is bound within the DP by a SUBJ PRO, and in turn this SUBJ PRO is controlled by the matrix SUBJ. So it does not matter whether the reciprocal possessor is in the nominative as in (2c) or in the dative case as in (8b), the f-structures of both possessive DPs in these examples will be identical except for the case specifications of the possessive reciprocal. By contrast, L&R19's approach predicts (8a) to be ungrammatical, because the f-structure of the possessive DP in this example is the same as that of the possessive DP in (2a) shown in (5b), again, except for the case specifications of the possessive reciprocal. So on the basis of (5b) (8a) should be ruled out, contrary to fact.

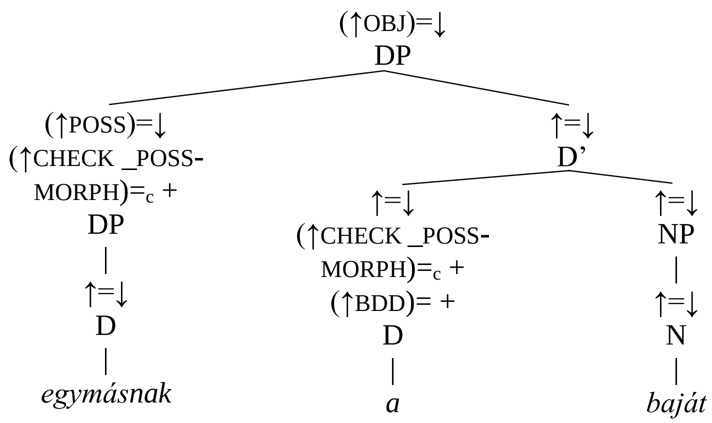
4 Modification of L&R19's analysis

We propose the following solution. Dative reciprocal possessors are exempt from the BDD constraint. This can be encoded in the lexical form of the reciprocal as shown in (9).

(9) *egymás*: ((GF* $\quad$ GF$_{pro}$ ↑) GF$_{ante}$) = (↑ ANTECEDENT)
~(→ TENSE)
{ ~(→ BDD)
| (→ BDD) & (→ POSS CASE =$_c$ DAT) &
(→ POSS PRON-TYPE =$_c$ RECIP) }

We build this exemption into the off-path constraint set of the reciprocal. The first constraint encodes the Minimal Complete Nucleus Condition. The BDD disjunction has the following effect. First disjunct: the path must not contain the BDD feature. Second disjunct: the path contains this feature AND there is a reciprocal possessor in the dative on the path. Consider the c-structure and the f-structure of the possessive DP in (8a) in (10a) and (10b), respectively, and compare them with the corresponding structures in (5).

(10) a.



b.
$$\left[\begin{array}{ll} \dots & \\ \text{OBJ} & \left[\begin{array}{ll} \text{PRED} & \text{‘problem < (POSS) >’} \\ \text{POSS} & \left[\begin{array}{ll} \text{PRED} & \text{‘pro’} \\ \text{PRON-TYPE} & \text{RECIP} \\ \text{CASE} & \text{DAT} \end{array}\right]_i \\ \text{DEF} & + \\ \text{CH\_P-M} & + \\ \checkmark\ \text{BDD} & + \end{array}\right] \end{array}\right]$$

This modification of L&R19’s analysis appropriately handles the binding properties of possessive DPs with ordinary noun heads containing reciprocal possessors in the dative. However, the following legitimate question arises in this connection. What makes the dative possessor reciprocal different from the nominative possessor reciprocal and the reciprocal in all the other case forms? Our answer is that in Hungarian dative case-marking has a remarkably distinguished status in general and in the context of possessive DPs in particular.

To begin with, the dative in Hungarian has the customary lexical (i.e. “inherent”) case use. For instance, in the case of the three-place predicate *ad* ‘give’ the recipient argument is expressed by a dative DP. In addition, the dative is also a multi-functional non-semantic (i.e. “structural”) case. For instance, the overt subject of infinitives receives dative.[6] Moreover, the dative is used to mark the XCOMPs of “raising-to-object” constructions and “contrastive as regards” type topics. It can be considered an all-purpose marker, because in these roles it can be attached not only to noun phrases but also adjectival phrases.

As we have seen, within possessive DPs the possessor can be either dative or nominative, in Spec,DP and in Spec,NP, respectively. In addition, the dative possessor, but not the nominative possessor, can also follow the noun head, as in (11).

(11)	a.	a	baj-a	János*(-nak)
		the	problem-POSS.3SG.NOM	John(-DAT)
		‘John’s problem’		

Furthermore, dative possessors (but not nominative possessors) can be “extracted” from their host possessive DPs, see (12).

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[6] Due to lack of space, here we cannot exemplify those uses of the dative that are not directly related to the possessive nominal domain.

(12) (János-nak) Mi ismerjük [DP a baj-á-t]
John-DAT we know.1PL the problem-POSS.3SG-ACC
jól (János-nak).
well John-DAT
'We know John's problem well.'

Finally, in Hungarian clause-level possessive constructions the copula *van* 'be' is used, the possessum is the subject noun phrase in nominative, while the possessor is expressed by a dative-marked DP.[7]

(13) János-nak van pénz-e.
John-DAT is money-POSS.3SG.NOM
'John has money.'

We think that the properties of the dative marker discussed above provide at least a partial justification or explanation for why dative reciprocal possessors can be exempt from an otherwise general binding constraint.

In Szabolcsi's (1994) classic GB analysis the possessor is base-generated in Spec,NP, where it receives nominative case. It can stay there, or it can move to Spec,DP, where it acquires dative, which according to Szabolcsi is not a case-marker but an operator marker in the sense that Spec,DP is the same kind of A-bar (operator) position as Spec,CP at the clause level (also see the all-purpose function of the dative as described above). The dative-marked possessor can remain in Spec,DP, or it can be extracted from that position, i.e. the possessor can use the Spec,DP position as an escape hatch, just like *wh*-phrases can use Spec,CP as an escape hatch in embedded questions.[8]

A possible LFG alternative of Szabolcsi's extraction operation analysis is to base-generate the dative possessor outside the possessive DP and to provide it with the following annotations.

(14) (↑GF POSS)=↓
(↓CASE)$=_c$ DAT
DP

Dative possessor reciprocals can also be involved in "extraction".

[7] For an LFG analysis, see Laczkó (2012).
[8] In Szabolcsi's approach possessive sentences are existential clauses in which the dative possessor is extracted from a nominative possessive noun phrase.

(15)	(Egymás-nak)	Mi	ismerjük	[$_{DP}$	a	baj-á-t]
	each_other-DAT	we	know.1PL		the	problem-POSS.3SG-ACC

jól (egymás-nak).
well each_other-DAT
'We know each other's problem well.'

Notice that given the annotated c-structure representation in (14), the f-structure of the possessive DP containing the dative possessor reciprocal in (8a) and that of the possessive DP with an extracted dative possessor reciprocal in (15) are identical. Thus, our proposal handles both configurations in a uniform and equally feasible fashion.

5 No suppression in Hungarian event nominals

In the LFG literature *by*-phrases have received both an "OBL_{ag}" analysis and a "suppressed argument and adjunct" analysis at the clausal passive level, see Bresnan (1982) and Bresnan et al. (2016), respectively, for instance.[9] The choice between the two approaches is of particular importance in the context of the account developed in this paper. The reason for this is that it is the cornerstone of the account that there is a SUBJ PRO in the relevant possessive nominal domain for the treatment of binding and control facts. The question is whether we find independent evidence for the postulation of such a PRO. If the answer is in the affirmative then we have two independent motivations for assuming that there is no suppression in Hungarian event nominals, and if a *by*-phrase appears in them, it has an oblique argument function.

It seems to be a rather widely-held, cross-theoretical view in the generative literature on Hungarian that the postulation of a PRO argument is necessary in complex event nominal constructions for the generally used, principled treatment of binding and control phenomena in this domain, see, for instance, Szabolcsi (1992), Laczkó (2004, 2005, 2008, 2009), Kenesei (2005), and Laczkó & Rákosi (2019). Consider Szabolcsi's (1992: 169) classic examples on the basis of which she argues for the PRO (as opposed to the suppression) analysis of the unexpressed external argument.[10]

[9] Although the suppression approach seems to be the preferred alternative these days, for a relatively recent proposal along the no suppression lines, see Kibort (2004: 360-363), who also argues for the downgraded argument status of *by*-phrases in passive constructions.

[10] She claims that Grimshaw's (1990) suppression analysis of English complex event nominals cannot be adopted to the corresponding Hungarian phenomena as there is evidence in Hungarian for assuming that the overtly unexpressed external argument is realized by PRO, and it is not suppressed, see below.

(16) Context: When Peter was visiting Mary, a bee stung Peter.

a. Péter megcsíp-és-e után .
Peter.NOM sting-DEV-POSS.3SG after

a méh megdöglött.
the bee.NOM died.3SG
'The bee died after stinging Peter.'

b. Péter méh általi megcsíp-és-e
Peter.NOM bee by sting-DEV-POSS.3SG

bosszantotta Mari-t.
annoyed.3SG Mary-ACC
'Stinging of Peter by a bee annoyed Mary.'

c. *Péter megcsíp-és-e bosszantotta Mari-t.
Peter.NOM sting-DEV-POSS.3SG annoyed.3SG Mary-ACC
'Stinging of Peter annoyed Mary.'

Szabolcsi's argumentation is as follows. In the case of (16a) it is feasible to assume a PRO agent, which is controlled by the subject of the sentence. As (16c) shows, when there is no controller, the interpretation of the unexpressed external argument is obligatorily [+human], which straightforwardly calls for a PRO_{arb} treatment. (16b) demonstrates how the non-human agent can be expressed in complex event nominal constructions.

The discussion above has two dimensions. On the one hand, if we want to capture the control facts of event nominal DPs coupled with the binding phenomena analyzed in this paper, we need a PRO (as opposed to suppression) analysis of the external argument of the derived nominal predicate. On the other hand, and independently from the former scenario, in an "uncontrolled" configuration there is strong evidence for the PRO_{arb} (as opposed to the suppression) analysis. From all this it follows that it is much more reasonable to assume that when there is a *by*-phrase in the DP it is an oblique argument rather than an adjunct linked to a suppressed external argument. Also notice that in this scenario we do not even need to assume a Ø/OBL_{ag} GF duality as in the early treatment of passivization in LFG. Here the nature of the duality is that between mapping onto SUBJ-PRO or OBL_{ag}.

6 Anaphoric control into Hungarian DPs

To round up the discussion about the nature of complex event nominals (CENs) in Hungarian, this section is concerned with the nature of the control-mechanism into these constituents.

According to widely-held assumptions, the implicit subject of complex event nominals is under non-obligatory control (NOC, as opposed to e.g.

control into infinitivals). For example, Landau (2013: 40) claims that “the DP layer intervening between the matrix predicate and the complement TP/CP disrupts the OC dependency – plausibly, due to some locality constraint on the syntactic operation establishing OC – giving rise to NOC”. This is illustrated by (17), where the subject of the CEN (the examiner, represented as PRO for convenience and expository purposes in the subsequent examples) may either refer to the main clause subject John or to some other person.

(17)	János$_i$	unta	[Kati	PRO$_{i/j}$	levizsgáztat-ás-á-t].
	John	felt.bored.by.3SG	Kate		examine-DEV-POSS.3SG-ACC

‘John felt bored by the examination of Kate.’

Landau’s ideas are couched in a minimalist framework, so the NOC-effect is explained in terms of the DP-layer, but an LFG-theoretic explanation is equally possible, see the discussion in section 4 of this paper.

Nevertheless, Szűcs (2019) calls attention to the fact that with certain main clause predicates, the referential dependency between the main clause subject and the CEN’s subject may be obligatory. This is illustrated by the predicate *abbahagy* ‘cease’ in (18). The examiner in this case can only be John.

(18)	János$_i$	abbahagyta	[PRO$_{i/*j}$	Kati	levizsgáztat-ás-á-t].
	John	ceased.3SG		Kate	examine-DEV-POSS.3SG-ACC

‘John ceased the examination of Kate.’

In (18) the CEN functions as the object of the main predicate. The same phenomenon may be observed with subject and oblique CENs, shown in (19)-(20), respectively. The “a” examples show the expected NOC pattern, while the “b” examples illustrate the cases where the referential dependency is constrained.

(19)	a.	[Kati PRO$_{i/j}$	levizsgáztat-ás-a]	tetszett	János-nak$_i$.
		Kate	examine-DEV-POSS.3SG	appealed.3SG	John-DAT

‘The examination of Kate was appealed to John.’

	b.	[Kati PRO$_{i/*j}$	levizsgáztat-ás-a]	sikerült	János-nak$_i$.
		Kate	examine-DEV-POSS.3SG	succeeded.3SG	John-DAT

‘The examination of Kate was a success for John.’

(20)	a.	Kérdeztem	János-t$_i$	[PRO$_{i/j}$	Kati	levizsgáztat-ás-á-ról].
		asked.1SG	John-ACC		Kate	examination-DEV-POSS.3SG-DEL

‘I asked John about the examination of Kate.’

b. Megakadályoztam János-t$_i$ [PRO$_{i/*j}$ Kati
prevented.1SG John-ACC Kate
levizsgáztat-ás-á-ban].
examination-DEV-POSS.3SG-INE
'I prevented John from examining Kate.'

It is intuitively clear why these contrasts hold: the semantics of the predicates involved differs. While it is certainly possible that anyone's actions may be boring to an observer, one can only cease to do whatever one had been doing. Similarly, any action may appeal to me, but if I am successful in doing something, the doer of that something must be me. The same applies to "ask someone about doing something" vs. "prevent someone from doing something".

The question for an LFG-theoretic account is how to model this difference. It seems uncontroversial that the bare bones of a lexical entry for such predicates should look like these (the parts that are relevant for the CEN-perspective are underlined):

(21) a. *verb* <(SUBJ)(OBJ)>
b. *verb* <(SUBJ)(OBL)>
c. *verb* <(SUBJ)(OBJ)(OBL)>

If the respective GFs are CENs, there is a SUBJ inside them, which gets its value via some mechanism. The default case is that there is an f-structural PRO, which may refer to any contextually available entity. This is what is called *arbitrary* anaphoric control.

To get the OC-reading there are essentially two paths that one can take: either one can say that *obligatory* anaphoric control is instantiated (which may ultimately be a shorthand for a purely semantic explanation)[11], or one can say that functional control is established. Thus the lexical entries may be supplemented in the ways shown in (22 – functional control) and (23 – obligatory anaphoric control).

(22) a. (↑SUBJ) =(↑OBJ SUBJ)
b. (↑OBL) =(↑SUBJ SUBJ)
c. (↑OBJ) =(↑OBL SUBJ)

(23) a. (↑SUBJ)$_\sigma$ = (↑OBJ SUBJ)$_\sigma$ ANTECEDENT
b. (↑OBL)$_\sigma$ = (↑SUBJ SUBJ)$_\sigma$ ANTECEDENT
c. (↑OBJ)$_\sigma$ = (↑OBL SUBJ)$_\sigma$ ANTECEDENT

[11] We thank Dag Haug at LFG20 for this remark.

While functional control has been primarily associated with raising and long-distance dependency constructions (question formation, topicalization) there has been several proposals in the LFG literature about its availability for equi-type control. For instance, while Dalrymple (2001) analyzes all control-constructions as anaphoric in nature, Falk (2001) proposes that there should be a bifurcation whereby some predicates like *try* instantiate functional control while others like *agree* utilize anaphoric control. Support for this approach is provided for example by the availability of a partial control interpretation for the latter, but not the former predicate, see (24).[12]

(24) a. *John$_{i}$ tried PRO$_{i+}$ to meet at 6.
   b. John$_{i}$ agreed to PRO$_{i+}$ meet at 6.

Since functional control involves a full syntactic identity of the respective constituents, such referential flexibility is ruled out, while in principle they are available for anaphoric control, which is more akin to run-of-the-mill pronominal dependencies. At the same time Falk notes that "obligatory anaphoric control" (a strict referential identity) is also an option in the theoretical space. So while referential flexibility (e.g. partial control) implies anaphoric control, the lack of such a flexibility may be either the result of functional control or obligatory anaphoric control.

As the contrast that is shown in (17)-(20) also involves the referential options for the implicit subject of the CENs, an analytical suggestion along the lines of functional and anaphoric control is not without merit. Nevertheless, we argue against such a proposal and maintain that all CENs involve anaphoric control, even the ones where the referential possibilities are fixed. That is, the equations in (23), with obligatory anaphoric control are the correct path for the analysis of (18), (19b) and (20b).

First we would like to make a few remarks about some general points about the relevant aspects of the LFG-theoretical analysis of control. Functional control is associated with the grammatical function XCOMP, the predicative complement.[13] However the CENs at hand are definitely not XCOMPs, but SUBJ, OBJ and OBL (respectively). They are nominal in character and possess all the relevant properties (e.g. case-marking) of these grammatical functions. While there is a line of research in LFG which proposes that functional control into other grammatical functions should be allowed (see e.g. Alsina et al. 2008, Patejuk & Przepiórkowski 2014, Szűcs 2018a), this is still a noncanonical move by LFG-standards. Anaphoric control is a subtype of standard pronominal dependencies and as such, it is not associated with a particular grammatical function.

[12] See Haug (2013) for more on partial control.
[13] According to Asudeh (2002: 42), containing "a grammatical function that is the target of a functional control equation" is the defining property of XCOMP.

Another relevant theoretical point is that in classic LFG, the controller (whether anaphoric or functional) must be a term function (SUBJ, OBJ), see e.g. Bresnan (1982: 354), Dalrymple (2001: 344). The problem is that "oblique control is a very common option in many languages" (Landau 2015: 15), see e.g. (19), or Landau's Hebrew example in (25). Besides, for LFG, Cook (2006) argues for the existence of OBL functional controllers into certain infinitival passives in German (see e.g (26)), and for the existence of oblique functional controllers in general, note the English example in (27).

(25)	Gil	kafa	alay	le'hitpater	etmol.
	Gil	compelled	on.me	to.quit	yesterday

'Gil compelled me to quit yesterday.' (Hebrew, Landau 2015: 75)

(26)	weil	mir	[von	der	Firma]$_i$	versprochen	wurde,	den
	since	me	by	the.DAT	company	promised	was	the.ACC
	Rohrbruch	bis	Mittag	PRO$_i$	zu	reparieren		
	burst.pipe	until	afternoon		to	repair		

'because it was promised to me by the company that that the burst pipe would be repaired afternoon' (German, Cook 2006: 117)

(27) John$_i$ counted on / relied on / called upon Susan$_j$ PRO$_{j/*i}$ to take care of herself/*himself/*oneself.
(Cook 2006: 115, referencing Culicover & Jackendoff 2005: 433)

It seems then that theoretical considerations cannot really arbitrate between the functional and anaphoric control approaches. Anaphoric control might be said to be more in line with the standard treatment of control into nominals in LFG, but by itself this is hardly a clincher. Thus, empirical matters should weigh in. As it turns out, there is substantial empirical evidence that favors the anaphoric approach over the functional one.

One piece of evidence comes from the assumption that if a predicate can be proven to go with anaphoric control in some (non-CEN) construction it is unlikely for that predicate to switch to functional control in a CEN. Take *sikerül* 'is a success for', from (19b). This predicate also occurs with a controlled infinitival subject. It is also true that in some cases, Hungarian infinitivals can be inflected. But crucially, according to Rákosi (2006: 205-228) the possibility of inflection on infinitives is contingent on the presence of a (covert) subject in the infinitival clause. This covert subject may be the PRO of the CEN, regardless of the actual implementation (c-structure in Chomskyan frameworks or f-structure in LFG). *Sikerül* does occur with an inflected infinitive subject, which suggests that it utilizes anaphoric control in (28). Presumably the same mechanism is present in a CEN.

(28)

János-nak	sikerült	megbuk-ni(a)	a	vizsgán.	
John-DAT	succeeded.3SG	fail-INF(.3SG)	the	exam.SUP	

‘John managed to be the only person to fail the exam.’

Moreover, Szabolcsi (2009) shows that this covert subject can be made overt in some circumstances (e.g. focussing in the infinitival clause). This is a very clear indication of anaphoric control, since the controller and the controlled element are distinct entities. Functional control means full identity, which is obviously not applicable in such cases.

(29)

János-nak	sikerült	csak neki	megbuk-ni(a)	a	vizsgán.
John-DAT	succeeded.3SG	only him	fail-INF(.3SG)	the	exam.SUP

‘John managed to be the only person to fail the exam.’

Clearly, (29) is an instantiation of anaphoric control. It is a natural assumption that this carries through to CENs, especially given the fact that anaphoric control seems to be the default option anyway, see the theoretical points discussed earlier.[14]

Another piece of evidence for the primacy of anaphoric control in CENs is that partial control seems to be an interpretational option in CENs, e.g. in (30).

(30)

[Kati $\text{PRO}_{?i+}$	levizsgáztat-ás-a]	sikerült	János-nak_i.
Kate	examine-DEV-POSS.3SG	succeeded.3SG	John-DAT

‘The examination of Kate was a success for John.’

This is even true for predicates that are otherwise plausibly analyzed as relying on functional control as regards their infinitival complements. For example, *try* and its Hungarian equivalent *megpróbál* is a prime example for a verb that might be associated with functional control, for instance because of it disallowing partial control readings, as in (24a) and (31a). However, even *megpróbál* possibly allows partial control with a CEN. This is a strong indication of anaphoric control, since as noted, the full identity brought about by functional control is not compatible with such a semantics.

(31) a.

János	megpróbálta $\text{PRO}_{i/*i+}$	levizsgáztat-ni	Katit.
John	tried.3SG	examine-INF	Kate.ACC

‘John tried to examine Kate.’

b.

János	megpróbálta $\text{PRO}_{i/?i+}$	Kati	levizsgáztatását.
John	tried.3SG	Kate	examine-DEV-POSS.3SG-ACC

‘John tried examining Kate.’

[14] It might be added that anaphoric control is a more flexible mechanism overall, featured in a number of phenomena like partial control, split control (Haug 2013), *tough*-movement (Dalrymple & King 2000), prolepsis (Szűcs 2018b).

We must note that the partial readings in (30) and (31b) are marked with a ? because there seems to be some disagreement about them among native speakers. Note however that partial control is a discourse/context-sensitive phenomenon and "there is no reason to expect categorical intersubjective judgments on such constraints" (Haug 2013, footnote 3).

In sum, both the theoretical and the empirical landscape favor anaphoric control into complex event nominals, so this analysis, formalized in (23), is maintained even for cases where the superficial picture might appear to warrant functional control.

7 Conclusion

In this paper we concentrated on certain binding and control phenomena in Hungarian possessive DPs. First of all, we modified Laczkó & Rákosi's (2019) account in order to handle the binding facts of the dative possessor reciprocal. The essence of this modification was that we proposed that this reciprocal should be exempt from the effect of the BDD feature carried by the definite article. Secondly, we subscribed to the general SUBJ PRO (as opposed to the suppression) analysis of the *by*-phrase-less construction type, and we assumed that if the *by*-phrase occurs in the event nominal DP, it has the OBL_{ag} GF status. Finally, we argued both on theoretical and empirical grounds for the anaphoric type of control into event nominals.

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F-structure and s-structure of Urdu complex predicates

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Abstract

This paper proposes a solution to the problem of constituent-sensitive interpretation of semantic scope in Urdu complex predicates in the analysis of Lowe (2015). In this novel approach, the PRED value of the main verb in an Urdu complex predicate appears in its own f-structure with no grammatical functions. The lexical entry of the light verb constructs a complex s-structure which links the single set of grammatical functions with semantic arguments in a connected s-structure. This approach avoids the formal complications of the hybrid f-structure proposal of Andrews (2018). Resolving the semantic scope problem provides support for the idea that complex predicates are formally unproblematic in LFG, as long as argument selection is constrained by glue semantics (instead of general Completeness and Coherence constraints). This approach to complex predicates is a possible alternative to the approach of Butt (1995) which postulates the formal complications of a-structure and unifiable semantic forms.

1 Introduction

Asudeh and Giorgolo (2012) posit a version of the LFG architecture that builds on the idea that glue semantic constraints can effectively replace Completeness and Coherence (Dalrymple et al. 1993, Kuhn 2001, Andrews 2008). They argue that, under this assumption, there is no need for a level of a-structure (distinct from s-structure) located between c-structure and f-structure, as in the architecture posited by Butt, Dalrymple and Frank (1997). Asudeh and Giorgolo (2012: 69-72) further point out that a level of a-structure separate from s-structure significantly complicates the architecture, in particular by requiring two separate links between a-structure and s-structure, one via f-structure and one direct (if no overt argument is expressed in f-structure; see Findlay (2016: 303-309) for further discussion). The basic architecture proposed by Asudeh and Giorgolo (2012) is illustrated in Figure 1.

$$\underset{\text{c-structure}}{\bullet} \xrightarrow{\ \ \phi\ \ } \underset{\text{f-structure}}{\bullet} \xrightarrow{\ \ \sigma\ \ } \underset{\text{s-structure}}{\bullet}$$

Figure 1: LFG architecture (Asudeh and Giorgolo 2012)

Several researchers have worked on developing different aspects of this architecture: Asudeh and Giorgolo (2012) on optional arguments, Asudeh et al. (2014) on valency and derived arguments, Findlay (2016, 2020) on function-argument linking, Przepiórkowski (2017) on the argument-adjunct distinction, as well as

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Lovestrand (2018) on argument sharing in serial verb constructions. Of particular interest in this regard is Lowe's (2015) analysis of Urdu complex predicates. Data from Urdu complex predicates are closely tied to the original a-structure architecture proposal. If complex predicates cannot be analyzed without a-structure, then the complexity introduced into the architecture by a-structure might still be exactly the level of complexity needed. The simpler architecture of Asudeh and Giorgolo (2012) is only as good as the most complex type of construction it can represent.

2 Urdu complex predicates

Complex predicates in Urdu/Hindi have been described and analyzed in extensive detail by Butt and colleagues (e.g. Butt 1995, 1997, Butt, King and Maxwell III 2003, Butt, King and Ramchand 2010, Butt and Ramchand 2005, Butt 2014). Butt's earlier work primarily examines two types of complex predicates:[1] Aspectual complex predicates which have an effect on the lexical semantics of the main verb without changing the valency, and permissive complex predicates which increase the valency of the main verb. Only the latter will be discussed here. In a permissive complex predicate, the light verb *de* 'give' increases the overall valency of the predicate by adding a "permitter" to the argument structure. In example (1), the main verb is *paṛʰ-ne* 'read'. Its agent is *baccõ* 'children', and its patient is *kıtab-ẽ* 'books'. The presence of the light verb *dĩ* 'give' coincides with an additional argument, *mã=ne* 'mother', understood to be the permitter, allowing the child to read the book.

(1) mã=ne bɑccõ=ko kıtab-ẽ pɑṛʰ-ne
mother(F)=ERG child(M).PL.OBL=DAT book(F).-PL.NOM read-INF.OBL
dĩ
give.PRF.F.PL
Mother let (the) children read (the) books. (Butt 2014: 2)

In example (1), grammatical relations correspond to case marking in a straightforward manner. The permitter is a subject, as indicated by its ergative case. The patient of the main verb, in nominative case, is an object, and the agent of the main verb, in dative case, can be considered a secondary object. The semantics of the Urdu permissive intuitively suggest (at least from an anglocentric perspective) that the patient is the grammatical object of the main verb, and that while the agent may be a secondary object in relation to the light verb, it functionally could also be a subject of the main verb. This "control" analysis is illustrated in example (2). However, the Urdu data contradicts this intuition.

[1]More detailed analyses of Urdu causatives are included in later work (e.g. Butt and King 2006, Butt et al. 2010, Butt 2014).

(2) **Intuitive yet impossible analysis of example (1)**

$$\left[\begin{array}{ll}
\text{PRED} & \text{`give/let<(SUBJ)(OBJ}_{goal}\text{)>'} \\
\text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`mother'} \end{array}\right] \\
\text{OBJ}_{goal} & \left[\begin{array}{ll} \text{PRED} & \text{`children'} \end{array}\right] \\
\text{XCOMP} & \left[\begin{array}{ll} \text{PRED} & \text{`read<(SUBJ)(OBJ)>'} \\ \text{SUBJ} & \rule{2cm}{0.4pt} \\ \text{OBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`book'} \end{array}\right] \end{array}\right]
\end{array}\right]$$

Despite the fact that the secondary object (OBJ$_{goal}$) is the semantic agent of the main verb, there is no evidence that it functions as a subject in any sense (Butt 2014: 10-13,18-19), so the control analysis in example (2) is unsupported by the evidence. Furthermore, the agreement patterns in example (1) indicate that the object (plural feminine) is the object of the light verb, despite being the patient of the main verb (Butt 2014: 13-15). An analysis of Urdu permissive constructions must account for the fact that there is just a single set of grammatical functions linked to a complex argument structure.

This configuration of semantic arguments and grammatical functions is particular puzzling for any theory of argument realization. It is typically assumed that a predicate determines its arguments (e.g. agent and patient) and that there is a standard process for determining (or constraining) which grammatical function each argument should have (i.e. Lexical Mapping Theory; Bresnan and Kanerva 1989). For a verb like 'read', the expected standard alignment is for the agent to be the subject and the patient to be the object. The light verb in the permissive construction does two things: it introduces a new argument that is not part of the lexical semantics of the main verb, and its presence coincides with a different linking: the agent of the main verb is no longer expressed as subject.

3 Butt's LFG analysis

Butt's (1995) analysis of Urdu complex predicates follows the traditional LFG assumption that arguments are licensed by the semantic form (the value of PRED) of a predicate in a subcategorization frame. The generalized constraints of Completeness and Coherence restrict the grammatical functions that can appear in the f-structure of that PRED to all and only the grammatical functions appearing in the subcategorization frame of the semantic form (Bresnan and Kaplan 1982). The implication is that the light verb in a valency-increasing complex predicate must have a PRED attribute. If both the light verb and the main verb have a PRED attribute, each with its own subcategorization frame, it is unclear how Completeness and Coherence can be satisfied if there is only a single set of grammatical functions in f-structure.

Butt proposes that complex predicates should be treated as a case of two PRED values unifying in the syntax, modifying the original position of Bresnan and Kaplan (1982) in which semantic forms are considered non-unifiable. Assuming that at least some semantic forms can be unified, Butt develops a model in which the main verb's lexical entry retains its standard subcategorization frame, for example, 'read<(SUBJ)(OBJ)>', but this is altered when it interacts with a light verb in the syntax so that the agent is no longer linked to the SUBJ, but to the OBJ_{goal}. Butt (1995: 145) calls this "argument fusion" or "argument merger" (Butt 2014: 20).[2] In argument fusion, the lexical semantic structure of the main verb is embedded in the argument structure of the light verb, and at least one of the arguments of the embedded main verb is co-indexed with an argument of the higher verb in the resulting semantic structure. The result is an f-structure of a complex predicate with a single PRED attribute whose semantic form is composed from the two predicates, as shown in example (3). This provides a natural account for why only a single set of grammatical functions are found in the construction, under the standard assumption that the presence of grammatical functions is licensed by the subcategorization frame of the semantic form.

(3) **Analysis of example (1) based on Butt (1995) and Butt et al. (1997: 12)**

a-structure

$$\begin{bmatrix} \text{REL} & \text{let} \\ \text{AGENT} & \begin{bmatrix} \text{REL} & \text{mother} \end{bmatrix} \\ \text{THEME} & \begin{bmatrix} \text{REL} & \text{children} \end{bmatrix} \\ \text{EV} & \begin{bmatrix} \text{REL} & \text{read} \\ \text{AGENT} & \\ \text{THEME} & \begin{bmatrix} \text{REL} & \text{book} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

λ

f-structure

$$\begin{bmatrix} \text{PRED} & \text{`let-read<(SUBJ)(OBJ)(OBJ}_{goal}\text{)>'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`mother'} \end{bmatrix} \\ \text{OBJ}_{goal} & \begin{bmatrix} \text{PRED} & \text{`children'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`book'} \end{bmatrix} \end{bmatrix}$$

There have been two basic critiques of argument fusion. The first critique is that it has not been satisfactorily shown how this approach can be fully integrated into the formal assumptions of the LFG architecture (Lowe 2015: 419-423). The second critique is that it is a syntactic process that modifies a lexical entry. "A fundamental assumption of early lexicalist syntax was the principle of Direct Syn-

[2]Note that Butt's work builds on original proposals by Alsina (1993, 1997) working on causative constructions in Romance and Bantu languages.

tactic Encoding, i.e. the principle that lexical properties such as argument structure should not be manipulable in the syntax. This plays out in LFG in the fact that, at least originally, semantic forms are not manipulable in the syntax" (Lowe 2015: 418). Ideally, an analysis of complex predicates should be fully implementable and should not require modifying semantic forms in the syntax.

4 Lowe's LFG+glue re-analysis

Lowe (2015), following a similar proposal by Dalrymple et al. (1993), proposes an analysis of Urdu complex predicates within the architecture proposed by Asudeh and Giorgolo (2012). The relationships between the semantic arguments and their grammatical functions are modeled through meaning constructors in the semantics, without reference to a-structure. Example (4) shows a standard glue meaning constructor for the verb 'read'. On the left side of the colon, the semantic representation represents the relationship between the two arguments of the predicate. On the right side of the colon, the glue expression requires two kinds of semantic arguments, here labeled ARG2 and ARG1, in order to produce the meaning of the predicate. The lexical entry of the verb also contains optional equations, as in example (5), allowing the ARG1 to link to either a SUBJ or OBL; and the ARG2 to link to either a OBJ or OBJ_θ (for further discussion, see Findlay 2016, 2020).

(4) $\lambda y.\lambda x.read(x, y)$:
$(\uparrow_\sigma \text{ ARG2}) \multimap (\uparrow_\sigma \text{ ARG1}) \multimap (\uparrow_\sigma \text{ EV}) \multimap \uparrow_\sigma$

(5) a. $((\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma \text{ARG1}))$
b. $((\uparrow \text{OBJ})_\sigma = (\uparrow_\sigma \text{ARG2}))$

In Lowe's analysis, the meaning constructor of the light verb (example (6)) increases the valency of the construction while simultaneously ensuring that each argument is associated with the correct part of the semantic interpretation. On the meaning side, the light verb consumes a single argument and its predicate, and returns a predicate requiring two arguments, effectively adding an ARG3 to the argument structure. On the meaning side, the variable P represents the meaning of the main verb, and its meaning is embedded as an argument of the light verb's permissive predicate. The first argument, ARG3 is associated with the permittee role and the agent role of the embedded predicate. The ARG1 is assigned the permitter role.

(6) $\lambda P.\lambda y.\lambda x.\lambda e.let(x, y, P(y, e))$:
$[(\uparrow_\sigma \text{ ARG1}) \multimap (\uparrow_\sigma \text{ EV}) \multimap \uparrow_\sigma] \multimap$
$(\uparrow_\sigma \text{ ARG3}) \multimap (\uparrow_\sigma \text{ ARG1}) \multimap (\uparrow_\sigma \text{ EV}) \multimap \uparrow_\sigma$

Since subcategorization is handled by glue semantics, it is divorced from the PRED attribute. Under these assumptions, there is no need to assume that the light verb has a PRED attribute, even though it licenses the permitter argument in the semantics. Lowe (2015: 427) represents the contribution of the light verb to f-structure with a binary feature PERMISSIVE, as in example (7).

(7) **F-structure of example (1) based on Lowe (2015)**

$$\begin{bmatrix} \textsc{pred} & \text{`read'} \\ \textsc{permisive} & + \\ \textsc{subj} & \begin{bmatrix} \textsc{pred} & \text{`mother'} \end{bmatrix} \\ \textsc{obj}_{goal} & \begin{bmatrix} \textsc{pred} & \text{`children'} \end{bmatrix} \\ \textsc{obj} & \begin{bmatrix} \textsc{pred} & \text{`book'} \end{bmatrix} \end{bmatrix}$$

The s-structure resulting from this analysis is similar to the f-structure. It is a flat structure containing a single ARG1, a single ARG2 and a single ARG3. The ARG3 in s-structure is linked to the $\textsc{obj}_{goal}$ in f-structure, as expected in a straightforward linking of grammatical function and semantic arguments. One potential disadvantage to this approach is that the s-structure representation does not model the complex meaning of the predicate. The permissive semantics are only found in the glue semantics, and not modeled at any level of representation, including s-structure. Whether or not this is problematic depends on one's view of s-structure. The approach proposed in Section 6 leaves open the possibility of treating s-structure as a model of complex semantic meaning, especially complex meaning composed of more than one predicate.

5 Andrew's proposed solution to the scope problem

Lowe (2015: 453) identifies a shortcoming in a strictly glue-based analysis. The approach overgenerates possible interpretations of (very) complex predicates with more than one light verb. Example (8) is an Urdu construction with a causative complex predicate embedded in an aspectual complex predicate embedded in a permissive complex predicate. There are two valency-increasing predicates, but it is the verb *di-ya* that is higher in scope: 'allow to cause', not 'cause to allow'.

(8) Tara=ne Amu=ko hathi pinc **kar-va** **le-ne**
Tara=ERG Amu=DAT elephant.M.SG.NOM pinch do-CAUS take-INF.OBL
di-ya
give-PERF.M.SG
Tara let Amu have the elephant pinched (completely). (Butt et al. 2010: 1)

In Lowe's approach, the basic format of the meaning constructors of both the permissive and the causative predicates would be the same, and no mechanism is suggested to distinguish which one applies to the other in the semantics. Andrews (2018) proposes a solution to this problem which treats f-structures as hybrid objects. A hybrid object is an AVM that includes both an attribute-value pair and a set of one or more AVMs (Dalrymple et al. 2019: 49). In a hybrid object, distributive features are those that must hold true of all AVMs in the set, as well as of the AVM that contains the set. Andrews creates a hybrid object by positing a phrase structure rule like the one in example (9) in which the f-structure of the main verb is placed in a singleton set in the f-structure of the light verb. This results in an f-structure like the one in Figure 10 in which the PRED of the light verb and main verb appear in different f-structures, yet those f-structure must share any distributive features.[3]

(9) $$\begin{array}{cccc} \text{VP} & \rightarrow & \text{V} & \text{V} \\ & & \downarrow \in \uparrow & \uparrow = \downarrow \end{array}$$

(10) **F-structure of example (1) based on Andrews (2018)**

$$\begin{bmatrix} \text{PRED} & \text{'let'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'mother'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'books'} \end{bmatrix} \\ \text{OBJ}_{\theta} & \begin{bmatrix} \text{PRED} & \text{'child'} \end{bmatrix} \\ \left\{ \begin{bmatrix} \text{PRED} & \text{'read'} \end{bmatrix} \right\} & \end{bmatrix}$$

This allows a named entity (e.g. %G) in the lexical entry to constrain which s-structure elements can be plugged into the meaning of the light verb, as in example (11). The light verb can only consume s-structure attributes that are projected by the f-structure which is in the named f-structure, the one inside the singleton set.

(11) $\%\text{G} \in \uparrow$
$\lambda P.\lambda y.\lambda x.\lambda e.let(x, y, P(y, e))$:
$[(\%G_{\sigma}\ \text{ARG}1) \multimap (\%G_{\sigma}\ \text{EV}) \multimap \%G_{\sigma}] \multimap$
$(\uparrow_{\sigma}\ \text{ARG}3) \multimap (\uparrow_{\sigma}\ \text{ARG}1) \multimap (\uparrow_{\sigma}\ \text{EV}) \multimap \uparrow_{\sigma}$

Since Andrews' (2018) proposal greatly expands the use of hybrid objects in f-structure, it requires a method for stipulating whether features are distributive or non-distributive on a construction-by-construction basis. Andrews (2018: 144) proposes a solution called "undersharing" but also states that "such undersharing specifications are theoretically somewhat undesirable."

[3]The motivation for distributive and nondistributive features comes from analyses of feature resolution in coordination. For example, King and Dalrymple (2004) analyze the sentence *This boy and girl eat pizza.* Note that the determiner *this* as well as each of the nouns in the conjoined noun phrase must all be a singular form. Despite this, the verb form, *eat*, is not a third-person singular form, but a plural form. King and Dalrymple (2004) propose that there are two types of agreement. In the agreement internal to the noun phrase, the singular feature must hold true of each part of the phrase which contains a determiner and a set of conjoined nouns. It is a distributive feature. However, the plural feature that is reflected in the verb agreement does not have to hold of any of the elements of the phrase, only of the phrase itself. It is a nondistributive feature.

6 New proposal

6.1 F-structure

A similar, but simpler solution is to assume that the main verb's f-structure is embedded as the value of a grammatical function, arbitrarily labeled EP (cf. Lowe 2015: 422), as in example (12).[4] Since Completeness and Coherence are handled in glue semantics, a PRED can appear in an f-structure with no grammatical functions. Placing all grammatical functions in the f-structure of the light verb accounts for the emprical evidence showing that the f-structure only has a single set of grammatical functions (Section 2).

(12) **Proposed f-structure of example (1)**

$$\begin{bmatrix} \text{PRED} & \text{`let'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`mother'} \end{bmatrix} \\ \text{OBJ}_\theta & \begin{bmatrix} \text{PRED} & \text{`child'} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`books'} \end{bmatrix} \\ \text{EP} & \begin{bmatrix} \text{PRED} & \text{`read'} \end{bmatrix} \end{bmatrix}$$

The embedded f-structure allows glue semantics to refer to the main verb by a local name. The meaning construction is identical to that in example (11), except that the local name is defined as %G = (↑ EP). Like the proposal of Andrews (2018), this allows the glue semantics to specify a particular structure as its input, but without having to adopt the additional complication of modeling the f-structure of complex predicates as a hybrid object. In the approach proposed here, no theoretical adjustments are needed other than those already proposed to adopt glue semantics as a replacement for Completeness and Coherence.

The proposed phrase structure rule for Urdu complex predicates is shown in example (13).[5] The node of the main verb is annotated as the value of EP of the verb that heads its constituent. Note that the EP node can also be a noun in the case of light verbs that take a nominal complement as in the causative verb in example (8).

(13) **Proposed PS rule for Urdu complex predicates**

$$\begin{array}{ccc} \text{V} & \rightarrow & \{\text{V} \mid \text{N}\} & \text{V} \\ & & (\uparrow \text{EP}) = \downarrow & \uparrow = \downarrow \end{array}$$

[4] I leave open the question of what kind of f-structure attribute is needed for this function. In some languages, it may be possible to use the attribute COMP, but this depends on the particular analysis of each language, and any cross-linguistic claims made about the nature of particular f-structure attributes.

[5] The phrase structure rules in example (13) and elsewhere ignore constraints on the level of structure. Butt (1995) labels this mother node V′ although it is never dominated by a VP. A formal solution to how to model levels of structure that do not conform to the standard two levels proposed in X-bar theory can be found in minimal c-structure (Lowe and Lovestrand 2020).

The phrase structure rule in example (13) indicates that the light verb and main verb form a constituent in the c-structure. This analysis is confirmed by the fact that the light verb and main verb can “scramble” appearing in a non-sentence final position as long as they remain adjacent to each other, as in example (14).

(14)	anjum=ne	[**lik^{h}-ne**	**d-ii**]	ciṭṭ^{h}ii	saddaf=ko
	Anjum=ERG	write-INF.OBL	give-PRF.F.SG	note(NOM)	Saddaf=DAT

Anjum let Saddaf write a note. (Butt 1995: 46)

Butt (1995) shows that there are two types of c-structures for complex predicates in Urdu (see also Butt 1994). In addition to the main verb and light verb forming a verbal cluster constituent, it is also possible for the main verb and the object to form a constituent, as in example (15). This requires another kind of phrase structure rule, the one proposed in example (16).

(15)	anjum=ne	d-ii	saddaf=ko	[**ciṭṭ^{h}ii**	**lik^{h}-ne**]
	Anjum=ERG	give-PRF.F.SG	Saddaf=DAT	note(NOM)	write-INF.OBL

Anjum let Saddaf write a note. (Butt 1995: 46)

(16) **Proposed PS rule for Urdu complex predicates**

$$\mathrm{V} \rightarrow \underset{(\uparrow \text{OBJ}) = \downarrow}{\mathrm{N}} \quad \underset{(\uparrow \text{EP}) = \downarrow}{\mathrm{V}}$$

Avery Andrews (personal communication) points out that the constituents licensed by the phrase structure rules in examples (13) and (16) cannot co-occur because both verbs would contribute a PRED attribute to the same f-structure, the value of EP. This predicts that in the case of very complex predicates in Urdu with more than one light verb, the light verbs must always be adjacent. It seems that this prediction will not bear out, however, more investigation is needed to determine what kind of constituent structures are permitted under what conditions (Miriam Butt, personal communication). This is a noteworthy gap in the empirical coverage of the approach to complex predicates proposed in this paper.

6.2 S-structure

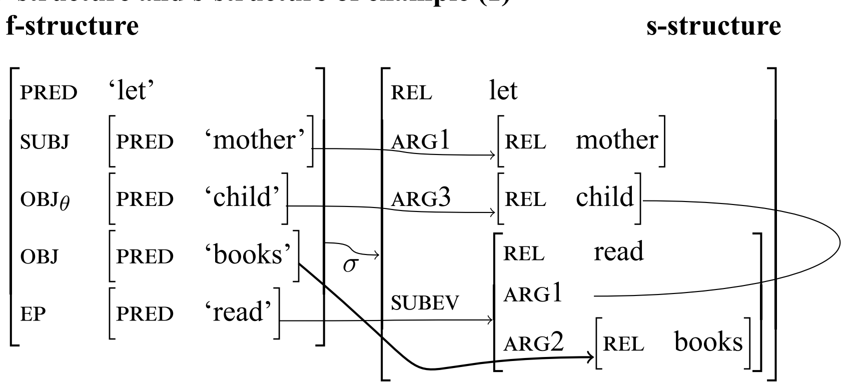
The f-structure proposed in Section 6.1 allows a reasonably straightforward way to construct an s-structure of complex predicates that models the semantic composition of the construction. Asudeh and Giorgolo (2012) propose that the links between f-structure and s-structure be constrained by equations in the lexical entry of the predicate, as in example (17). Ideally, these constraints should be encoded in templates in the most generalized manner possible (Findlay 2016), but for immediate purposes the equations are only meant to represent relevant aspects of the lexical entry of the light verb in the permissive complex predicate.

(17) *dii* ‘let’

a. $(\uparrow \text{PRED}) = \text{‘let’}$
b. $(\uparrow_{\sigma} \text{REL}) = \text{let}$
c. $((\uparrow \text{SUBJ})_{\sigma} = (\uparrow_{\sigma} \text{ARG}1))$
d. $((\uparrow \text{OBJ}_{\theta})_{\sigma} = (\uparrow_{\sigma} \text{ARG}3))$
e. $(\uparrow \text{EP})_{\sigma} = (\uparrow_{\sigma} \text{SUBEVENT})$
f. $(\uparrow_{\sigma} \text{ARG}3) = (\uparrow_{\sigma} \text{SUBEVENT ARG}1)$
g. $((\uparrow \text{OBJ})_{\sigma} = (\uparrow_{\sigma} \text{SUBEVENT}^{+} \text{ARG}2))$

The first two equations in example (17) state what the PRED and REL values are. The third equation links the SUBJ with ARG1 and the fourth equation links the OBJ_{θ} with ARG3. These are standard links that any general account of argument realization must include. The fifth equation embeds the semantic structure of the main verb, the s-structure projected from the value of EP, with the value of a SUBEVENT in s-structure.[6] The sixth equation creates a link in s-structure between the ARG3 and the ARG1 of the SUBEVENT—the permitee and the agent (as in example (3)). Note that the verb ‘let’ does not have an ARG2 in its s-structure, but the final equation links a grammatical function, OBJ, directly to an ARG2 in the value of a SUBEVENT. This linking equation is very similar to a standard equation needed in any theory of argument realization, with the difference being that one or more SUBEVENT attributes appear in the link between the grammatical function and the argument. Example (18) shows the f-structure and s-structure of example (1) under this analysis.

(18) **F-structure and s-structure of example (1)**



The lexical entry in example (17) also allows a representation of the s-structure of the very complex predicate in example (8) as shown in example (19). In this s-structure, the OBJ is linked to an ARG2 that is embedded in two SUBEVENTS. This flexibility in allowing different levels of embedding is allowed by the Kleene plus sign (one or more) in the equation in example (17g). The use of a regular expression

[6]The attribute SUBEVENT is a general label without any particular claims made about whether s-structure should only have one general type of attribute to embed other predicates, or whether there are several types.

to capture this kind of indeterminacy is not so different from the use of similar equations which place a Kleene star on a grammatical function to allow long distance dependencies in f-structure (Dalrymple et al. 2019: 207-208).

(19) **F-structure and s-structure of example (8)**
f-structure

$$\begin{bmatrix} \text{PRED} & \text{`let'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`Tara'} \\ \text{CASE} & \text{ERG} \end{bmatrix} \\ \text{OBJ}_\theta & \begin{bmatrix} \text{PRED} & \text{`Amu'} \\ \text{CASE} & \text{DAT} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`elephant'} \\ \text{CASE} & \text{NOM} \end{bmatrix} \\ \text{EP} & \begin{bmatrix} \text{PRED} & \text{`cause'} \\ \text{EP} & \begin{bmatrix} \text{PRED} & \text{`pinch'} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

σ

s-structure

$$\begin{bmatrix} \text{REL} & \text{let} \\ \text{ARG1} & \begin{bmatrix} \text{REL} & \text{Tara} \end{bmatrix} \\ \text{ARG3} & \begin{bmatrix} \text{REL} & \text{Amu} \end{bmatrix} \\ \text{SUBEV} & \begin{bmatrix} \text{REL} & \text{cause} \\ \text{ASP} & \text{COMPLETE} \\ \text{ARG1} & \\ \text{SUBEV} & \begin{bmatrix} \text{REL} & \text{pinch} \\ \text{ARG2} & \begin{bmatrix} \text{REL} & \text{elephant} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

This analysis can be extended to cover another version of the Urdu permissive complex predicate, the "allow-to-happen" permissive. The permissive complex predicates discussed above (examples (1) and (8)) are the "allow-to-do" type in which the permission is directed towards a particular person or other animate argument. In constrast, in the "allow-to-happen" permissive, an event is allowed to take place (or not) without respect to permission being granted to any particular person, as in example (20).

(20) ḍakṭar=ne mɑriz=ko buxar a-ne nɑhĩ
doctor.SG=ERG patient.SG=DAT fever.M.SG.NOM come-INF.OBL not
di-ya
give-PRF.M.SG
'The doctor did not let the patient get a fever.' (Butt 2014: 22)

Butt's (2014: 22) analysis of the "allow-to-happen" permissive is to posit a modified lexical entry for the light verb *de* 'give' in this context. Along those lines, the lexical entry proposed for the permissive light verb in this paper can also be modified for the "allow-to-happen" interpretation. The assumption is that the difference in meaning reflects the absence of an ARG3 in the semantics. The first adjustment to the meaning constructor is that the *y* variable in example (21) only appears once in the semantics, as an argument of *P*, whereas above, in example (6), it also appears as an argument of the permissive predicate *let*. The effect is that the permissive predicate is treated as a two-place predicate, rather than a three-place predicate. The second adjustment is to remove the ARG3 from the glue expression, and replace it with an ARG1 embedded in a SUBEVENT.

(21) %G = (↑ EP)
$\lambda P.\lambda y.\lambda x.\lambda e.let(x, P(y, e))$:
$[(\%G_\sigma\ \text{ARG1}) \multimap (\%G_\sigma\ \text{EV}) \multimap \%G_\sigma] \multimap$
$(\uparrow_\sigma\ \text{SUBEVENT ARG1}) \multimap (\uparrow_\sigma\ \text{ARG1}) \multimap (\uparrow_\sigma\ \text{EV}) \multimap \uparrow_\sigma$

The equations linking f-structure and s-structure also need to be adjusted. The fourth equation in example (22) links the secondary object directly to the ARG1 of the subevent. This contrast with the lexical entry in example (17) where the OBJ_θ is linked to an ARG3 which is itself linked to the ARG1 of a SUBEVENT. The f-structure and s-structure resulting from this analysis are shown in example (23).

(22) *dii* 'let' ("allow-to-happen")

a. (↑ PRED) = 'let'
b. $(\uparrow_\sigma$ REL) = let
c. $((\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma\ \text{ARG1}))$
d. $((\uparrow \text{OBJ}_\theta)_\sigma = (\uparrow_\sigma\ \text{SUBEVENT ARG1}))$
e. $(\uparrow \text{EP})_\sigma = (\uparrow_\sigma\ \text{SUBEVENT})$
f. $((\uparrow \text{OBJ})_\sigma = (\uparrow_\sigma\ \text{SUBEVENT}^+\ \text{ARG2}))$

(23) **F-structure and s-structure of example (20)**

f-structure **s-structure**

$$\left[\begin{array}{ll} \text{PRED} & \text{'let'} \\ \text{SUBJ} & [\text{PRED 'doctor'}] \\ \text{OBJ}_\theta & [\text{PRED 'patient'}] \\ \text{OBJ} & [\text{PRED 'fever'}] \\ \text{EP} & [\text{PRED 'come'}] \\ \text{NEG} & + \end{array}\right] \xrightarrow{\sigma} \left[\begin{array}{ll} \text{REL} & \text{let} \\ \text{ARG1} & [\text{REL doctor}] \\ \text{SUBEV} & \left[\begin{array}{ll} \text{REL} & \text{come} \\ \text{ARG1} & [\text{REL patient}] \\ \text{ARG2} & [\text{REL fever}] \end{array}\right] \end{array}\right]$$

An additional link is needed to account for complex predicates that express indirect causation, as in example (24). In this example the agent of the main predicate, ‘pinch’, can optionally be expressed in an instrumental phrase. Instead of an OBJ$_\theta$ linked to the ARG1 of the SUBEVENT as in example (22), an OBL$_{agent}$ is linked to that argument, as shown in example (25).

(24) ɑmu=ne (bɑcce=se) hatʰi pɪnc kar-va-ya
Amu=ERG child.OBL=INST elephant.M.SG.NOM pinch do-CAUS-PERF.M.SG
‘Amu had the elephant pinched (by the child).’ (Butt et al. 2010: 3)

(25) $((\uparrow_\sigma \text{ OBL}_{agent}) = (\uparrow_\sigma \text{ SUBEVENT}^{+} \text{ ARG1}))$

7 XLE implementation

The analysis of Urdu permissive complex predicates proposed in this paper has been partially implemented in a mini-grammar in XLE. The major shortcoming of the current implementation is that it does not include a model of glue semantics. The result is that the parses allow many ambiguities which would be accounted for by the glue semantics. This shortcoming can likely be resolved by implementing a version of glue for XLE currently under development (Dalrymple et al. 2020). The space and format limitation of this paper prevent a detailed look at the XLE implementation, but f-structure and s-structure resulting from parsing example (8) in XLE is shown in Figure 2.

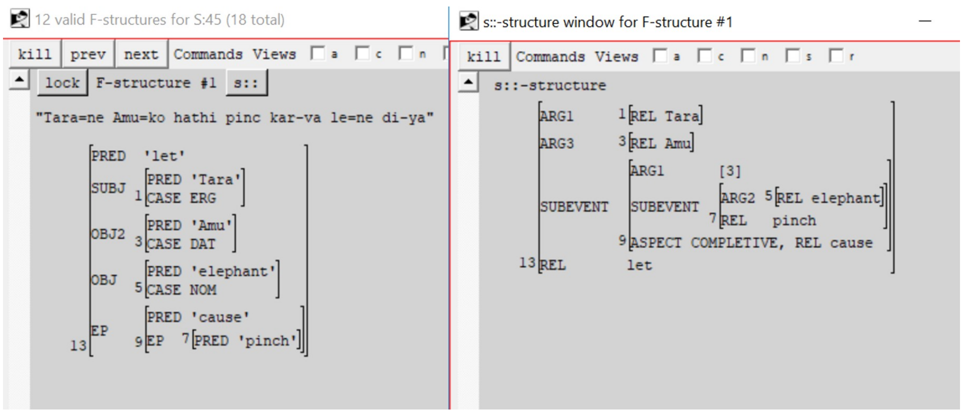


Figure 2: XLE parsing of example (8)

8 Conclusion

The work of Butt (1995) and others on complex predicates has made it clear that the original formulation of Lexical-Functional Grammar (Bresnan and Kaplan 1982) needs to be amended, but how? The most well-developed proposals on complex predicates in LFG have focused on removing the requirement that semantic forms be non-unifiable, allowing them to unify in the syntax. The alternative is to remove the Completeness and Coherence constraints, and allow glue semantics to handle constraints on what arguments appear, giving much more flexibility in f-structure representations. Although this was first proposed by Dalrymple et al. (1993), only in more recent years has the proposal been more fully developed (Asudeh and Giorgolo 2012, Lowe 2015, 2019, Andrews 2018). This paper adds to the development of this approach to complex predicates. It has now been established that a glue-based approach allows a model of complex predicates in which semantic forms remain non-unifiable. The model captures the empirical facts related to f-structure, and allows s-structure to not only model argument structure, but also to be the locus of a more complete representation of syntactically relevant semantic information. It also seems that this approach can be implemented in XLE, pending further development of incorporating glue meaning constructors in XLE.

However, the approach also makes a prediction that the components of a very complex predicate (two or more light verbs) will necessarily appear in a cluster in the c-structure. This prediction does not seem to hold up against the facts of Urdu (Miriam Butt, personal communication). Nonetheless, the approach can be further tested against other types of complex predicates in Urdu and other languages, such as the Romance complex predicates analyzed by Andrews (2018), potentially revealing other gaps or new insights that could resolve the apparent issue.

Another weakness of this approach is that it remains relatively stipulative in regards to the lexical entries of light verbs. More cross-linguistic work is needed to make any generalizations about how complex predicates fit into the templatic approach to representing links between f-structure and s-structure (Findlay 2016, 2020). More generally speaking, the connected s-structure used in this approach is relatively undeveloped. The potential of a connected s-structure for representing lexical semantics and argument realization remains unexplored. For example, can s-structure be used to model the semantic features that Butt (1995) uses Lexical Conceptual Structures (Jackendoff 1990) to model?

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Locative Inversion in Cantonese

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Abstract

Locative inversion constructions in Cantonese have received scant and isolated academic attention in the past decades. However, it relates closely to the question of assignment of grammatical functions in Cantonese, a topic-prominent language with relatively flexible word order and scant inflectional morphology, as well as a lack of case marking or noun class marking systems. This paper explores whether locative inversion constructions exist in Cantonese, and what are the features and characteristics of these constructions with reference to empirical data. It further explores the changes in grammatical functions, in particular, the locative phrase (or localiser) as the subject from a locative oblique. It considers and critically analyses the previous literature, and proposes an easy and accessible analysis based on Lexical Mapping Theory (LMT) and the Lexical-Functional Grammar (LFG) framework in general. This paper also draws on comparative perspectives by referring to relevant literature on Mandarin locative inversion where appropriate, in particular, on the use of aspect markers in these constructions.

1 Introduction

Locative inversion is a construction that has received attention in the literature for Mandarin (for example, Pan, 1996), English (for example, Bresnan, 1994) and Chicheŵa (Bresnan & Kanerva, 1989). In Chicheŵa, subject-verb agreement for the noun classes is also triggered by the locative phrase instead of the logical subject (that is, the theme), which provides evidence that the locative phrase has become the subject.

However, in some other languages, such constructions (if they do exist) were not analysed in the same way. Particularly, the existence of locative inversion is questionable in Cantonese, a language with relatively flexible word order and scant inflectional morphology, as well as a lack of case marking or noun class marking systems. This has received little attention in the literature, despite also involving the important issue of the assignment of grammatical functions in Cantonese. This paper seeks to review and advance the understanding of the topic by applying the Lexical-Functional Grammar (LFG) framework and the Lexical Mapping Theory (LMT).

This paper has three aims. The first aim is to determine what is locative inversion in Cantonese (if at all) (in Section 2). The second aim is to understand the features (in Section 3) and the assignments of grammatical functions (in Section 4) in Cantonese locative inversion constructions. In achieving this aim, this paper also reviews the long-standing debate of whether locative phrases in Cantonese can be treated as subjects, and critically analyses the previous attempts to prove that locative phrases in some constructions are subjects. The third aim is to explain the observed mandatory usage of the aspect marker *zo2* in these constructions (in Section 5), when compared and contrasted with the usage of aspect markers in Mandarin locative inversion constructions.

2 Expressing Location in Cantonese

Ng (2015) collected empirical data on methods used for expressing location in Cantonese for the first time, adopting two sets of standardised pictures to elicit responses from native Cantonese speakers. In that paper, a total of five strategies were identified. These include (with the proposed name on the left, and the observed structure on the right):

1. 'single locative copula strategy': [NP + *hai2* + localiser]

(1)	zek3	bui1	hai2	zoeng1	toi2	soeng6-min6
	CL	cup	COV	CL	table	up-face

'The cup is on the table.'

2. 'postural verb strategy': [NP + postural verb + *hai2* + localiser]

(2)	go3	naam4-zai2	lei1-zo2	hai2	dang3	hau6-bin6
	CL	boy-DIM	hide-PERF	COV	chair	back-side

'The boy hid behind the chair.'

3. 'resultative complement strategy': [NP + verb + *zo2* + *hai2* + localiser]

(3)	bun2	syu1	baai2-zo2	hai2	syu1-gaa2	soeng6-min6
	CL	book	place-PERF	COV	book-shelf	up-face

'The book is placed on the bookshelf.'

4. 'existential strategy': [localiser + *jau5* +NP]

(4)	toi2	soeng6-gou1	jau5	zi1	bat1
	table	up-high	have	CL	pen

'There was a pen on the table.'

5. 'locative inversion': [localiser + verb + NP]

(5)	coeng4	soeng6-gou1	baai2-zo2	bou6	din6-waa2
	wall	up-high	place-PERF	CL	telephone

'On the wall, there is (lit. placed) a telephone.'

Ng (2015) phrased the last strategy as 'locative inversion'. By deliberately setting up a separate category of 'locative inversion', it is implied that the other constructions were non-'locative inversion' constructions. However, one must be cautious that the label was not conclusive: it was unclear from the text of the study whether the phrase was merely a coined one or was comparable with the definition in other scholarly works, such as that in Bresnan and Kanerva (1989) on Chicheŵa. Nonetheless, I argue that only this last category of 'locative inversion' identified by Ng (2015) will qualify as locative inversion in Cantonese, the features of which will be discussed in Section 3 below.

The data from Ng (2015) showed that 'locative inversion' was only employed in 1.58% of the elicited Cantonese responses, which was relatively insignificant. However, locative inversion was suggested to be employed to generate a form of 'transitive subject' relative clause in Cantonese (Lau & Matthews, 2018). This adds to the need to understand locative inversion in Cantonese and its features in a more thorough and comprehensive manner.

3 Features of Locative Inversion in Cantonese

Previous definitions of locative inversion in Cantonese include all situations in which 'a locative phrase appears at the sentence-initial position and its logical subject occurs postverbally' (Mok, 1992) or in which 'the verb subcategorizes for an objectlike THEME role and a subjectlike LOCATIVE role' (Lee, 2003). Neither of these views seems to precisely account for locative inversion, in terms of both its structure and the grammatical functions involved. It is this uncertainty that forms the main aim of this paper.

For example, Mok's definition would also include what was known as 'existential strategy' constructions in Ng (2015) (see (4) above). Mok indeed adopted that stance and then sought to argue that the existential *jau5* in a locative construction is the same as other unaccusative verbs by passing all three 'tests' of locative inversion. However, this stance was not satisfactory as seen in Ng (2015, pp. 43–46) and Section 4.1 below. In particular, a cautious attitude should be adopted by making a distinction between existential constructions and locative constructions, as exemplified very recently in Paul et al. (2020) for Mandarin.

Moreover, neither of these definitions pins down the grammatical functions of the locative phrase and the theme NP, or describes their differences before or after locative inversion. Mok (1992) simply described the locative phrase at the 'sentence-initial position' without describing it as the subject (despite later attempting to prove that the locative phrase was the subject) and termed the other argument the 'logical subject'. Lee (2003) took a more cautious approach by using the words 'subjectlike' and 'objectlike' to describe the status of the two arguments. These labels also accurately reflected the study's unfruitful attempt to prove the subjecthood of the locative phrase.

There is therefore a need to 're-define' Cantonese locative inversion, as the position adopted in the literature so far, like Mok (1992) and Lee (2003), was more laxly and 'broad', as opposed to the 'narrow' approach taken, for instance, in Bresnan and Kanerva (1989). This relaxation was somehow understandable given the differences between Cantonese and Chicheŵa. In Chicheŵa, locative phrases can be shown as the subject with compelling evidence of morpho-syntactic changes. Bresnan and Kanerva (1989) had also proposed other reasons to support this argument. However, as introduced in Section 1 above, Cantonese has no evidence of similar compelling force. Therefore, in the Cantonese literature, it was tempting to define a phenomenon based on the particular characteristics of the language. For instance, Mok (1992) argued that Cantonese 'locative inversion' occurred in another simpler manner: a localiser in the sentence-initial position followed by a noun phrase is sufficient to complete the 'inversion'.

I suggest that a 'narrower' approach should be adopted to exclude these 'false' cases. An excessively broad definition will bar many cross-linguistic comparisons on the same phenomenon, at least within the category of languages which exhibit similar features of locative inversion (the category of Chinese and some Bantu languages versus the category of English and Romance languages: see Paul et al., 2020, p. 256).

For a Cantonese construction to qualify as 'locative inversion', two requirements must be satisfied: there must be (1) an inversion of the order of the arguments to form the [localiser + verb + NP] structure, and (2) changes to the grammatical functions of the arguments, such that the localiser must take up the subject function, and the theme must take up the object function.

This working definition is largely based on the observations of Bresnan and Kanerva (1989) on Chicheŵa locative inversion. Although there are potential differences in the semantic properties between Chicheŵa and Chinese locative inversion (Du, 1999, p. 339), I argue that they still possess comparable syntactic properties. Paul et al. (2020, p. 256) took the same view by separating Chinese and some Bantu languages from English and Romance languages. Many Chinese papers also took Bresnan and Kanerva (1989) as the starting point of their discussion.

For the first requirement, the localiser must take the sentence-initial position, followed by the verb, and lastly, the 'inverted' NP, which now comes after the verb. This word order originates from the data collected by Ng (2015), where the observed 'locative inversion' constructions in Cantonese firstly involves a localiser (*coeng4 soeng6-gou1* in (5)), then a verb (*baai2*) (followed by an aspect marker *zo2*: see Section 5 below), and lastly, a NP, which is the thing to be described (*bou6 din6-waa2*). This general 'inversion' requirement was also accepted by Diercks (2017).

The definition above involves the word 'localiser'. Localisers are, very generally, morphemes that express location, but what the category (if there is a distinct category of localisers in Cantonese) entails is very much unsettled (see, for example, Cheung, 2007, pp. 322–326, 349; Matthews & Yip, 2011, pp. 71–72). Without going off a tangent to resolve the debate, I took an inclusive approach so that a localiser can be monosyllabic (like *soeng6* 'up', *haa6* 'down', *zo2* 'left', *jau6* 'right'), disyllabic (like *soeng6-min6* 'up' (lit. 'up-face'), *haa6-min6* 'down' (lit. 'down-face'), *zo2-bin1* 'left' (lit. 'left-side'), *jau6-bin1* 'right' (lit. 'right-side')), or of the [NP + monosyllabic/disyllabic localisers] structure (like *ce1 soeng6-min6* 'above the car', *dang3 hau6-bin6* 'behind the chair'). It can also be a NP in some circumstances (Cheung, 2007, p. 326). This approach does not make a distinction between a localiser and a locative phrase, but such distinction is immaterial for the current discussion. The terms are therefore used interchangeably in this paper. The only caveat is that some localisers (monosyllabic localisers in particular) are not possible in locative inversion constructions—this restriction is however not the focus of this paper.

For the second requirement—the changes in the grammatical functions—I argue that the localiser must be the subject, and the theme NP must be the object. I now turn to this second requirement.

4 Assignment of Grammatical Functions in Locative Inversion in Cantonese

There were previous attempts to assign the locative phrase in some constructions to be the subject in Cantonese, but these had largely failed (see Section 4.1 below; see also Lui, 2019). The question was not resolved with previous frameworks or analyses.

As discussed above, neither Mok (1992) nor Lee (2003) took a clear view on the grammatical functions of the locative phrase and the theme NP. Ng (2015, p. 104) seemed to accept that if a construction is considered as 'locative inversion' (in her view), the ground object, instead of the figure, must occupy the 'subject position'. However, it was unclear throughout that study whether this 'subject position' also meant that the locative phrase is the subject.

In this section, I start by examining and analysing the previous studies in the area. I then adopt LMT to provide new insights into the issue.

4.1 Previous Studies

Whether the locative phrase in constructions 'becomes' the subject after occupying the sentence-initial position was heavily debated in the mid-20th century. Ding et al. (1961, p. 72) treated the locative phrase as subject. They argued that some subjects may neither be the agent nor the patient/theme. It was a 'feature' of locative phrases to appear as a subject when expressing the existence, appearance or disappearance of things. Cheung (2007, pp. 63–65) believed that subject was defined broadly so that it can perform as an agent, a patient, a described entity, a locative, or a temporal expression.

There were contrary opinions. Shen (1956) expressly warned of the dangers of determining subjects and objects by excessively relying on word order. He argued that the need for emphasis may cause the inversion of some sentences, without changing the respective grammatical functions of the locative phrase and the theme. Wang (1956) took a more extreme view and attempted to argue that, unless there are exceptional circumstances, locative phrases should only be treated as 'relational words'.

As mentioned at the start of this section, Mok (1992) and Lee (2003) each provided their own analyses, but these are rejected in this paper for two reasons. First, some of the provided examples were not even examples of locative inversion to start with. The analyses on 'false' cases have led to much confusion. For example, Lee (2003, p. 62) thought the following was an instance of locative inversion, in which another verb *ceot1-lei4* 'come out' followed the theme NP:

(6)	?gaan1	uk1	tiu3-zo2	zek3	gau2	ceot1-lei4
	CL	house	jump-PERF	CL	dog	come.out
	(lit. 'Out of the house, the dog jumped.')					

These examples could lead to completely different analyses based on, for example, topicalisation. This again reinforces the need to depart from the conception in the previous literature and insist on a 'narrower' approach.

Second, the various attempts to test for the subjecthood of locative phrases in locative inversion were not properly reasoned and were inconclusive. The details of these arguments were set out in Lui (2019, pp. 10–11). A short summary is provided below.

Mok (1992) saw the task as proving both (1) locative phrases are not topics and (2) locative phrases are subjects. For the first claim, the 'correlative conjunction', 'sentence adjunct', and 'subordinate clause' tests were attempted. The 'correlative conjunction' test showed that locative phrases (unlike other topics) could fit into the *m4 zing6 zi2 … zung6 jau5 …* 'not only … also …' sentence structure. However, this structure did not test for topics, but rather for contrastive focus. The other two tests were merely derived from some general 'observations' of the word order of topics; they were not rigorous 'tests' at all and were not supported by any other literature.

For the second claim, the attempt was to show that locative phrases took up the subject position through movement by occupying the [SPEC, IP] position. The approach taken was nevertheless not a 'positive' one by showing how the movement occurred; rather, it was a 'negative' approach by 'eliminating' other possibilities through various assumptions. There was a distinct lack of positive evidence.

Lee (2003) attempted reflexivisation and possessor relativisation to show that the locative phrase is the subject. However, as the reflexive *zi6-gei2* 'self' is only applicable to animate entities, the test could only be used to show an unsuccessful reflexivisation on the 'logical subject', in order to argue against its subjecthood. Even though this would be true (ignoring the 'false' cases that were used in that study), it still failed to show that the locative phrase 'automatically' became the subject. Again, positive evidence is lacking. The other test of possessor relativisation used yet another 'false' case with a [verb + adjective] *tip3-mun2* 'stuck fully' (and without the aspect marker *zo2*).

Ng (2015) simply did not address that question directly, although that study was more focused on a qualitative account of locative constructions.

Recently, Paul et al. (2020, pp. 247–249) in discussing Mandarin locative inversion attempted an 'obligatoriness' test to show the obligatory presence of the locative phrase in the sentence-initial position. Together with a *wh*-question test (Paul et al., 2020, pp. 249–250), the locative phrase was said to be a subject rather than a topic.

4.2 Lexical Mapping Theory (LMT)

An easy and accessible solution to understand the changes in the grammatical functions of these constructions in Cantonese is provided with reference to LMT. Through LMT, the LOCATIVE can be properly mapped to the SUBJ function, and therefore be accounted for as the subject, despite the lack of clear positive morpho-syntactic evidence. An LMT approach was also utilised in Her (2003, pp. 10–11) to account for the changes in the grammatical functions in Mandarin locative inversion 'quite [straightforwardly]', although a different operation was adopted (discussed below).

LMT originated from Bresnan and Kanerva (1989) who proposed the ±R(estricted) and ±O(bjective) feature specifications in order to cross-classify the grammatical functions SUBJ, OBJ, OBJ_θ and OBL_θ:

(7)

	–R	+R
–O	SUBJ	OBL_θ
+O	OBJ	OBJ_θ

Through a set of intrinsic and default classification principles, the thematic roles are then mapped with these grammatical functions.

Of relevance here are locative arguments, which are intrinsically encoded with [–O] and thus must be linked to a non-objective function (SUBJ or OBL_{LOC}). Then, the special default linking rule of [–R] informational focus/locative argument was proposed to account for locative phrases as subjects, which was supported by noun class agreement as seen in Chicheŵa locative inversion constructions.

The same [–R] rule can be used to account for Cantonese locative inversion, but this would only be possible upon a proper reorientation of the definition and features of Cantonese locative inversion (see Sections 2 and 3 above). For example, to account for example (5), the following mapping is possible:

(8)

baai	<	THEME	LOCATIVE	>
intrinsic:		[–R]	[–O]	
defaults:			[–R]	
		SUBJ/OBJ	SUBJ	
w.f.		OBJ	SUBJ	

Alternatively, the valency template in Kibort (2007) can be adopted:

(9)

<	arg_1	arg_2	arg_3	arg_4	…	arg_n	>
	[–O/–R]	[–R]	[+O]	[–O]		[–O]	

Under this proposal, the classification [+O] can be added to arg$_1$ as THEME, so that arg$_4$ as LOCATIVE maps to SUBJ (see also Dalrymple et al., 2019, pp. 345–346). Again, to account for example (5):

(10)

			THEME	LOCATIVE	
	baai	<	arg$_1$	arg$_4$	>
			[–R]	[–O]	
loc. inv.			[+O]		
			OBJ	SUBJ	

Huang and Her (1998) argued that the mapping principles in Bresnan and Kanerva (1989) were not applicable to Mandarin and proposed three language-specific morphological operations to justify the appropriate mapping, namely, 'locative inversion', 'locative transitivisation' and 'locative detransitivisation':

(11)

(a) Locative Inversion:	(b) Locative Transitivisation:	(c) Locative Detransitivisation:
< th loc >	< th loc >	< ag th loc >
| |	|	|
[+O] [–R]	[+O]	Ø

These operations are similarly attractive to explain the phenomenon. They were indeed adopted by Lee (2003) to analyse Cantonese locative inversion without much hesitation. I discuss two major motivations of Huang and Her (1998) in proposing a language-specific operation for locative inversion. The first motivation was to account for the locative phrase as the unmarked object in Mandarin, as in the following example (Huang & Her, 1998, p. 291):

(12) Hen3duo1 ren2 zhu4 tai2bei3
many people live Taipei
'Many people live in Taipei.'

As LMT would only account for the locative phrase as either a subject or a locative oblique (SUBJ or OBL$_{LOC}$), Huang and Her (1998) claimed that the rules in LMT may be inapplicable to fully account for locative inversion in Mandarin, such as those sentences like (12).

The second motivation was the need to account for the universality of default classifications across languages. Huang and Her (1998) emphasised the need for language-specific morphological operations in order to explain the non-occurrence of locative inversion in some other languages while maintaining the universality of intrinsic and default role classifications.

However, there does not seem to be a similar Cantonese example in which the locative phrase is an unmarked object. It therefore seems that the Bresnan and Kanerva (1989) framework is also sufficient to account for Cantonese locative inversion through the special default linking rule [–R], as shown above in (8). Thus, even though the strength of the arguments made in the newer papers, including the later works of Her (2003) and Her (2013), is fully appreciated, the Bresnan and Kanerva (1989) proposal should also be recognised as well applicable for the Cantonese data.

To conclude, there is very little difficulty in applying mapping principles in LMT to account for the change in grammatical functions in Cantonese locative inversion, although which of the proposed mapping principles is the best to apply remains debatable. The mapping principles also circumvent the difficulty in the lack of morpho-syntactic evidence or in applying other grammatical 'tests', some of which are of questionable persuasiveness. LMT provides an easy and accessible solution to the issue. In the future, there will also be much potential for LMT and LFG more generally to be applied to similar puzzles in Cantonese and other Sinitic languages.

5 The Aspect Marker *zo2*

There is one particular feature in Cantonese locative inversion constructions that this section will focus on. It is the consistently observed aspect marker *zo2* that follows the verb.

5.1 The Mandatory Aspect Marker

Cantonese locative inversion constructions seem to mandate the use of the perfective aspect marker *zo2*, as inferred from the data in Ng (2015). For example (taking the examples from Ng, 2015, p. 105):

(13)

(a)	ngo5	zong1-(zo2)	go3	haap2	hai2	(go3)	doi2	jap6-min6
	I	place-(PERF)	CL	box	LOC	(CL)	bag	in-face
	'I placed the box in the bag.'							
(b)	go3	doi2	jap6-min6	zong1-*(zo2)	go3	haap2		
	CL	bag	in-face	hold-*(PERF)	CL	box		
	'Inside the bag is a box.'							

In the uninverted example (13a), the perfective marker *zo2* can be omitted. However, in the inverted example (13b), *zo2* is mandatory and its omission will render the sentence ungrammatical.

The mandatory usage of aspect markers is similarly echoed in Mandarin (Du, 1999), with either the perfective marker *le* (the equivalent of *zo2* in Cantonese) or the imperfective/durative marker *zhe* (the equivalent of *zyu6* in Cantonese):

(14)	(zai4)	chuang2-shang4	fang4	*(le/zhe)	yi4	ben3	shu1
	(at)	bed-on	place	*(PERF/DUR)	one	CL	book

5.2 The Cantonese 'Puzzle' and Mandarin Perspectives

However, *zyu6* in Cantonese occurred far less frequently in locative inversion constructions than *zhe* in Mandarin. In other words, Cantonese employed one (and seemingly only one) aspect marker, that is, the perfective *zo2*, while Mandarin employed two aspect markers, *le* and *zhe*. Hypothetical constructions show that locative inversion constructions with *zyu6* are either ungrammatical or very problematic (see (5') and (15), the latter of which is a Cantonese translation of (14)), unless *zo2* is further added after *zyu6* (see (15')):

(5')	*coeng4	soeng6-gou1	baai2-zyu6	bou6	din6-waa2		
	wall	up-high	place-DUR	CL	telephone		
(15)	??cong4	soeng6-min6	fong3-zyu6	jat1	bun2	syu1	(≈ (14))
	bed	up-face	place-DUR	one	CL	book	
(15')	cong4	soeng6-min6	fong3-zyu6-zo2	jat1	bun2	syu1	
	bed	up-face	place-DUR-PERF	one	CL	book	

Pan (1996) suggested that *zhe* 'deleted' the agent role from the a-structure <agent, theme, location>, on the conditions that the verb in question is an 'accomplishment verb', and that the sentence is not 'stative'. This view had been subject to various challenges (see, for example, Zhang, 2008, pp. 895–900; Paul et al., 2020, pp. 259–262). The relationship of *zhe* with the agent is however possible to explain the rejection of *zyu6* in Cantonese constructions (see Section 5.3 below).

Du (1999) viewed *le* and *zhe* as occurring mutually exclusively in most circumstances, hypothesising *le* as an 'agent/theme-oriented marker' and *zhe* as a 'theme-only-oriented marker'.

5.3 The Cantonese 'Reasons'

I propose two reasons to explain the seemingly perplexing differences between the two languages.

The first reason is partially related to Pan's proposal of *–zhe* 'agent deletion'. Cantonese is stricter than Mandarin in requiring an agent. This was shown in passivisation in Cantonese, as observed by Matthews and Yip (2011, p. 7):

(16)

(a)	wo3	bei4	(ren2)	tou1-le	che1-zi		(Mandarin)
	I	by	(person)	steal-PERF	car		
	'I have had my car stolen.'						
(b)	ngo5	bei2	*(jan4)	tau1-zo2	ga3	ce1	(Cantonese)
	I	by	*(person)	steal-PERF	CL	car	
	'I have had my car stolen.'						

Here, the deletion of the agent *jan4* is not acceptable in the Cantonese example (16b), while the deletion of the agent *ren2* is acceptable in the Mandarin example (16a). Therefore, locative inversion could still occur when the agent is 'deleted' or suppressed by *zhe* in Mandarin but would be impossible when this was done by *zyu6* in Cantonese.

In contrast, locative inversion constructions with *zo2* in Cantonese (*le* in Mandarin) involves an 'implicit presence' of the agent (Paul et al., 2020, pp. 258–259), and therefore does not 'violate' the requirement of an agent in Cantonese. This can possibly account for why *zo2* is employed far more frequently than *zyu6* in Cantonese locative inversion constructions.

This may also be evidence that there is a link between perfectivity (*zo2*) and agentivity. The literal meaning of a *zo2* sentence is that an 'implicitly present' agent (a person or the course of events) had caused the location of the entity 'to have so happened'. There is no apparent agent. Rather, there is 'implicit presence' of the agent through using the perfective marker *zo2*.

Contrast this with the 'existential strategy' constructions, in which the verb *jau5* 'have' replaced both the verb and *zo2*. The literal meaning of a *jau5* sentence is simply that the entity 'existed'. The agent (that existed) is the entity itself. There is therefore no need to use *zo2* in these existential *jau5* sentences.

The second reason is a more speculative one: the other strategies as identified in Section 2 above might be more preferred in Cantonese for 'theme-oriented' expressions of location as framed by Du (1999). Svorou (1994, pp. 10–12) noted that there was a 'typical' tendency in constructing expressions of spatial arrangements by reference to the size, the cultural significance, or the overall frequency of encounter of a particular object. It might be that locative inversion is not a preferred strategy to generate these expressions due to these factors. To determine the motivations of employing (or not employing) a particular strategy in Section 2 above will require further study, as is the question of the limitations on the verbs in Cantonese locative inversion constructions (see, for example, the research directions in Levin & Rappaport Hovav, 1995).

6 Conclusion

To conclude, Cantonese locative inversion constructions have not been properly defined in previous studies, with the issue of subjecthood being unresolved for decades. There is a need to carefully define locative inversion in order to include only ‘true’ cases for analysis. I argue Cantonese ‘locative inversion’ must involve (1) an inversion of the order of the arguments to form the [localiser + verb + NP] structure, and (2) changes to the grammatical functions of the arguments, in which the localiser must take up the subject function, and the theme must take up the object function. The LMT approach in Bresnan and Kanerva (1989) is adequate to account for these changes in the grammatical functions in Cantonese locative inversion constructions, with potential modifications as proposed in papers such as Huang and Her (1998), Kibort (2007), and Her (2013).

This paper also explores the use of the perfective marker *zo2* (but not the imperfective/durative marker *zyu6*), which seems to be mandatory in Cantonese locative inversion constructions. This differs from Mandarin with both *le* and *zhe* used commonly. Two potential reasons are proposed: (1) the requirement of agent in Cantonese makes *zyu6* unacceptable, and (2) other strategies are employed for constructions in which *zyu6* would have been used.

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Ojibwe Agreement in Lexical-Realizational Functional Grammar

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Abstract

Lexical-Realizational Functional Grammar (L_RFG) is a novel theoretical framework that incorporates the realizational, morpheme-based approach to word-formation of Distributed Morphology into the declarative, modular framework of LFG. L_RFG differs from standard LFG in that terminal nodes of c-structure are not words, but are bundles of features that are realized in a separate, linearized v-structure. The mapping from c- to v-structure is many-to-one, using the mechanism of Spanning. In this paper we demonstrate L_RFG with an account of a part of the Ojibwe (Algonquian) verbal agreement system. We provide descriptions of the relevant templates and vocabulary items and discussion of some relevant examples.

1 Our project

We are developing a theoretical framework that couples Lexical-Functional Grammar (LFG; Bresnan et al. 2016) with the realizational, morpheme-based approach to word-formation of Distributed Morphology (DM; Halle and Marantz 1993). The resulting framework, which we call Lexical-Realizational Functional Grammar (L_RFG), is particularly well-suited to modelling Canadian Indigenous languages, which are characterized by *polysynthesis* and *nonconfigurationality*. In this paper we summarize the framework, and demonstrate it with an analysis of the inflectional system of Ojibwe, a language showing these properties. Note that the intent of the paper is not to make new claims about Ojibwe, but instead to take existing descriptions (e.g., Jones 1977, Nichols 1980, Valentine 2001) and analyses (e.g., Oxford 2019) of the language and adapt them to the present formalism as a demonstration of the framework. The paper is structured as follows: Section 2 outlines the L_RFG framework, comparing and contrasting it to standard LFG and providing details on the exponence function. Section 3 provides a brief introduction to Ojibwe, and a background on relevant aspects of the language's morphosyntax. Section 4 provides

[†]This work was presented in similar form in short succession at two virtual conferences: CLA (May 31, 2020) and LFG20 (June 24, 2020). Versions of the work have been submitted for the proceedings of both conferences. This paper focuses more on the theoretical mechanics of the project, while the other paper includes more detail on the Ojibwe data itself and on points of variation between dialects. Readers who are particularly interested in the analysis of Ojibwe may wish to also consult Melchin et al. (2020).

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a demonstration of our analysis, including a presentation and discussion of the templates used and specifications of the Vocabulary Items needed for animate agreement in Ojibwe, as well as the structure and discussion of some representative example sentences. Section 5 is a brief conclusion.

2 The framework

2.1 Comparison with standard LFG

$\mathrm{L_R}$FG is similar to standard LFG, with changes to the c-structure and its relationship with words/morphemes.[1] The terminal nodes of c-structures are not words, but instead are f-descriptions (sets of f-structure equations and constraints). The c-structure is mapped to a v(ocabulary)-structure, a linearized structure in which vocabulary items (VIs) *expone* (i.e., realize) the features in the terminal nodes, via a correspondence function, ν. The relationship between terminal nodes and VIs is many-to-one, using the mechanism of *Spanning* (Haugen and Siddiqi 2016, Merchant 2015, Ramchand 2008, Svenonius 2016); i.e. one VI may realize features of multiple terminal nodes. The result is similar to the Lexical Sharing model of Wescoat (2002, 2005), but maintains the complex internal structures of words as part of syntax.

Formally, v-structure is a list, each member of which is a feature structure defining morphophonological properties relevant to the linear placement and metrical properties of the item. This includes the phonemes/segments, as well as the metrical frame which determines syllable structure, affix/clitic status, and so on. Thus, the v-structure roughly corresponds to the p(honological)-form portion of a lexical entry in the metrical theory of Bögel (2015).[2] In this paper, only the strings themselves are relevant, so we make some simplifying assumptions: (i) We represent the output of the exponence function, ν, simply as a string, not a full VI structure; (ii) We show alignment informally using the standard notational convention of adding a dash to the left or right of the string; (iii) We do not show the mapping to prosody and phonology (see Figure 1 below), but instead let the phonological forms stand in for the VI strings (i.e., we conflate the two for simplicity/presentational purposes).

Vocabulary structure is a morphophonological structure that maps to phonological form via prosodic structure. We capture this by introducing a new

[1] We do not have space to rehearse the debate on word-based versus morpheme-based views of morphology. This literature is vast, but for representative discussion see Stump (2001: chapter 1) and Siddiqi (2019a,b).

[2] We would like to thank Tina Bögel for her insightful comments on this point at the LFG20 conference itself, and in extensive discussion afterwards. The details of the interaction between v-structure and the phonological string, in particular the effects of the metrical properties of VIs on mismatches in ordering between c-structure and the p-string, are currently being worked out and will be presented in future work in the $\mathrm{L_R}$FG framework.

phonological correspondence function, o, which maps from prosodic structure to phonological strings, and treating the ρ mapping as a mapping from vocabulary items to prosodic structures. In other words, the output of ρ is the prosodic structure and the output of o is the final result of phonological processes, a set of strings that are based on the prosodic well-formedness conditions of VIs. The morphology is responsible for the input to phonology, but phonology does whatever phonology does to create the output, which is not part of morphology per se. Given the set of VIs, V, and a set of prosodic structures, P:

(1) $\rho : V \to P$

The o correspondence function takes the output of this ρ correspondence function as its input and thus maps to the phonological string (o's output) from the prosodic structure that corresponds to the vocabulary item. In sum, in $\mathrm{L_R}$FG, v-structure precedes the phonological string in the Correspondence Architecture (see, e.g., Asudeh 2012: 53), resulting in the architecture in Figure 1.

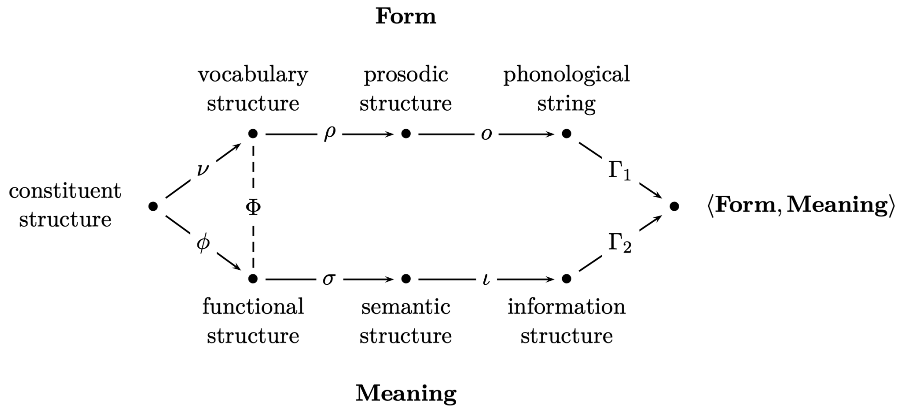

Figure 1: $\mathrm{L_R}$FG Correspondence Architecture

We assume that the morphological structure of Butt et al. (1996) is no longer necessary, given vocabulary structure, and that the Φ function would allow us to address the concerns of Frank and Zaenen (2002) regarding Butt et al. (1996). The Φ function, which is discussed in detail in Section 2.2, is not strictly a correspondence function, but it captures a relationship between vocabulary structure and functional structure. Let us call this kind of function a *bridge function*, as it bridges the form/meaning branches of the architecture. Further details remain to be worked out, including the necessity of another bridge function from prosodic structure to information structure.[3] We have eliminated the independent level of argument structure based on the proposal that this information is best captured at sem(antic)-structure (Asudeh and Giorgolo 2012). The output

[3] We thank Tina Bögel (p.c.) for drawing our attention to this issue.

of the grammar consists of a form–meaning pair, where the form incorporates prosody (still fed by constituent structure) and the meaning incorporates information structure (still fed by semantic structure).

The L$_{\text{R}}$FG architecture in Figure 1 is both similar to and yet noticeably distinct from an LFG architecture, due to the differing understanding of c-structure. Here are some salient points of comparison. First, the Vocabulary Items of L$_{\text{R}}$FG contain much the same information as LFG's lexical entries, but without the commitment that morphophonological form is bundled as part of the c-structure terminal node. Second, L$_{\text{R}}$FG could be considered to be offering a morphological theory that uses the foundational formal assumptions of LFG, in particular its notion of linguistic modularity and correspondence, and adopts most of its assumptions about semantics, information structure, and prosody. Since LFG is no longer just a theory of syntax but seeks to offer a theory of the broader grammatical system, it owes some kind of theory of word structure. L$_{\text{R}}$FG can be viewed as part of recent attempts to remedy this (see, e.g., Dalrymple 2015, Dalrymple et al. 2019). One could view L$_{\text{R}}$FG as offering a microscopic view of the structure of "words", in particular major categories like verb and noun. For example, consider the TP node in Figure 4 ('they saw us(incl)') on the final page of the paper, after the references. In some sense, this just *is* the verb, but the L$_{\text{R}}$FG c-structure shows its internal structure. A standard LFG c-structure for this example would instead look like the following (setting the f-description aside), which is not fully illuminating about structure.

(2)
S
|
$\uparrow = \downarrow$
V
|
gigiiwaabamigwnaanag

2.2 The exponence function ν

The exponence function ν maps from a pair of arguments to a VI, the exponent of the arguments. The first argument is a list of pre-terminal categories, typically of length 1, which are taken in the linear order in which they appear in the tree. The second argument is itself a function, Φ, which maps an f-description to the set of f-structures that satisfy the description; i.e. $\Phi(d \in D) = \{f \in F \mid f \models d\}$, where D is the set of valid f-descriptions and F is the set of f-structures.[4] In sum, ν maps *from* a pair whose first argument is a list of c-structure pre-terminal categories and whose second argument is a set of f-structures *to* a structured expression as described above.

[4]We thank Ron Kaplan (p.c.) for discussion of this point. Any remaining errors are our own.

A key condition on exponence can then be defined as follows. Let V be the range of the exponence function ν, the set of VIs (structured expressions); then the following condition on exponence holds.

(3) Given $\alpha \in A$ and $\beta \in B$, where $A, B \subseteq V$, and a function $[\![\ ]\!]_p$ that returns the conventionalized presuppositions of a given expression,
If $\bigcup\limits_{a \in A} [\![a]\!]_p = \bigcup\limits_{b \in B} [\![b]\!]_p$
Then **MostInformative**(α, β)

The conventionalized presuppositions of an expression are the set of presuppositions lexically triggered by the expression (Keenan 1971, Beaver 2001, Beaver and Geurts 2014). Presuppositions are propositions. Propositions are sets of possible worlds. So $[\![\ ]\!]_p$ returns a set of sets of possible worlds. The antecedent of the conditional in (3) therefore collects the conventionalized presuppositions of its arguments in two sets and tests whether the sets are equal. **MostInformative**(α, β) returns whichever of α,β has the most specific f-structure in the set of f-structures returned by Φ applied to the unions of α/β's collected f-descriptions. Formally:

$$\textbf{MostInformative}(\alpha, \beta) = \begin{cases} \alpha \textbf{ if } \exists f \forall g. f \in \pi_2(\nu^{-1}(\alpha)) \wedge g \in \pi_2(\nu^{-1}(\beta)) \wedge g \sqsubset f \\ \beta \textbf{ if } \exists f \forall g. f \in \pi_2(\nu^{-1}(\beta)) \wedge g \in \pi_2(\nu^{-1}(\alpha)) \wedge g \sqsubset f \\ \bot \textbf{ otherwise} \end{cases}$$

Thus, the condition in (3) amounts to a combination of the elsewhere condition/subset principle and an economy constraint that enforces spanning when possible.

3 Ojibwe: Background

Ojibwe exhibits many of the features that we hope to be able to model: *Nonconfigurationality* – word order is very free;[5] *polysynthesis* – complex verb morphology with extensive head-marking; a *direct-inverse-based agreement system* cross-referencing all core arguments; and *various morphological processes*, including verbal reflexives, noun incorporation, applicatives, various kinds of (anti)passives, and more, providing a rich testing ground for a theory of morphosyntax.

[5]When we say that Ojibwe is "nonconfigurational", we do not intend to claim that word order is completely free. We are using the term in the LFG sense (Bresnan et al. 2016), meaning that word order and phrase structure are not used to distinguish grammatical functions like subject and object. Instead, word order is determined by a combination of factors, including obviation and information structure, i.e., determined by discourse and pragmatic factors more so than grammatical function. See Dahlstrom (2017) for extensive discussion and references, with special focus on the context of Algonquian.

3.1 Dialects and data

Ojibwe can be classified either as a group of dialects or as a closely-related subfamily of languages in the Central Algonquian group. The data and analysis in this talk is meant to be widely applicable across the different varieties of Ojibwe, including the Nishnaabemwin (such as Ottawa) and Anishinaabemowin dialects (such as Southwestern Ojibwe and Algonquin). The data are taken mainly from Nichols's (1980) grammar of Southwestern Ojibwe, corroborated with the paradigms in Jones (1977) (Algonquin) and Valentine (2001) (Nishnaabemwin).

3.2 Prominence and direction marking

The distribution of agreement affixes, and the choice of direct or inverse morphology, is based on arguments' relative positions in a *prominence/person hierarchy*, which ranks arguments in terms of person, obviation and animacy.[6] The hierarchy is characterized as follows (adapted from Valentine 2001: 268; abbreviations largely follow common Algonquianist practice):

(4) *Prominence Hierarchy*

2	2nd person
1	1st person
3	3rd person animate proximate
3′	3rd person animate obviative
0	3rd person inanimate

In transitive clauses, the relationship between the two arguments' relative ranking in the prominence hierarchy and their thematic roles is tracked by the *direct/inverse* morpheme, known traditionally as a Theme Sign (analyzed as Voice; e.g., Oxford 2014, 2019). When the agent is the higher-ranked argument and the patient is lower, the verb is marked as *direct*.[7] When the patient is the higher-ranked argument and the agent is lower, the verb is marked as *inverse*.

This contrast is illustrated in (5) (adapted from Rhodes 1994: 434; note that *mitig* 'tree' is grammatically animate). In both, *nJohn* 'John' is proximate and thus outranks *mitig-oon* 'tree-OBV', which is obviative. Therefore, in the direct example in (5a) the proximate argument is the agent and the obviative argument is the patient, and vice versa in the inverse example (5b).

[6] In Ojibwe and other Algonquian languages, grammatical animacy is a form of gender marking, which does not always match with semantic gender; specifically, all notionally animate entities are of animate gender, but notionally inanimate entities may be of either gender.

[7] Following common practice, we are using the term *agent* to refer to agent-like roles, including causes and many experiencers – i.e., the agent proto-role in the sense of Dowty (1991). Similarly, the term *patient* is used for the proto-role that includes patients, recipients, themes, and so on.

(5) a. o-gii-miigishkaw-aa-an mitig-oon nJohn.
3-PST-hit-DIR.3OBJ-OBV tree-OBV John
'John hit the tree.'
b. o-gii-miigishkaw-igw-an mitig-oon nJohn.
3-PST-hit-INV-OBV tree-OBV John
'The tree hit John.'

The theoretical status of inversion in Ojibwe is still under debate. One question involves the relationship between inversion and the grammatical functions of subject and object. For some, the agent is always the subject and the patient is always the object (e.g., Valentine 2001, Dahlstrom 2014, Oxford 2019). In this analysis, the role of direction marking is to indicate the correspondence between grammatical function and prominence ranking.

(6) *GFs-as-θ-roles analysis*
Direct: subject is higher-ranked, object is lower-ranked
Inverse: subject is lower-ranked, object is higher-ranked

This can be represented as in Figure 2, where the solid lines represent the correspondences in a direct form, and the dashed lines the correspondences in inverse. For others, the higher-ranked argument is always the subject and the lower-ranked argument is always the object (e.g., Rhodes 1994, 2010, Bruening 2005). In this view, direction marking indicates the relationship between grammatical function and thematic role.

(7) *GFs-as-prominence analysis*
Direct: subject is agent, object is patient
Inverse: subject is patient, object is agent

This is represented in Figure 3, where the solid lines represent the correspondences in a direct form, and the dashed lines the correspondences in inverse.

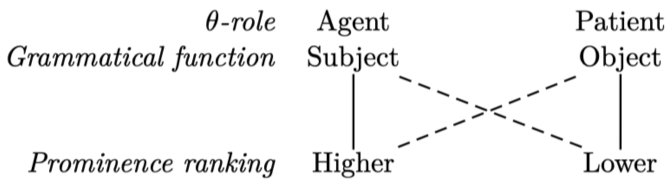

Figure 2: GFs-as-θ-roles analysis

There is syntactic evidence for both analyses (Rhodes 1994, 2010, Bruening 2005, Dahlstrom 2014, Alsina and Vigo 2017, Oxford 2019). However, on both sides the evidence largely relies on judgements that vary between Algonquian languages, and even between dialects or individual speakers of Ojibwe,

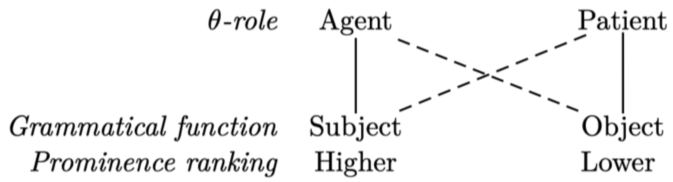

Figure 3: GFs-as-prominence analysis

as pointed out by Rhodes (1994, 443).[8] Furthermore, as Rhodes (1994) emphasizes, from a theory-neutral standpoint it is not clear that many of the types of evidence and argumentation that are relied on constitute real evidence for subject or object; this is especially true in an LFG-style parallel architecture where various different structures are available to explain such things, not just the f-structural grammatical functions. It is also possible that languages differ as to which is the proper analysis, as is claimed by McGinnis (1999) and Alsina and Vigo (2017). For these reasons, we consider the empirical evidence to be somewhat inconclusive in determining which analysis is correct.

With that in mind, we adopt the *GFs-as-prominence analysis*, where the grammatical functions are defined in terms of the prominence hierarchy. This allows us to treat direct/inverse marking as determining the mapping between grammatical functions at f-structure and thematic/argument roles at semantic structure. It also means that the subject and object have more consistent (word-internal) c-structural positions, as with the clausal structure in configurational languages; the alternative would be to have specific positions for the higher- and lower-ranked arguments, which is more difficult to model. In other words, the analysis we chose allows for a more elegant formalization of both the templates and the VIs involved. Our formalization is presented in the next section.

4 Analysis

The analysis presented in this section accounts for a subset of the Ojibwe inflectional system, specifically that occurring in (most) matrix clauses and involving animate subjects and (primary) objects. The clausal context (matrix versus embedded) is relevant because Ojibwe, like most other Algonquian languages, has two separate verbal inflectional paradigms or verbal "orders": independent order, which occurs in most matrix clauses; and conjunct order, which occurs in embedded clauses and certain matrix clauses, including *wh*-questions and certain narrative contexts. The two differ in much of their inflectional morphology, and in the distribution of direct and inverse marking; in terms of the present analysis, this includes most of the VIs that realize c-structure terminal

[8]Dahlstrom (nd: 3-21–3-23) notes that the proposal by Rhodes (1994) does not hold for Meskwaki, but this does not mean that it does not hold for Ojibwe (and she never claims this).

nodes occurring between (but excluding) TP and vP. We represent the contrast in templates, which are defined in Table 3, above Section 4.2. Here we focus on the independent order, although the conjunct order is discussed in connection with certain templates in Section 4.1. For further details of our analysis of Ojibwe agreement, see Melchin et al. (2020).

We do not present our full c-structure rules here but leave them to be reasonably inferred from the c-structures in Figures 4 and 5 at the end of the paper. Above the TP node, Ojibwe is highly nonconfigurational, so we assume this:

(8) $$\text{S} \rightarrow \underset{@\textsc{anygf}}{\text{XP}^*} \quad \underset{\uparrow = \downarrow}{\text{TP}} \quad \underset{@\textsc{anygf}}{\text{XP}^*}$$

The template ANYGF := $\{ (\uparrow \text{GF} - \text{ADJ}) = \downarrow \mid \downarrow \in (\uparrow \text{ADJ}) \}$; see the next section for details on LFG templates.

4.1 Templates

We make use of the LFG mechanism of *templates* (Dalrymple et al. 2004, Asudeh et al. 2008, 2013) to encode bundles of grammatical descriptions that get expressed in the language. The templates involved in our analysis can be divided into five groups: those encoding general constraints, those encoding the prominence hierarchy (person/gender), those encoding obviation and number, those encoding verb classes, and those encoding the mapping between grammatical function and argument structure (direction, argument suppression). For space reasons, we must omit more in-depth discussion and exemplification of the phenomena mentioned here; see Melchin et al. (2020) for further details.

The first set of templates define *constraints* that determine the distribution of animacy, person, and alignment across grammatical functions and contexts. The first two constraints hold in all contexts. The first constraint, which we call the *Transitive Subject Constraint*, ensures that the subject of a clause with an object (either OBJ or OBJ_θ, i.e. PLUSO, as per Findlay 2016) must be animate; inanimate subjects are possible only in intransitive clauses (Rhodes 1990, 2010, Valentine 2001):

(9) *Transitive Subject Constraint*
$@\text{TSC} := [(\uparrow \text{SUBJ})\ \&\ (\uparrow \text{PLUSO})] \Rightarrow [(\uparrow \text{SUBJ ANIM}) = +]$

This ensures that transitives with an inanimate ARG_1 are inverse, regardless of context (independent or conjunct form).[9] It correctly ensures that verbs with a secondary object (OBJ_θ) must have an animate subject (in Algonquianist terms,

[9]This is already ruled out in independent contexts by (12), but not in conjunct contexts with a participant ARG_1.

correctly predicts that there are AI+O verbs, but no II+O verbs).[10,11]

The second constraint, which we call the *Participant Argument Constraint*, ensures that 1st and 2nd person (i.e., participant) pronominals are possible only as subjects and (direct/primary) objects; secondary objects and obliques must be 3rd person (Rhodes 1990, 2010, Valentine 2001):

(10) *Participant Argument Constraint*
$@\textsc{pac} := \neg(\uparrow \textsc{plusr pers part})$

Since these two rules co-occur in every sentence, we assume they are grouped together in the following template, which is specified in the c-structure rule introducing the root node:

(11)
$$@\textsc{root} \quad := \quad \begin{array}{l} @\textsc{tsc} \\ @\textsc{pac} \end{array}$$

The last constraints, the *Prominence Constraints*, capture the different distributions of direct and inverse Voice heads in the independent and conjunct orders:

(12) *Independent Prominence Constraint*
$@\textsc{ipc} :=$
$[(\uparrow \textsc{subj})\ \&\ (\uparrow \textsc{obj})] \Rightarrow$
$\{[(\uparrow \textsc{subj pers part}) = +\ \&\ (\uparrow \textsc{obj pers part}) = +]\ |$
$[(\uparrow \textsc{obj pers}) \sqsubset (\uparrow \textsc{subj pers})]\}$

(13) *Conjunct Prominence Constraint*
$@\textsc{cpc} :=$
$[(\uparrow \textsc{subj})\ \&\ (\uparrow \textsc{obj})] \Rightarrow$
$\{[(\uparrow \{\textsc{subj}|\textsc{obj}\}\ \textsc{pers part}) = +]\ |\ [(\uparrow \textsc{obj pers}) \sqsubset (\uparrow \textsc{subj pers})]\}$

Following Bejar and Rezac (2009) and Oxford (2014), among others, we assume that the person and animacy features are decomposed into a number of privative features. Instead of the feature geometries used by the above authors, in our system the implicational relationships between the features are encoded in a set of nested *prominence templates*, given in Table 1, providing a way to represent the prominence hierarchy without stipulating independent structures beyond those already provided by the LFG framework.

We use the *number and obviation templates* in Table 2 to encode singular

[10] AI+O stands for "animate intransitive with secondary object" and II+O stands for "inanimate intransitive with secondary object".

[11] While this is true for Ojibwe, there are Algonquian languages that do allow II+O verbs, derived through morphology that changes the specification of the subject from animate to inanimate; this occurs in Cree and Meskwaki (Will Oxford, p.c.). For these languages, the antecedent of the constraint is specified as $[(\uparrow \textsc{subj})\ \&\ (\uparrow \textsc{obj})]$ rather than $[(\uparrow \textsc{subj})\ \&\ (\uparrow \textsc{pluso})]$, such that the constraint does not apply to clauses with only SUBJ and $\textsc{obj}_\theta$.

Table 1: Prominence hierarchy templates

Template	*Description*	*Explanation*
INCLUSIVE(f)	(f PERS SPEAK) = + (f PERS HEAR) = + @PARTICIPANT(f)	1st person inclusive
SPEAKER(f)	(f PERS SPEAK) = + @PARTICIPANT(f)	1st person
HEARER(f)	(f PERS HEAR) = + @PARTICIPANT(f)	2nd person
PARTICIPANT(f)	(f PERS PART) = + @PROXIMATE(f)	1 and/or 2
PROXIMATE(f)	(f PERS PROX) = + @ANIMATE(f)	3 and above
ANIMATE(f)	(f PERS ANIM) = + @ENTITY(f)	$3'$ and above
ENTITY(f)	(f PERS ENTITY) = +	All persons (0 and above)

and plural number, and combinations of number, animacy, and obviation that are encoded in the verbal agreement system.

Table 2: Number and obviation templates

Template	*Description*	*Explanation*
PLURAL(f)	(f NUM) = PL	
SINGULAR(f)	(f NUM) = SG	
INAN-PLURAL(f)	@PLURAL(f) ¬(f PERS ANIM)	Inanimate plurals
AN-PLURAL(f)	@PLURAL(f) @ANIMATE(f) ¬(f PERS PART)	Animate 3rd person plurals
OBVIATIVE(f)	(f OBV) = + @ANIMATE(f) {@SINGULAR(f) | @PLURAL(f)}	Animate obviatives Number is ambiguous

The *verb class and order templates* given in Table 3 define the properties of the four derivational verb classes and the two verbal orders, which are integral to the inflectional morphology in the language. The names of the verb class templates come from traditional Algonquianist verb class terminology: VTA means transitive, animate object; VTI means transitive, inanimate object; VAI means intransitive, animate subject; VII means intransitive, inanimate subject.

The *argument structure templates* in Table 4 determine the mapping between grammatical functions (in the f-structure) and argument roles (in the

Table 3: Verb class and order templates

Template	*Description*	*Explanation*
VTA	$(\uparrow_\sigma$ ARG$_1)$ $(\uparrow_\sigma$ ARG$_2)$	Two semantic arguments
VTI	$(\uparrow_\sigma$ ARG$_1)$ $(\uparrow_\sigma$ ARG$_2)$ $\neg(\uparrow$ OBJ PERS ANIM$)$	Two semantic arguments Object is inanimate
VAI	$(\uparrow_\sigma$ ARG$_1)$	At least one semantic argument
VII	$(\uparrow_\sigma$ ARG$_1)$ $\neg(\uparrow$ SUBJ PERS ANIM$)$	At least one semantic argument Subject is inanimate
INDEP-ORDER(f)	@IPC $\neg$(GF f)	Indep. Prominence Constraint Cannot be embedded
CONJ-ORDER(f)	@CPC (GF f)	Conj. Prominence Constraint Must be embedded

sem-structure). We adopt certain templates from the account of lexical mapping in Findlay (2016, 2020) (building on Kibort 2007, Asudeh and Giorgolo 2012); their effects are summarized in the table. In addition to the templates in the table, we use the templates @PLUSR, @MINUSR, @PLUSO, and @MINUSO in the sense of Findlay (2016), which is based on the [±r] and [±o] features of standard Lexical Mapping Theory (Bresnan and Kanerva 1989).

Table 4: Templates for argument mapping

Template	*Description*	*Explanation*
DIRECT	@MAP(SUBJ,ARG$_1$) @MAP(OBJ,ARG$_2$)	Subject $\mapsto$ agent Object $\mapsto$ patient
INVERSE	@MAP(SUBJ,ARG$_2$) @MAP(OBJ,ARG$_1$)	Subject $\mapsto$ patient Object $\mapsto$ agent
REFLEXIVE	@SUPPRESS(ARG$_2$,BIND(ARG$_1$))	Patient reflexively bound
SHORT-PASSIVE	@SUPPRESS(ARG$_1$,CLOSE-OFF)	Agent existentially bound

4.2 Vocabulary items

Here we list the agreement VIs present in forms involving animate subjects and (primary) objects (i.e., SUBJ and OBJ) in the independent order. These fall into four syntactic categories: Voice heads, indicating the mapping between grammatical functions (in the f-structure) and thematic roles (in the sem-structure); Agr heads, which indicate agreement with one or both (or neither) of the core grammatical functions; person prefixes, which index the person of the higher-ranked of the two core grammatical functions; and number suffixes, which index the presence of a third-person plural or obviative object (in transitives) or subject (in intransitives). We also provide VIs for items outside the agreement system that appear in the example sentences provided. See Melchin et al. (2020) for further discussion.

With the exception of the reflexive morpheme (which is traditionally considered part of the verb stem), the *Voice heads* are traditionally referred to as "theme signs". The main Voice heads involved in this area of the agreement system are given in Table 5. The form *-aa* is underspecified, showing up as a direct form when the object is 3rd-person animate (i.e., either agent is participant and patient is 3rd-person proximate, or agent is 3rd-person proximate and patient is obviative), and a passive form when the subject is 3rd-person animate. These two roles have in common that the grammatical function that maps to $\textsc{arg}_2$ is animate (object in direct voice contexts, subject in the passive).

Table 5: Voice heads

$$\langle\ \text{[Voice]},\quad \Phi\left\{\begin{array}{l} @\textsc{direct} \\ @\textsc{addressee}(\uparrow \textsc{obj}) \end{array}\right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-in}$$

$$\langle\ \text{[Voice]},\quad \Phi\left\{\begin{array}{l} @\textsc{direct} \\ @\textsc{participant}(\uparrow \textsc{obj}) \end{array}\right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-i}$$

$$\langle\ \text{[Voice]},\quad \Phi\left\{\ @\textsc{animate}((\uparrow_{\sigma}\ \textsc{arg}_2)_{\sigma^{-1}})\ \right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-aa}$$

$$\langle\ \text{[Voice]},\quad \Phi\left\{\ @\textsc{inverse}\ \right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-igw}$$

$$\langle\ \text{[Voice]},\quad \Phi\left\{\begin{array}{l} @\textsc{short-passive} \\ @\textsc{participant}(\uparrow \textsc{subj}) \end{array}\right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-igoo}$$

$$\langle\ \text{[Voice]},\quad \Phi\left\{\ @\textsc{reflexive}\ \right\}\rangle \quad \xrightarrow{\nu} \quad \textit{-idizo}$$

The *Agr heads* are traditionally referred to as "central agreement suffixes". They are divided into two sets: one found in independent-order contexts, and one found in conjunct-order contexts. Here we analyze only the independent-order Agr heads, given in Table 6.[12]

The *person prefixes* (category Pers), given in Table 7, are introduced in Spec-TP in a node annotated $(\uparrow \textsc{minusr}) = \downarrow$; they index the person of either SUBJ or OBJ, whichever is higher on the relevant prominence hierarchy (here using the feature HEAR rather than SPEAK for the highest point in the hierarchy, meaning 2nd person outranks 1st person). Note that the 3rd-person prefix *o-* does not appear in intransitive forms (forms with neither OBJ nor $\textsc{obj}_{\theta}$, i.e.,

[12] Many of the independent Agr forms have separate allomorphs that arise when (a) there is a PLUSO element present, but (b) there is no animate OBJ present, a phenomenon known as "n-registration" (Rhodes 1990). However, we do not address these forms here.

Table 6: Independent Agr heads

$$\langle\, [\text{Agr}],\quad \Phi\left\{\begin{array}{l} (\uparrow \text{MINUSR}) = \%\text{GF} \\ @\text{SPEAKER}(\%\text{GF}) \\ @\text{PLURAL}(\%\text{GF}) \\ \{(\uparrow \text{OBJ PERS PART}) \mid \neg(\uparrow \text{OBJ})\} \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{-min}$$

$$\langle\, [\text{Agr}],\quad \Phi\left\{\begin{array}{l} (\uparrow \text{MINUSR}) = \%\text{GF} \\ @\text{PARTICIPANT}(\%\text{GF}) \\ @\text{PLURAL}(\%\text{GF}) \\ \{(\uparrow \text{OBJ PERS PART}) \mid \neg(\uparrow \text{OBJ})\} \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{-m}$$

$$\langle\, [\text{Agr}],\quad \Phi\left\{\begin{array}{l} \neg(\uparrow \text{SUBJ PERS PART}) \\ \neg(\uparrow \text{PLUSO}) \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{-w}$$

$$\langle\, [\text{Agr}],\quad \Phi\left\{\begin{array}{l} @\text{SPEAKER}(\uparrow \text{SUBJ}) \\ @\text{PLURAL}(\uparrow \text{SUBJ}) \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{-naan}$$

$$\langle\, [\text{Agr}],\quad \Phi\left\{\begin{array}{l} @\text{PROXIMATE}(\uparrow \text{SUBJ}) \\ @\text{PLURAL}(\uparrow \text{SUBJ}) \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{-waa}$$

$$\langle\, [\text{Agr}],\quad \Phi\{\ @\text{SHORT-PASSIVE}\ \} \rangle \quad \xrightarrow{\nu} \quad \textit{-m}$$

without PLUSO); there the Agr suffix *-w* appears instead.

Table 7: Person prefixes

$$\langle\, [\text{Pers}],\quad \Phi\{\ @\text{HEARER}(\uparrow)\ \} \rangle \quad \xrightarrow{\nu} \quad \textit{gi-}$$

$$\langle\, [\text{Pers}],\quad \Phi\{\ @\text{PARTICIPANT}(\uparrow)\ \} \rangle \quad \xrightarrow{\nu} \quad \textit{ni-}$$

$$\langle\, [\text{Pers}],\quad \Phi\left\{\begin{array}{l} @\text{ANIMATE}(\uparrow) \\ ((\text{SUBJ} \uparrow)\ \text{PLUSO}) \end{array}\right\} \rangle \quad \xrightarrow{\nu} \quad \textit{o-}$$

The *number suffixes* (category Num), given in Table 8, appear on a node in the specifier of AgrP,[13] which is annotated $\uparrow=\downarrow$; the @NUMSUFF template indicates which grammatical function's features are being specified, as defined in (14). These morphemes mark number/obviation of OBJ if there is an OBJ present; of OBJ_θ if there is an OBJ_θ but no OBJ; and of SUBJ if there is neither PLUSO function present. This is encoded in the @NUMSUFF template, defined as follows:

[13]In a fuller exposition of Ojibwe verbal inflection, which includes negation and modality, this will be revised so that these suffixes appear in spec-ModP, as they follow the modal suffixes. However, since we are omitting modal suffixes in this analysis, we will leave them here for now.

(14) $\quad$ @NUMSUFF(template) $:=$ $\{[(\uparrow \text{OBJ})\ \&\ \text{@template}(\uparrow \text{OBJ})]\ |$
$[\neg(\uparrow \text{OBJ})\ \&\ \text{@template}(\uparrow \text{OBJ}_\theta)]\ |$
$[\neg(\uparrow \text{PLUSO})\ \&\ \text{@template}(\uparrow \text{SUBJ})]\}$

Table 8: Number/obviation suffixes

$$\langle\ [\text{Num}],\quad \Phi\{\ \text{@NUMSUFF(AN-PLURAL)}\ \}\ \rangle \quad \xrightarrow{\nu} \quad \textit{-ag}$$

$$\langle\ [\text{Num}],\quad \Phi\{\ \text{@NUMSUFF(OBVIATIVE)}\ \}\ \rangle \quad \xrightarrow{\nu} \quad \textit{-an}$$

Other VIs that are used in the examples in Section 4.3 are given in Table 9. This includes the past tense prefix *gii-*, the root and verb final (v) in the verb *waab-am* 'see-VTA', and the animate-intransitive verb *wiisini* 'eat', which is lexically specified as a span of the $\sqrt{\ }$ and v heads.

4.3 Examples and discussion

Figures 4 and 5, which are at the end of the paper, provide glosses, c-, f-, and v-structures for two representative inflected verbs. The semantic structures are omitted for reasons of space. Here we walk through the examples, focusing on the exponence of the terminal nodes in Figure 4 and the instances of spanning in Figure 5. However, it should first be noted that these examples show only the internal structure of the verb, which we analyze as TP; this is assumed to be embedded in a larger structure corresponding to the sentence as a whole. While we have not attempted to analyze the c-structure of multi-word sentences, it would have to take into account the fact that word order is largely based on discourse factors as mentioned in Footnote 5 (see Dahlstrom 2017), as well as the presence of second-position discourse markers.

The example in Figure 4 exhibits no spanning (i.e., each VI realizes a single terminal node), and shows all of the syntactic categories described in Section 4.2. It has the Voice template @INVERSE (Table 4), which indicates that the agent is the object and the patient is the subject. The c-structure itself is

Table 9: Other VIs

$$\langle\ [\text{T}],\quad \Phi\{\ (\uparrow \text{TENSE}) = \text{PST}\ \}\ \rangle \quad \xrightarrow{\nu} \quad \textit{gii-}$$

$$\langle\ [\sqrt{\ }],\quad \Phi\{\ (\uparrow \text{PRED}) = \text{`see'}\ \}\ \rangle \quad \xrightarrow{\nu} \quad \textit{waab}$$

$$\langle\ [\text{v}],\quad \Phi\{\ \text{@VTA}\ \}\ \rangle \quad \xrightarrow{\nu} \quad \textit{-am}$$

$$\langle\ [\sqrt{\ }, \text{v}],\quad \Phi\left\{\begin{array}{l} (\uparrow \text{PRED}) = \text{`eat'} \\ \text{@VAI} \end{array}\right\}\ \rangle \quad \xrightarrow{\nu} \quad \textit{wiisini}$$

generated by c-structure rules that are not discussed in this paper. The root ($\sqrt{\ }$) head provides the PRED feature for the verbal f-structure, here 'see'. It is realized by the VI *waab* (Table 9); this realization is trivial since this is (presumably) the only VI that realizes this PRED feature. The v head supplies the verb class template @VTA (Table 3), which indicates that ARG_1 and ARG_2 are present in the sem-structure. Again, given the VIs in Table 9, this is trivial.

The exponence of the other two heads is non-trivial. The Agr head hosts the PRED, NUM, and PERS features of the subject and object. Both have the PRED value 'pro', and plural number. The subject is 1st-person inclusive, with the following PERS features: ENT, ANIM, PROX, PART, HEAR, and SPEAK; these are called by the template @INCLUSIVE. The object is 3rd-person proximate, @PROXIMATE, with the PERS features ENT, ANIM, and PROX. Of the Agr heads in Table 6, two are compatible with this feature bundle: *-waa* and *-naan*.[14] Of these two, *-naan* specifies a greater subset of the subject's PERS features than *-waa*, matching five of the six PERS features, while *-waa* matches only three. Of the Pers heads in Table 7, all three are compatible with the set of PERS features encoded in @INCLUSIVE. It is *gi-* that is inserted, since it realizes five of the six PERS features; *ni-* realizes only four and *o-* realizes only two.

For the sentence in Figure 5, the exponence of the Pers and T heads proceeds as above. However, note that the VI *wiisini* spans/expones three heads: $\sqrt{\ }$, v, and Agr. This exemplifies two separate spanning phenomena. As specified in Table 9, the VI *wiisini* is specified as realizing the two c-structure categories $\sqrt{\ }$ and v. This means that in an instance where the $\sqrt{\ }$ head specifies the PRED value 'eat' and there is an adjacent v head specifying @VAI, this VI expones both heads.[15]

This bears a superficial similarity to lexical sharing (Wescoat 2002, 2005, 2007). One key difference between our overall proposal and lexical sharing is the notion, which we'll call *Pac-Man Spanning*, that VIs can span any number of adjacent preterminal nodes, so long as the presuppositions of the exponed/realized expressions are held constant. Note that the Agr head is specified for a 1st-person singular subject, while none of the Agr heads in Table 6 are compatible with a singular participant (i.e., 1st or 2nd person) subject. Thus, the Agr head undergoes Pac-Man Spanning, being realized by the same VI that realizes an adjacent head, in this case *wiisini*. In sum, Figure 5 exemplifies both lexically-specified and Pac-Man Spanning.

[14] The heads *-min* and *-m* are ruled out by the constraining equation $\{(\uparrow \text{OBJ PERS PART}) \mid \neg(\uparrow \text{OBJ})\}$, which specifies that if an object is present, it must have the PART feature, which is lacking in the object here.

[15] The language also has two other VIs specified for the PRED value 'eat': *amw*, which spans the root and a v specified as @VTA, and *miiji*, which spans the root, a v specified @VAI, and a Voice head marking @DIRECT and specified for an inanimate object (i.e., *amw* occurs in transitive animate contexts, *miiji* occurs in transitive inanimate contexts).

5 Conclusion

The analysis of Ojibwe inflection given here is a part of a project to provide a larger, more complete analysis that includes inflection for inanimate arguments, OBJ_θ, and inflectional affixes found in the conjunct order. While the results of the larger study have not yet been published, the analyses involved are along the same lines as those given here. The fact that the complex agreement morphology of a polysynthetic language like Ojibwe can be succinctly and (we believe) insightfully accounted for in an L_RFG formalism lends credence to the overall project of developing a theoretical framework well-suited to capturing the properties of North American Indigenous languages that elude elegant analysis in more mainstream frameworks.

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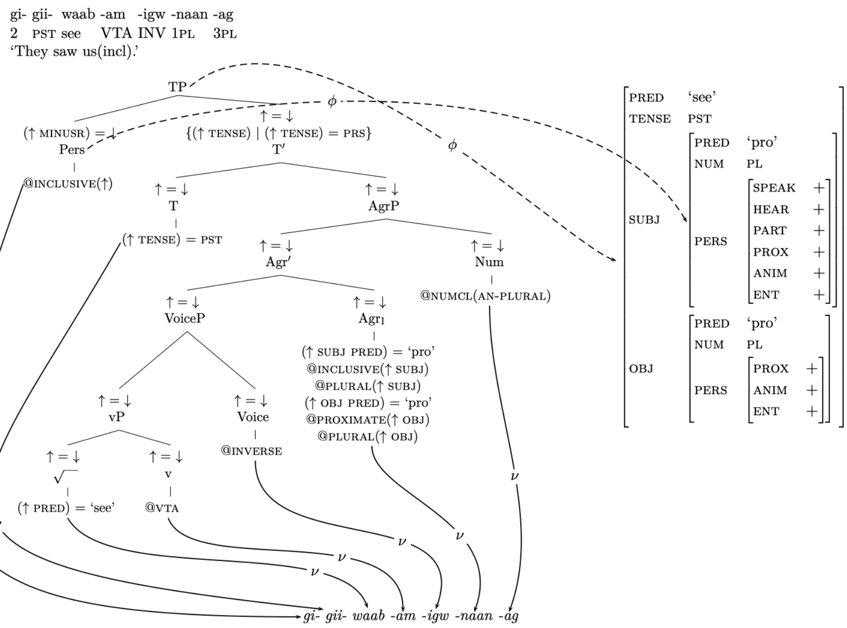

Figure 4: c-, f-, and v-structures for *gigiiwaabamigwnaanag* 'they saw us(incl)'

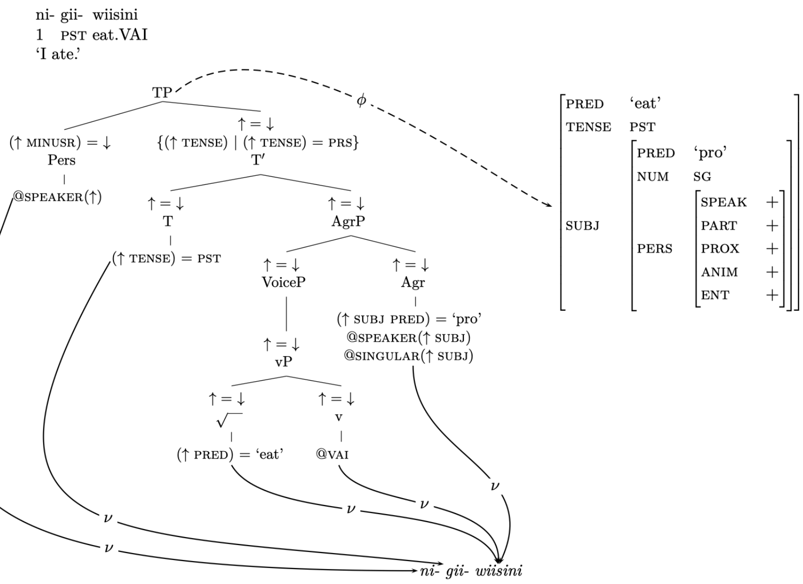

Figure 5: c-, f-, and v-structures for *nigiiwiisini* 'I ate'

A case of morphologically bound complementation in Abaza: an LFG analysis

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Abstract

The present paper deals with morphologically bound complementation, a type of construction where a matrix predicate and the head of its clausal complement constitute a single verb morphologically but retain their syntactic and semantic independence. I analyze one instance of this type of subordination: the construction with an element *ʒəš'a* 'seem' in Abaza (Northwest Caucasian). I discuss previous LFG analyses of morphologically bound complementation constructions and suggest that this class of constructions is a potential domain for expanding the mechanism of Lexical Sharing.

1 Introduction

Morphologically bound complementation[1] is a construction where a matrix predicate and the head of its clausal complement constitute a single verb morphologically but retain their syntactic and semantic independence. Example (1) presents a case of morphologically bound complementation in Abaza (Northwest Caucasian): a construction with the element *ʒəš'a* 'seem'.

(1) sara [awəj d-ʕa-j-wa]-ʒə-s-**š'**-əj-ṭ
1SG DIST 3SG.H.ABS-CSL-go-IPF-LOC-1SG.IO-**seem**-PRS-DCL
'I think s/he is coming.'[2] (*lit.* 'It seems to me that s/he is coming.')

The semantic and syntactic independence of the predicates in the construction with *ʒəš'a* can be illustrated by the fact that each predicate has its own argument structure and can be modified by adverbs, cf. (2).

(2) sara pasata [wara ŝabəžta
1SG earlier 2SG.M fast
wə-ʕ-wa]-ʒə-s-**š'**-əw-n
2SG.M.ABS-run-IPF-LOC-1SG.IO-**seem**-IPF-PST
'Before, I thought you run fast.'

The morphological boundness of the construction can be illustrated by single morphological marking. For example, when a temporal subordinate clause contains a complementation construction, the temporal prefix *an(ə)-* 'when' always appears on the matrix predicate (3). However, in the construction with *ʒəš'a* (4) the prefix *an(ə)-* appears to the left of the dependent verb stem, even though it modifies the matrix verb.

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[1] The term was first introduced in Maisak (2016: 837-838).

[2] A list of abbreviations is given in the end of the paper.

(3) d-š-psə-z anə-l-ba
3SG.H.ABS-REL.MNR-die-PST.NFIN **TMP**-3SG.F.ERG-see
d-ĉ̣əwa d-a-la-ga-ṭ
3SG.H.ABS-cry.IPF 3SG.H.ABS-3SG.N.IO-LOC-begin-DCL
'When she saw that he had died, she started crying.'

(4) [d-**an**-psə]-ʒə-l-**š'a** d-ĉ̣əwa
3SG.H.ABS-**TMP**-die-LOC-3SG.F.IO-**seem** 3SG.H.ABS-cry.IPF
d-a-la-ga-ṭ
3SG.H.ABS-3SG.N.IO-LOC-begin-DCL
'When she thought he had died, she started crying.'

Likewise, when circumfixal negation applies to the construction with *ʒəš'a*, the prefix *g'-* appears in the prefixal part of the whole construction, even when only its second part (the main clause) is negated, cf. (5) and (6).

(5) sara [d-ʕa-j-ta] **g'**-qa-s-c̣-əw-**m**
1SG 3SG.H.ABS-CSL-go-ADV **NEG**-LOC-1SG.ERG-believe-IPF-**NEG**
'I don't believe he came.'

(6) [awəj d-**g'**-ʕa-j]-ʒə-s-š'-əw-**m**
DIST 3SG.H.ABS-**NEG**-CSL-go-LOC-1SG.IO-seem-IPF-**NEG**
'I don't think he came.'

From a typological perspective, morphologically bound complementation can be divided into different types depending on the semantics of the matrix predicate (similarly to standard complementation, see e.g. Givón 1980). First, some of the constructions with manipulative predicates ('order', 'cause', etc.), better-known as "morphological causatives", demonstrate biclausal properties and thus can be considered a type of morphologically bound complementation. A good example is constructions with the morphological causative in Japanese where, in particular, both the matrix predicate and the embedded predicate can be in the scope of an adverbial (7).

Japanese (Shibatani 1990: 310)

(7) Taroo wa Hanako ni 6-zi ni oki-**sase**-ta
Taro TOP Hanako AGT 6-o'clock at wake_up-**CAUS**-PST
'Taro woke up Hanako at 6 o'clock.' / 'Taro made Hanako wake up at 6 o'clock.'

Other common types are morphologically bound constructions with phasal (e.g., 'start'), modal (e.g., 'want') and so-called perception-cognition-utterance (PCU) predicates ('know', 'say', etc.). An example illustrating the last semantic type is given in (8); the Abaza construction with *ʒəš'a* also belongs to this type.[3]

Yaqui, Uto-Aztecan (Guerrero 2006: 178)

(8) Joan-Ø tuuka enchi siim-**maachia**-Ø
Juan-NOM yesterday 2SG:ACC go-**believe**-PRS
'Juan believes you to have left yesterday.'

Table 1 shows the main differences of morphologically bound complementation from other types of subordinated constructions which at first glance might look similar. The classification is made according to three parameters: complement vs. adjunct, two clauses vs. one clause and morphologically free vs. morphologically bound. Morphologically bound types of constructions are discussed below in some more detail.

Table 1. Syntactic and morphological relations between heads (partly based on Maisak (2016: 837)).

		morphologically free	morphologically bound
complement	two clauses	complementation (e.g., propositional attitude or knowledge predicates in English)	**morphologically bound complementation** (e.g., *ʒəš'a*-construction in Abaza)
	one clause	clause union (e.g., *faire*-causative in French)	lexical union (e.g., continuative in Abaza)
adjunct	two clauses	adverbial clauses (e.g., *when*-clauses in English)	morphologically bound adverbial clauses
	one clause	serial verb constructions (e.g., verb serialization in Ewe)	verb-verb compounds (e.g., verbal incorporation in Bininj Gun-wok)

In contrast to morphologically bound complementation, constructions called "lexical union" are monoclausal. Lexical union can be illustrated by the Abaza continuative suffix *-rḳʷa* (9), which, according to Avidzba (2017), originates from the copula verb, but since synchronically it does not show any semantic and syntactic independence, it does not have its own PRED function (10).

(9) d-apχ'a-**rḳʷ**-əj-ṭ
3SG.H.ABS-read-**CNT**-PRS-DCL
'S/he continues to read.'

[3] For more examples of morphologically bound complementation, see Panova (2018).

(10) $$\begin{bmatrix} \textsc{pred} & \text{`continue to read}\langle(\uparrow\textsc{subj})\rangle\text{'} \\ \textsc{tense} & \textsc{prs} \\ \textsc{finiteness} & + \\ \textsc{subj} & \begin{bmatrix} \textsc{pred} & \text{`pro'} \\ \textsc{pers} & 3 \\ \textsc{num} & \textsc{sg} \\ \textsc{hum} & + \end{bmatrix} \end{bmatrix}$$

Verb-verb compounds which constitute a morphologically bound subtype of serial verb construction (see, e.g., verb serialization in Ewe (Kwa) (Ameka 2006))[4] are also monoclausal, cf. my hypothetical f-structure (12) of the Bininj Gun-wok wordform in (11).

Bininj Gun-wok (Gun-djeihmi dialect), Gunwinyguan (Evans 2003: 536)

(11) ga-ganj-ngu-nihmi-re
3-meat-eat-IVF-go.NPST
'He goes along eating meat.'

(12) $$\begin{bmatrix} \textsc{pred} & \text{`go eating }\langle(\uparrow\textsc{subj})(\uparrow\textsc{obj})\rangle\text{'} \\ \textsc{pred-type} & \text{incorporating-verb-form} \\ \textsc{tense} & \textsc{non-past} \\ \textsc{subj} & \begin{bmatrix} \textsc{pred} & \text{`pro'} \\ \textsc{pers} & 3 \end{bmatrix} \\ \textsc{obj} & \begin{bmatrix} \textsc{pred} & \text{`meat'} \end{bmatrix} \end{bmatrix}$$

Morphologically bound constructions with adverbial clauses are expected to be similar to morphologically bound complementation with the difference that a subordinate predicate is not a complement but an adjunct. However, at least for now I do not know any proven examples of this strategy (perhaps some verb-verb compounds actually have biclausal properties but I do not know any studies which would demonstrate that).

Thus, the aim of the present paper is to propose an LFG analysis of the construction with the element *ʒəš'a* 'seem' in Abaza (1), an example of morphologically bound complementation. A preliminary version of the proposed analysis has been discussed earlier in Panova (2020).

2 The Abaza language and LFG

Abaza is a polysynthetic Northwest Caucasian (Abkhaz-Adygean) language spoken by some 50 thousand people, mainly in Russian North Caucasus and in Turkey.

[4] Aikhenvald (2006) discusses wordhood as a parameter of variation across serial verb constructions. For a definition of serial verb constructions, see also Haspelmath (2016).

Elicited data presented in this paper were collected in 2017-2019 during field-trips to the village Inzhich-Chukun in the Karachay-Cherkess Republic, Russia.

For the basics of Abaza grammar, see Genko (1955), Tabulova (1976), Lomtatidze (2006) and Arkadiev (to appear). An example of the Abaza sentence from an oral narrative is given in (13).

(13) s-ph^{w}əs nina d-ʕa-s-c-qrəʕ-əw-mca
1SG.IO-woman Nina 3SG.H.ABS-CSL-1SG.IO-COM-help-IPF-CVB
s-š'ap˙-k^{w}a s-rə-k^{w}-lə-r-gəl-χ-d
1SG.IO-foot-PL 1SG.ABS-3PL.IO-LOC-3SG.F.ERG-CAUS-stand-RE-DCL
'My wife Nina helped me to get on my feet.'

Abaza has never been analyzed within LFG, so before starting the analysis of the *ʒəš'a*-construction, several decisions concerning representation of some basic grammatical features of Abaza have to be made. First, due to the lack of compelling evidence for clause-level configurationality I postulate a flat c-structure of S. Second, Abaza is a morphologically ergative language (cf. argument prefixes in (13)) but there are no evidence for syntactic ergativity in Abaza, so in f-structure I will use standard notions SUBJ and OBJ. As a result, in examples below a subject can be encoded in the verb by the absolutive prefix, by the ergative prefix or in case of predicates which presuppose an oblique subject — by the indirect object prefix (importantly, *ʒəš'a* 'seem' belongs to this class of predicates).

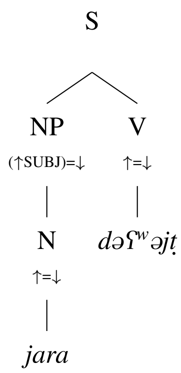
Example (14) shows an intransitive clause, where the argument is cross-referenced on the verb by the absolutive prefix and encoded as a subject in the lexical entry (15) and in the f-structure (16).

(14) jara də-ʕ^{w}-əj-ṭ
3SG.M/N 3SG.H.ABS-run-PRS-DCL
'He is running.' (Tabulova 1976: 118)

(15) *dəʕ^{w}əjṭ* V (↑ PRED) = 'run ⟨(↑SUBJ)⟩'
(↑ TENSE) = PRS
(↑ FINITENESS) = +
(↑ SUBJ PERS) = 3
(↑ SUBJ NUM) = SG
(↑ SUBJ HUM) = +

(16)

$$\begin{bmatrix} \text{PRED} & \text{`run } \langle(\uparrow\text{SUBJ})\rangle\text{'} \\ \text{TENSE} & \text{PRS} \\ \text{FINITENESS} & + \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`pro'} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEND} & \text{MASC} \end{bmatrix} \end{bmatrix}$$

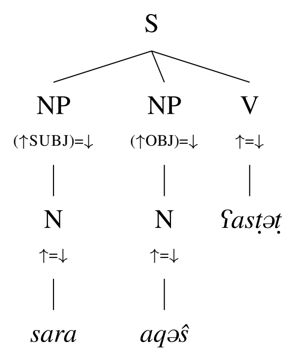


Example (17) illustrates a transitive clause. Note that the there is an ergative prefix in the verb, while the absolutive prefix is omitted. The absolutive prefix *j-* (3SG.N or 3PL) is usually dropped when a coreferential nominal expression (in this case *aqəŝ* 'the window') immediately precedes the verb. The lexical entry is presented in (18) and the f- and c-structures of sentence (17) are shown in (19).

(17) sara a-qəŝ ʕa-s-ṭə-ṭ
1SG DEF-window CSL-1SG.ERG-open-DCL
'I opened the window.'

(18) *ʕasṭəṭ* V
$(\uparrow \text{PRED}) = \text{'open } \langle(\uparrow\text{SUBJ})(\uparrow\text{OBJ})\rangle\text{'}$
$(\uparrow \text{TENSE}) = \text{AORIST}$
$(\uparrow \text{FINITENESS}) = +$
$(\uparrow \text{OBJ PERS}) = 3$
$\{(\uparrow \text{OBJ NUM}) = \text{SG}$
$(\uparrow \text{OBJ GEND}) = \text{NEUT} \mid$
$(\uparrow \text{OBJ NUM}) = \text{PL}\}$
$(\uparrow \text{SUBJ PERS}) = 1$
$(\uparrow \text{SUBJ NUM}) = \text{SG}$

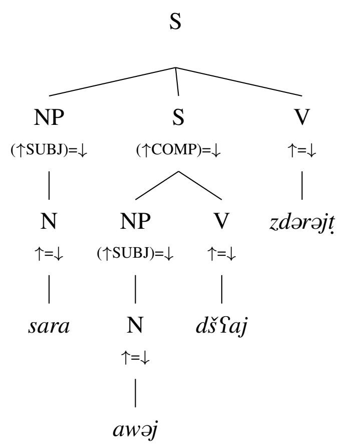
(19)
$$\left[\begin{array}{ll} \text{PRED} & \text{'open}\langle(\uparrow\text{SUBJ})(\uparrow\text{OBJ})\rangle\text{'} \\ \text{TENSE} & \text{AORIST} \\ \text{FINITENESS} & + \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{'pro'} \\ \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{array}\right] \\ \text{OBJ} & \left[\begin{array}{ll} \text{PRED} & \text{'window'} \\ \text{NUM} & \text{SG} \\ \text{DEF} & + \\ \text{GEND} & \text{NEUT} \end{array}\right] \end{array}\right]$$



Example (20) shows the most common complementation strategy in Abaza — manner relativization. A sentential complement is formed as a headless manner relative clause, thus (20) literally means 'I know (that) how he came'. In the f-structure (21) of sentence (20) I introduce the attribute COMP-TYPE, which indicates the complementation strategy.

(20) sara [awəj d-š-ʕa-j] z-dər-əj-ṭ
1SG DIST 3SG.H.ABS-**REL.MNR**-CSL-go 1SG.ERG-know-PRS-DCL
'I know that he came.'

(21)
$$\begin{bmatrix}
\textsc{pred} & \text{`know}\langle(\uparrow\textsc{subj})(\uparrow\textsc{comp})\rangle\text{'} \\
\textsc{tense} & \textsc{aorist} \\
\textsc{finiteness} & + \\
\textsc{subj} & \begin{bmatrix} \textsc{pred} & \text{`pro'} \\ \textsc{pers} & 1 \\ \textsc{num} & \textsc{sg} \end{bmatrix} \\
\textsc{comp} & \begin{bmatrix}
\textsc{pred} & \text{`come}\langle(\uparrow\textsc{subj})\rangle\text{'} \\
\textsc{tense} & \textsc{aorist} \\
\textsc{finiteness} & - \\
\textsc{comp-type} & \textsc{manner} \\
\textsc{subj} & \begin{bmatrix} \textsc{pred} & \text{`pro'} \\ \textsc{pers} & 3 \\ \textsc{num} & \textsc{sg} \\ \textsc{hum} & + \\ \textsc{pron-type} & \textsc{dist} \end{bmatrix}
\end{bmatrix}
\end{bmatrix}$$



Now, having shown how standard Abaza complementation can be formalized in terms of LFG, I proceed to morphologically bound complementation. I assume that the f-structure of the *ʒəš'a*-construction is simply equal to the f-structure of standard (morphologically free) Abaza complementation. What is less obvious is how the morphological boundness of the *ʒəš'a*-construction should be encoded in c-structure. In the next section I show how this question has been answered in previous literature for cases of morphologically bound complementation in other languages.

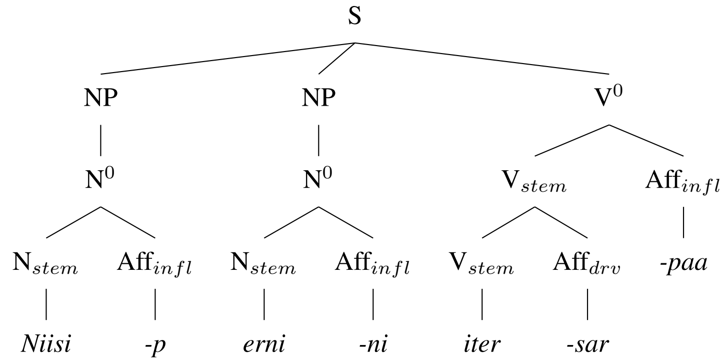
3 Previous studies and Analysis 1

Morphologically bound complementation constructions in West Greenlandic have been analyzed within LFG by Manning (1994). In the c-structure of example (22) he postulates a sublexical level which allows to show relations between morphemes constituting the verbal complex and, in particular, between the matrix and the embedded predicate, cf. (23).

West Greenlandic, Eskimo-Aleut (Manning 1994: 99-100)

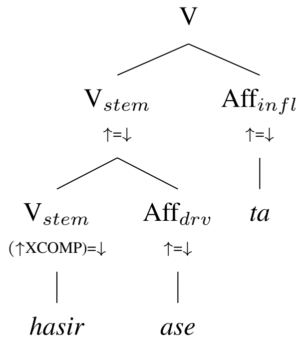
(22) Niisi-p erni-ni iter-**sar**-paa
Niisi-ERG son-SG.RFL(ABS) wake.up-**try**-IND.TR.3SG.3SG
'Niisi$_i$ tried to wake up his$_i$ son.'

(23)



A similar solution has been proposed for the morphological causative in Japanese by Bresnan et al. (2016: 395-396). For the wordform *hasir-ase-ta* ‘run-CAUS-PST’ they suggest an expanded c-structure involving a sublexical level at which the causative morpheme *-ase-* and the verbal root *hasir-* ‘run’ appear as two separate nodes, cf. (24).

(24)



$$\begin{bmatrix} \text{PRED} & \text{‘cause}\ \langle(\uparrow\text{SUBJ})(\uparrow\text{OBJ})(\uparrow\text{XCOMP})\rangle\text{’} \\ \text{TENSE} & \text{PST} \\ \text{OBJ} & \\ \text{XCOMP} & \begin{bmatrix} \text{PRED} & \text{‘run}\ \langle(\uparrow\text{SUBJ})\rangle\text{’} \\ \text{SUBJ} & \end{bmatrix} \end{bmatrix}$$

In both examples discussed above the subject of the embedded predicate is a part of the argument structure of the matrix, so there are no dependents belonging exclusively to the embedded clause. However, in the *ʒəš’a*-construction the embedded predicate can have its own dependents, cf. (2) repeated here as (25).[5]

(25) sara pasata [wara ŝabəžta
1SG earlier 2SG.M fast
wə-ʕ-wa]-ʒə-s-**š’**-əw-n
2SG.M.ABS-run-IPF-LOC-1SG.IO-**seem**-IPF-PST
‘Before, I thought you run fast.’

Thus, before applying the “sublexical” analysis to the *ʒəš’a*-construction, it has to be decided how the unshared arguments and other dependents (if any) of the incorporated predicate should be represented in c-structure.

[5]This property of morphologically bound complementation is well-described, in particular, for the morphologically bound construction with the matrix predicate ‘check, find out’ in Agul (Nakh-Daghestanian), see Maisak (2016).

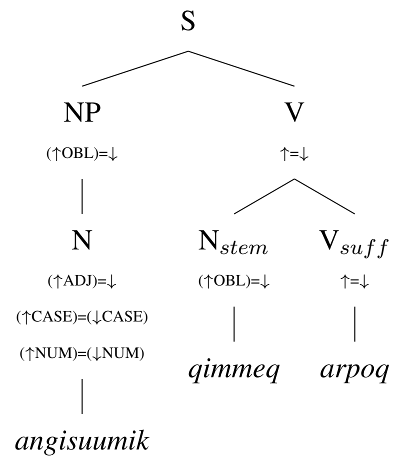
Essentially the same issue has already been resolved for a very similar case of modifier stranding in noun incorporation. Analyzing examples with modifier stranding in West Greenlandic (26), Bresnan et al. (2016: 446) introduce a headless NP which contains a modifier ('big'), while the incorporated head ('dog') appears as a dependent of the V node (27).

West Greenlandic, Eskimo-Aleut (Sadock 1980: 309)

(26) **angisuu-mik** qimmeq-arpoq
big-INST dog-have.IND.3SG
'He has a big dog.'

(27)

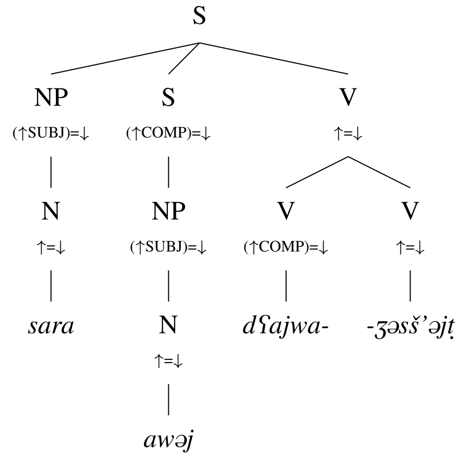
$$\left[\begin{array}{ll} \text{PRED} & \text{`have}\langle(\uparrow\text{SUBJ})(\uparrow\text{OBL})\rangle\text{'} \\ \text{MOOD} & \text{INDIC} \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{`pro'} \\ \text{NUM} & \text{SG} \\ \text{PERS} & 3 \\ \text{CASE} & \text{ABS} \end{array}\right] \\ \text{OBL} & \left[\begin{array}{ll} \text{PRED} & \text{`dog'} \\ \text{CASE} & \text{INST} \\ \text{NUM} & \text{SG} \\ \text{ADJ} & \left[\begin{array}{ll} \text{PRED} & \text{`big'} \\ \text{CASE} & \text{INST} \\ \text{NUM} & \text{SG} \end{array}\right] \end{array}\right] \end{array}\right]$$



In a similar fashion, the S phrase dominating the dependents of the incorporated predicate can be introduced for the *ʒəš'a*-construction in Abaza. This is illustrated in (29): the c-structure of sentence (28) contains a headless S phrase with the absolutive argument of the embedded predicate, while the embedded predicate is placed together with the matrix.

(28) sara [awəj d-ʕa-j-wa]-ʒə-s-**š'**-əj-ṭ
1SG DIST 3SG.H.ABS-CSL-go-IPF-LOC-1SG.IO-**seem**-PRS-DCL
'I think s/he is coming.'

(29)



Thus, it has been shown that the analysis with a sublexical level can be applied to simple sentences with the *ʒəš'a*-construction like (28). However, in some aspects the "sublexical" analysis may be problematic.

The sublexical level of the morphologically fused subordinated construction is easily derived with tree structures only if the order of morphemes within the predicate is semantically compositional. However, as was mentioned in Section 1, in the Abaza *ʒəš'a*-construction this is often not the case due to the ongoing morphologization process. For example, the prefix *an-* 'when' modifying the main verb and, therefore, the whole construction ('when she thought he had died') is located to the right of the absolutive prefix of the first (embedded) verb, cf. (4) repeated here as (30).

(30) [d-**an**-psə]-ʒə-l-š'a d-ĉ̣əwa
3SG.H.ABS-**TMP**-die-LOC-3SG.F.IO-seem 3SG.H.ABS-cry.IPF
d-a-la-ga-ṭ
3SG.H.ABS-3SG.N.IO-LOC-begin-DCL
'When she thought he had died, she started crying.'

Let's assume that the prefix *an-* 'when' gives a value 'temporal' to a special function ADJ-TYPE, cf. a fragment of the hypothetical c-structure in (31). But since this prefix is located to the right of the absolutive prefix of the embedded predicate, it cannot take the matrix predicate into its scope. Therefore, wordforms containing morphemes whose order does not follow the principle of compositionality cannot be represented on a sublexical level with tree structures.

(31) ≠ 'when she thought he had died'

S
↓∈ (↑ ADJ)

V
↑=↓

V	V
(↑COMP)=↓	↑=↓
*d-**an**-psə-*	*-ʒə-l-š'a*
3SG.H.ABS-**TMP**-die-	LOC-3SG.F.IO-seem
⟨...⟩	
(↑ ADJ-TYPE) = TMP	

In principle, it is not required in LFG to use tree structures in a sublexical level, see, e.g., Kaplan et al. (2004), Boegel et al. (2019). But the sublexical tree structure captures constraints on the order of dependents of the matrix and embedded predicates in the *ʒəš'a*-construction, so rejecting it completely does not seem to be an optimal decision either.

A constraint on word order in the *ʒəš'a*-construction that is not implied by the tree structure is the order of matrix and embedded predicates. In standard Abaza complementation there are two options: an embedded clause may either precede or follow the matrix, cf. (32).

(32) a. sara [awəj d-**š**-ʕa-j] z-dər-əj-ṭ
1SG DIST 3SG.H.ABS-**REL.MNR**-CSL-go 1SG.ERG-know-PRS-DCL
'I know that he came.'

b. sara z-dər-əj-ṭ [awəj d-**š**-ʕa-j]
1SG 1SG.ERG-know-PRS-DCL DIST 3SG.H.ABS-**REL.MNR**-CSL-go
'I know that he came.'

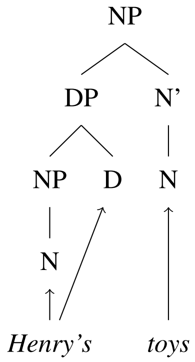
However, in the *ʒəš'a*-construction the word order is strictly head-final and all the arguments and adjuncts of the complement clause must precede the verbal complex. The Analysis 1 does not imply any constraints on the choice between word order patterns (32a)-(32b), so some additional rules have to be postulated.

Thus, we need to take into account the following properties of the *ʒəš'a*-construction. First, due to the ongoing process of morphologization, the linear positions of morphemes are better to be defined before the verbal complex appears in the c-structure — namely, in a special morphological module. At the same time, at some level of the c-structure there must be two heads in two different clauses. Finally, it would be better to have independently motivated restrictions on the order of predicates within the construction. Given all these considerations, I propose to analyze the Abaza case of morphologically bound complementation using a mechanism of Lexical Sharing.

4 Analysis 2

Lexical Sharing is a mechanism which allows two adjacent terminal nodes to be co-instantiated by one word (Wescoat 2002). For example, according to the Lexical Sharing analysis of the English possessive marker *'s* (Lowe 2015a), a head noun and the possessive constitute a single element in the lexicon but correspond to two distinct nodes in the c-structure (33).

(33)

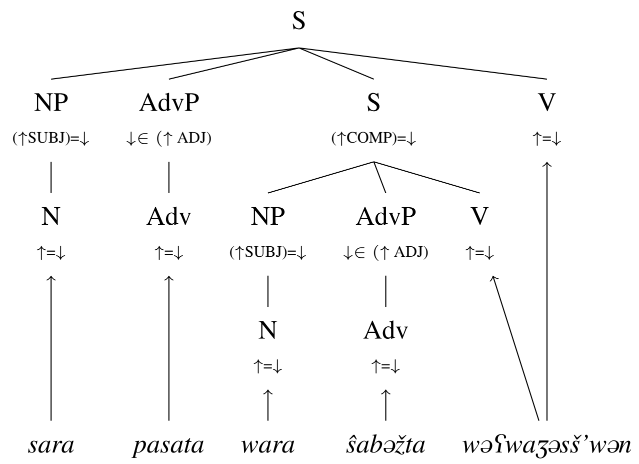


Previously this mechanism has been applied to such grammatical phenomena as pronoun-auxiliary constrictions (Wescoat 2005), suspended affixation (Broadwell 2008, Belyaev 2014), nominal compounds (Lowe 2015b), etc. Lowe (2015a) notes that the Lexical Sharing approach can account for syntactic change, i.e. diachronic processes.

The c-structure of (34) demonstrates how the Lexical Sharing mechanism can be used to model morphologically bound complementation. According to (35), the complex verbal form with *ʒəš'a* appears as a morphologically fully formed verb which maps to two neighboring positions in the c-structure and this allows it to have dependents in both embedded and matrix clauses.

(34) sara pasata [wara ŝabəžta
1SG earlier 2SG.M fast
wə-ʕ-wa]-ʒə-s-**š'**-wə-n
2SG.M.ABS-run-IPF-LOC-1SG.IO-**seem**-IPF-PST
'Before, I thought you run fast.'

(35)



A lexical entry for the complex verbal form is given in (36). It consists of two parts: features associated with the embedded verb and features associated with the matrix. Note that Lexical Sharing requires predicates to be together, so there is no need to postulate any additional rules to exclude word order pattern (32a) discussed earlier.

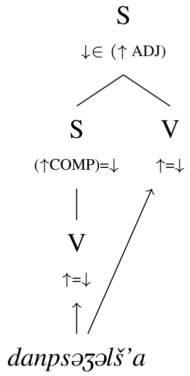
(36) *wəʕwaʒəsš'wən*:

V	(↑ PRED) = 'run ⟨(↑SUBJ)⟩'	V	(↑ PRED) = 'seem ⟨(↑SUBJ)(↑COMP)⟩'
	(↑ TENSE) = PRS		(↑ TENSE) = IMPERFECT
	(↑ FINITENESS) = –		(↑ FINITENESS) = +
	(↑ SUBJ PERS) = 2		(↑ OBJ PERS) = 3
	(↑ SUBJ NUM) = SG		{(↑ OBJ NUM) = SG
	(↑ SUBJ GEND) = M		(↑ OBJ GEND) = NEUT |
			(↑ OBJ NUM) = PL}
			(↑ SUBJ PERS) = 1
			(↑ SUBJ NUM) = SG

As for the cases with non-compositionally located morphemes, they can also be modeled with Lexical Sharing, cf. (37)-(39). Since the linear position of morphemes in the wordform is determined by a morphological template that is independent from c-structure, all features in the lexical entry can be already assigned in the right way.

(37) [d-**an**-psə]-ʒə-l-š'a
3SG.H.ABS-**TMP**-die-LOC-3SG.F.IO-seem
'when she thought he had died'

(38)



(39) *danpsəʒəlš'a*:

V	(↑ PRED) = 'die ⟨(↑SUBJ)⟩'	V	(↑ PRED) = 'seem ⟨(↑SUBJ)(↑COMP)⟩'
	(↑ TENSE) = AORIST		(↑ TENSE) = AORIST
	(↑ FINITENESS) = –		(↑ FINITENESS) = –
	(↑ SUBJ PERS) = 3		(↑ OBJ PERS) = 3
	(↑ SUBJ NUM) = SG		{(↑ OBJ NUM) = SG
	(↑ SUBJ HUM) = +		(↑ OBJ GEND) = NEUT |
			(↑ OBJ NUM) = PL}
			(↑ SUBJ PERS) = 3
			(↑ SUBJ NUM) = SG
			(↑ SUBJ GEND) = F
			(↑ **ADJ-TYPE**) = **TMP**

Of course, a more detailed analysis should involve a model of the relevant Abaza morphology in some lexicalist model, e.g., PFM (Stump 2001), and a description of the morphology-syntax interface, e.g., in terms of Dalrymple (2015) and Dalrymple et al. (2019), but I leave this for further research.

5 Conclusion

In this paper two analyses of the case of morphologically bound complementation in Abaza were discussed: the analysis with a sublexical level and the analysis involving Lexical Sharing. Although both analyses are possible, I tried to show that Lexical Sharing is a more elegant way to formalize morphologically bound complementation because it requires co-instantiated nodes to be adjacent in the c-structure and thus excludes impossible word order patterns. Moreover, I believe that morphologically bound complementation, being a result of the morphologization of the complementation construction, is a peculiar phenomenon that can hardly be well-formalized in a purely synchronically-oriented model. Therefore, Lexical Sharing that has been shown to be a good tool for modeling diachronic change (Lowe 2015a) seems to be a more natural way to account for morphologically bound complementation constructions.

Abbreviations

1 — 1st person; 2 — 2nd person; 3 — 3rd person; ABS — absolutive; ACC — accusative; ADV — adverbial; AGT — agentive; CAUS — causative; CNT — continuative; COM — comitative; CSL — cislocative; CVB — converb; DCL — declarative; DEF — definite; DIST — distal demonstrative; ERG — ergative; F — feminine; H — human; IND — indicative; IO — indirect object; INST — instrumentalis; IPF — imperfective; IVF — incorporating verb form; LOC — locative preverb; M — masculine; MNR — manner subordination; N — neuter; NEG — negation; NFIN — non-finite; NOM — nominative; PL — plural; PRS — present; PST — past; RE — repetitive; REL — relativization; RFL — reflexive; SG — singular; TMP — temporal subordination; TR — transitive.

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Corpus-based approach meets LFG: the puzzling case of voice alternations of kena-verbs in Indonesian

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Abstract

This paper discusses the meaning-preserving hypothesis of voice alternation in Indonesian from an LFG perspective. The hypothesis predicts that the meaning encoded by a transitive verb is available for both active and passive forms, differing only in the alignment of grammatical relations and semantic roles. Using quantitative corpus linguistic analysis, we argue that voice alternation needs to be relativised to (i) a certain sense of a verb and (ii) (statistical) usage constraints of the verb's semantics in certain voices. We also demonstrate the viability of the LFG framework and related analytical issues in capturing such empirical facts.

1 Introduction*

This paper describes a novel approach to the study of grammatical voice (hereafter, voice) in Indonesian by providing fresh, corpus-based evidence in support of the claim that voice alternations in a given verb, especially between active and passive, are not always a meaning-preserving phenomenon (Kroeger 2005: 271). It further demonstrates that a given sense of a verb can be bias to one voice type. The idea of "meaning-preserving" in the active-passive alternation is that active and passive clauses involving the same verb should "describe the same kind of event" (Kroeger 2005: 271). To illustrate this point simply, we focus on verbs derived from the root *kena* 'be hit; get into contact with',[1] exemplified in (1) and (2).[2]

(1) *murid* *Go bie-pay* *yang* ***meng-(k)ena-kan*** *baju* *warna* *hitam*.
pupil NAME REL AV-hit-CAUS shirt colour black
'Go bie-pay's student who *wears/puts on* a black shirt.' (755227)[3]

(2) *Gaun* *yang* ***di-kena-kan*** *berwarna* *hitam*
dress REL PASS-hit-CAUS have.colour black
'The dress that *is worn* is black' (802596)

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* We would like to thank (i) the two anonymous reviewers for their constructive comments on the first draft of the paper, and (ii) Charbel El-Khaissi (Australian National University) for proofreading our paper. Any remaining errors and inconsistencies are ours.

[1] One reviewer asked about our choice of the verb HIT, which is said to have elastic meanings, including strong metaphorical tendency, its tendency to be a light verb and as part of serial verb constructions. This should not be an issue. *Kena* 'be hit' represents the prototypical transitive impact verb in Indonesian, expressed by different forms appearing in different voice types with core and extended metaphorical meanings. Our research reported here is part of a larger research covering other verbs (cf. Rajeg, Rajeg & Arka 2020c). Any research for the meaning-preserving hypothesis should in principle also cover a wide range of verb types, including those with elastic meanings.

[2] Abbreviation in the interlinear glossing: 1, 2, 3, first, second, third person; APPL applicative; ART article; AV active voice; CAUS causative; DEM demonstrative; FUT future marker; INDEF indefinite; LOC locative; PASS passive voice; PL plural; POSS possessive; REL relativiser; SG singular.

[3] This number is the sentence ID which indicates where in the corpus the sentence is taken. See §2.3 for further details on the corpus.

The base verb *kena-kan* in (1) and (2) conveys the event of 'wearing a piece of clothing', both in its active form (hereafter AV) with the prefix *meN-* (1) and in the passive (PASS) with the prefix *di-* (2). Given these two sentences, the meaning-preserving status does indeed hold for the voice alternation of *kenakan* 'to wear' in AV and PASS. The meaning-preserving hypothesis would categorically (and implicitly) predict that any senses expressed by a verbal stem in AV can be expressed in PASS, but would not predict whether a certain sense is equally likely to be expressed in AV and PASS (cf. McDonnell 2016: 243). That is, the hypothesis does not predict the conventionality of a certain sense according to the voice type given that the same sense is attested in both AV and PASS. We scale up the amount of data we analysed because relying on a pair of examples fails to capture distributional asymmetry of senses for a given verb in different voice types (see Bernolet & Colleman 2016 for a similar study in Dutch Dative Alternation). Based on quantitative analyses (§3) on the usage of verbs derived from *kena*, we argue the following two empirical claims:

a. A certain sense of a given *kena*-based verb is significantly more frequently expressed in one voice type than in the other. This suggests that a certain sense may be strongly and conventionally associated with a certain voice compared to its voice-counterpart (Figure 2 and Figure 3).
b. A certain sense of a given verb can be directly constructed in one voice, in this case PASS with *kena* as shown in this study, with no corresponding form in the other voice, in this case AV (§3.1 and Footnote 6). This indicates that (i) voice alternation should be relativised to a certain sense of a verb such that one sense of a verb may not enter voice alternation, and that (ii) the PASS form of a verb in a given sense is not always derived from its AV counterpart; hence not showing voice alternation, let alone a meaning-preserving property (Figure 2).

To these ends, this paper is structured as follows. In §2, we present an overview of related works that this paper builds on (§2.1), followed by the studied verbs (§2.2) and some methodological points (§2.3). The corpus analysis in §3 demonstrates the points in (a) and (b) above. Then, the proposed LFG analyses of the corpus findings in §4 include (i) argument-structure-based analyses of the entries of the morphological formatives and (ii) predicate composition and argument-fusion. We conclude in §5 with the implications of this study and pointers to a future investigation.

2 Corpus-based quantitative research on Indonesian voice

2.1 Some background

Corpus-based, quantitative research on voice in Austronesian languages focuses on discourse-pragmatic factors (e.g. topicality of patient, transitivity of the event, grounding) that influence voice selection in discourse (among others, Wouk 1989, for Jakarta Indonesian; Pastika 1999, for Balinese; McDonnell 2016, for recent overview and his study in Besemah).[4] Despite extensive research on voice, very little attention has been paid to the role of verb senses and their interaction with the voice type of the verb. The question is whether voice alternation for a given verb stem interacts with the semantic potentials of the verb, given a verb can be polysemous.

McDonnell's (2016: 242–244) *Collostructional Analysis* (Gries & Stefanowitsch 2004) on Besemah's symmetrical voice constructions has shown that certain verbal roots more frequently occur in agentive voice than in patientive voice (see Gries & Stefanowitsch 2004 for a collostructional analysis for voice alternation in English). McDonnell further demonstrates that such a degree of attraction plays a role in voice selection, in addition to the other factors (e.g. discourse transitivity and clausal mood). In line with our goal, McDonnell (2016: 250) notes an unexplored factor in voice selection, namely the possibility for semantic properties of the verbal root to account for voice selection (cf. §4.3). Another preliminary, quantitative study in Indonesian investigates the association between (metaphorical and literal) meaning and morphologically different verbs of the same root (based on *panas* 'hot') that include voice morphologies (Rajeg & Rajeg 2019). That study revealed that certain morphological forms of a verb display a stronger preference for metaphorical contexts than literal ones (e.g., inceptive verb *memanas* 'to become hot' is significantly associated with metaphorical contexts, while the passive causative *dipanaskan* 'be heated up' is significantly associated with literal contexts). We follow a similar line of inquiry with other roots in Indonesian (see also Rajeg, Rajeg & Arka 2020c).

2.2 Object of the present study

Of particular interest are the syntactic-semantic differences of the derivatives of *kena* with two transitive suffixes, namely *-kan* (*kena**kan***) and *-i* (*kena**i***). Let us start with the properties of the root *kena* 'be hit; get into contact with', exemplified in (3). The verb *kena* is lexically Patient-oriented; that is, its syntactic subject (e.g. *orang* 'person' in (3)) is linked to a Patient-like role.[5] *Kena* is also associated with negative affectedness on the subject. These two properties appear to be critical in constructing the derived meaning, and therefore in constraining the voice alternation in *kena*-based verbs.

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[4] Besemah is "a little-known Malayic language spoken in the remote highlands of South Sumatra in western Indonesia" (McDonnell 2016: 11).

[5] The ten most strongly attracted R1 collocates for *kena* (i.e. words immediately following *kena* within the sentence boundary) identified via Collostructional Analysis (Stefanowitsch & Gries 2003) are *pajak* 'tax', *batunya* 'the stone' (parts of idiom *kena batunya* 'get into trouble'), *tipu* 'deceive', *marah* 'angry/anger', *racun* 'poison', *getahnya* 'the resin', *hukuman* 'punishment', *imbasnya* 'the impact/effect', *penyakit* 'disease' and *semprot* 'spray' (which can have a metaphoric meaning of 'getting a scolding'). They all evoke entities giving rise to negative affectedness on the subject of *kena*.

(3)	*seperti*	*orang*	*yang*	***kena***	*hukuman*	*di*	*kursi*	*listrik.*
	as.if	person	REL	be hit	punishment	at	chair	electricity

‘…as if a person who *gets punished* on an electrifying chair.’ (848667)

It should be noted that the predicate *kena* carries a complex set of inter-related senses, schematised in Figure 1; ‘(be.)hit’ is the semantic core with its sub-senses, which can interact with the semantics of the morphological formatives (cf. §4.3). For instance, the *-kan/-i* suffixes can express an applicative or causative reading, depending on the semantic transitivity of the root (Arka et al. 2009).

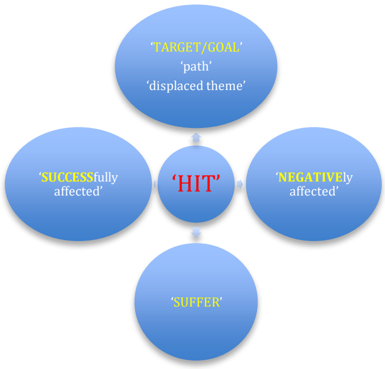

Figure 1: Semantic network of *kena* ‘hit’

The stems *kenakan* and *kenai* can then take the *meN-* and *di-* prefixes that respectively encode AV and PASS voice types. These two stems, *kenakan* and *kenai*, show puzzling behaviour in relation to their meanings as expressed in certain voice forms (key examples are in (4)a and (4)b).

(4)	a.	*Pengusaha*	***meng-(k)ena-kan/*meng-(k)ena-i***	*pajak*
		enterpreneur	AV-be hit-CAUS/AV-be hit-APPL	tax

‘Enterpreneurs *imposes/charges* tax (to their consumers)…’ (754049)

b.	*motor*	*kedua*	*akan*	***di-kena-kan/di-kena-i***	*pajak*	*sebesar*	*2*	*persen.*
	motor	second	FUT	PASS-be hit-CAUS/-APPL	tax	as.large	2	percent

‘…the second motorbike will be *subject to/charged with* 2% tax.’ (296558)

The original example in (4)a with the *-kan* AV verb *mengenakan* expresses the meaning, ‘subject to/impose’, however the AV *-i* form *mengenai* is not an acceptable alternative to convey the same ‘subject to/impose’ sense. In contrast, example (4)b shows that the *-kan* verb *kenakan* can alternate with *kenai* in PASS to express the meaning, ‘subject to’. In other words, the PASS alternation (*dikenai* and *dikenakan*) allows synonymy in expressing ‘subject to’ in (4)b, but such synonymy is not possible and infelicitous in the AV (4)a. LFG analysis (§4) will capture the empirical facts about the dynamics of meaning construction and language use, particularly how semantic properties of *kena* join forces with the semantics of voice morphology and valency-changing suffixes in the construction of meaning that is found in the derived verbs.

2.3 Data source and coding

We retrieved all usage occurrences of the four target verbs, *mengenai* (N = 284 tokens), *dikenai* (N = 139), *mengenakan* (N = 1,101), and *dikenakan* (N = 446), from one corpus file, namely ind_mixed_2012_1M-sentences.txt (15,052,159 million word-tokens), a part of the *Indonesian Leipzig Corpora* collection (Quasthoff & Goldhahn 2013). This file consists mostly of shuffled sentences from Indonesian online news (Quasthoff & Goldhahn 2013: 26). The string *mengenai* actually occurs across a total of 7,148 tokens among which 95.93% occur as a preposition meaning 'concerning to' (5) (Rajeg, Rajeg & Arka 2020a: 336–339). Despite this grammaticalised usage, *mengenai* can still be used as a lexical transitive verb (cf. (7) and (8) below) and this use of *mengenai* was manually identified.

(5)	*teman-temannya*	*tahu*	***mengenai***	*siapa*	*'kakaknya'*	*itu*
	friend.PL	know	concerning	who	older.sibling	DEM

'h(is/er) friends know *regarding* who h(is/er) older sibling is' (212649)

The senses of each verb were coded based on two heuristic guidelines: (i) the description of the verb in the online *Kamus Besar Bahasa Indonesia* (KBBI) (the online Great Dictionary of Indonesian), and more importantly (ii) the semantic types of arguments that co-occur with the verb. For instance, the 'subject to/impose' sense of *dikenakan* can be inferred from its co-occurrences with obligation-related arguments, such as *pajak* 'tax' in (4)b. Meanwhile, the 'wear (a piece of clothing)' sense of *dikenakan* is evoked when co-occurring with clothing-related arguments (see (1)). The primary 'hit' sense of *kenai* can be inferred when the event involves physical contact; see examples (4)a in §2.2 and (6) below for typical contexts. *Kenai* can also encode invisible/abstract affectedness, predominantly (i) medical affect, where a human or organ/parts of the body is affected by disease as in (7), and (ii) to a small extent, psychological affect as in (8).

(6)	*orang*	*yang*	***di-kena-i***	*anak*	*panah*	*itu*	*terkapar*	*mati*
	person	REL	PASS-be hit-APPL	child	arrow	DEM	PASS.sprawled	dead

'…several people who got *hit* by those arrows were sprawled dead…' (81198)

(7)	*Penyakit*	*ini*	*dapat*	***meng-(k)ena-i***	*pria*	*dan*	*wanita*
	disease	DEM	can	AV-be hit-APPL	man	and	woman

'This disease can *affect* (i.e. *hit*) men and woman …' (17661)

(8)	*tangkisan*	*yang*	*semata-mata*	***meng-(k)ena-i***	*pribadi*	*debitur*	*itu*.
	rebuttal	REL	merely	AV-be hit-APPL	personality	debtor	DEM

'a rebuttal that merely *affects* (i.e. *hit*) the personality of that debtor.' (214779)

3 Corpus-based results

3.1 Senses for kenai *in PASS and AV*

The most frequent sense for *kenai* is the literal 'hit; contact; touch' (N = 262; 61.94%), followed by 'subject to/imposed' (N = 124; 29.31%) and disease/mental 'affect' (N = 37; 8.75%). Figure 2 visualises the distribution of these senses in PASS and AV forms of *kenai*. The height of the bars represents percentages, with the raw numbers given inside the bars.

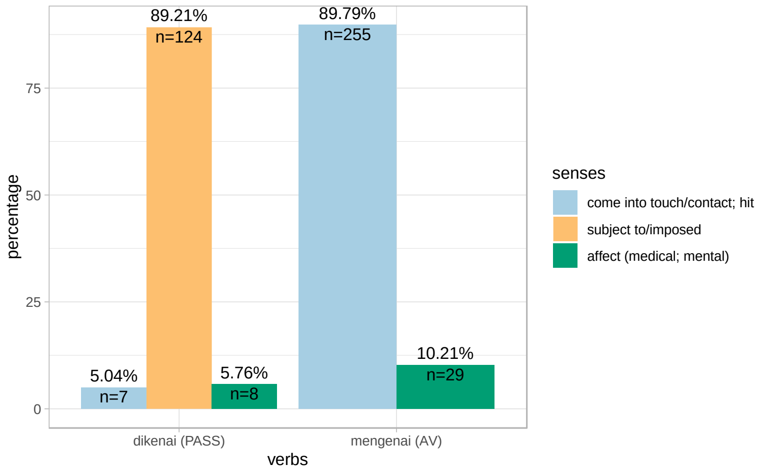

Figure 2: Distribution of senses for *kenai* in PASS and AV

It is clear that the distribution of senses for *kenai* is not equal across voice. The primary, physical sense 'hit; come into touch/contact' can indeed occur in PASS and AV (hence, categorically meaning-preserving) but its proportion is much greater in AV (89.79 %) than in PASS (5.04%). A slight distributional difference can also be seen in the 'medical/mental affect' sense. Figure 2 also provides empirical evidence that voice alternation is not always meaning-preserving, but rather sensitive to a given sense of a verb. This is shown by the absence of the 'subject to/be imposed' sense in AV (cf. (4)a); this sense is only found in PASS and is the most frequent of all senses of *kenai* in PASS[6]. This indicates that 'subject to/be imposed' is directly

[6] One reviewer asked how (any) corpus study can tell if the absence of AV *mengenai* to express 'impose' is a fact of grammar (a negative evidence), without recourse to native-speaker judgement in order to check if *mengenai* "could" mean 'impose', but would normally be infelicitous. We follow Stefanowitsch (2006; 2008), who proposes the corpus-based approach of negative evidence, and test for the statistical significance of a zero (0) frequency of 'impose' in AV *mengenai*. The goal is to check whether *mengenai* 'impose' is a possible form-meaning pair or not in Indonesian. Our analysis indicates that *mengenai* 'impose' is a highly significantly absent construction ($X^2 = 358.42$, $df = 1$, $p_{\text{two-tailed}} < 0.001$, $\phi = 0.921$), and our judgement as native speakers supports this corpus-based finding; the data and statistics are available at http://bit.ly/negative-evidence.

constructed and conventionalised in PASS. This 'subject to/be imposed' sense should not be regarded as a derivative of an (imaginary, underlying) AV form, which is empirically not attested for this sense in the corpus.

A chi-square test for independence reveals that the asymmetric distribution of senses for *kenai* in PASS and AV (i) is statistically highly significant (i.e. cannot be due to chance) (X^2 = 363.699, df = 2, $p_{\text{two-tailed}}$ < 0.001) and (ii) demonstrates a highly strong effect size (Cramer's V = 0.927).[7] The effect is indicated by the strong preference of the 'hit; come into touch/contact' sense expressed in AV (i.e. it has positive residuals[8] in AV) and of the 'subject to/be imposed' sense in PASS without AV occurrence. Therefore, the meaning-preserving hypothesis in voice alternation needs to be (i) relativised in terms of particular sense(s) of a given verb (cf. Bernolet & Colleman 2016), and (ii) viewed probabilistically, as also shown in previous works from a discourse-pragmatic approach (cf. §2.1, and §3.2).

3.2 *Senses for* **kenakan** *in PASS and AV*

The lion share of *kenakan* occurrences convey the 'wear; put on' sense (N = 1,182; 77.31%), followed by 'subject to/imposed' (N = 301; 19.69%) and other senses (N = 46; 3.01%). Figure 3 visualises the distribution of these senses in PASS and AV forms for *kenakan*.

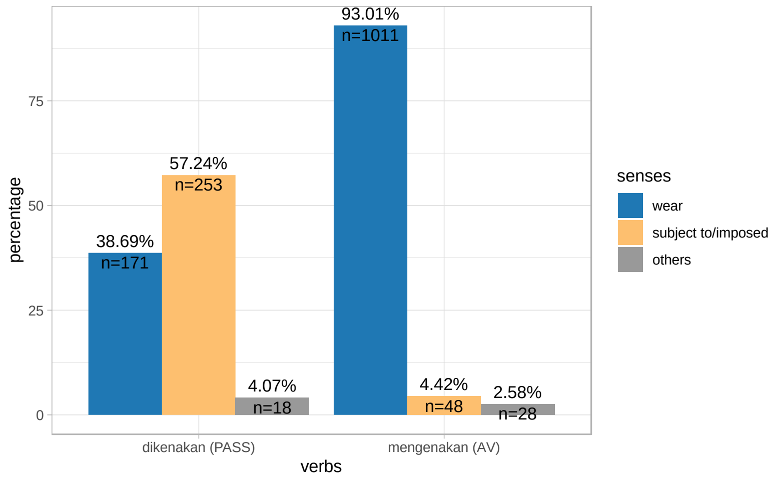

Figure 3: Distribution of senses for *kenakan* in PASS and AV

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[7] Cramer's V is a measure of effect size that is independent of sample size, unlike the significance level, which is dependent on the sample size (Levshina 2015: 209). Cramer's V ranges from 0 (no association) to 1 (strong and perfect association). Strong/large effect size is shown by Cramer's V value equal to or greater than 0.5 (Levshina 2015: 209).

[8] Space prevents us to include an Association plot that shows this strong preference effect for *kenai* and *kenakan* (§3.2), but see Rajeg, Rajeg & Arka (2020b) for links to the open-access supplementary materials, including the Association plot, data, and R codes.

A similar trend of distributional asymmetry can be seen from Figure 3, as observed previously in Figure 2. The proportion of the two most frequent senses for *kenakan* (i.e. 'wear' and 'subject to/be imposed') differs in AV and PASS. While 'wear; put on' is indeed attested in AV and PASS, it is much more frequently expressed in AV (93.01%) than in PASS (38.69%). In contrast, 'subject to/be imposed' is expressed much more frequently in PASS (57.24%) than in AV (4.42%). The chi-square test for independence indicates that this asymmetric distribution is statistically highly significant (X^2 = 567.676, df = 2, $p_{\text{two-tailed}}$ < 0.001) and has a strong effect size (Cramer's V = 0.609). This effect is shown by the strong preference for 'wear' to be encoded in AV (but not preferred in PASS) and for 'subject to/imposed' in PASS (but not preferred in AV).

An important point in the PASS constructions involving the two stems *kenai* (§3.1) and *kenakan* is their similar semantic trait, which predominantly conveys the 'subject to/be imposed' sense. This similarity unsurprisingly accounts for the fact that PASS *dikenai* and *dikenakan* can be interchangeably used to express 'subject to/be imposed' (cf. example (4)b).

4 LFG Analysis

In this section we sketch out a LFG analysis, which consists of two components. The first one is an argument-structure based analysis, with entries of the morphological formatives: the root (*kena*), the transitiviser (*-i/-kan*), and the voice prefix (*meN-/di-*). The second component outlines principles for predicate composition, argument fusion and argument linking in order to capture, among other things, the voice selection mechanism, constructional meaning, the restriction on semantic co-occurrences that evokes certain senses, and the AV/PASS preferential usage of these senses as reported in §3. Each of these components of analysis is discussed in order.

4.1 Lexical entry, argument structure and prominence-based linking.

We adopt a traditional morpheme-based analysis of Indonesian morphology, where the affixes, including the voice and the transitivisers *-i/-kan*, have their entries. Space precludes a full discussion of the precise linking mechanism, but in this subsection we briefly outline our simplified a-structure representation of the lexical entry that captures prominence-based linking[9] in grammar; see Arka et al (2009) for details. We adopt a version of a-structure-based linking as discussed in Arka (2003: 148–158), which is

[9] Prominence here relates to the idea of argument ranking, which can be based on three levels. First, surface grammatical relations (i.e. syntactically privileged): SUBJ-PIVOT>non SUBJ-PIVOT; CORE>Non-CORE. Second, semantic/thematic roles: AGENT/ACTOR>Non-ACTOR (A > Ground > Theme); agent > beneficiary > experiencer / goal > instrument > patient / theme > locative (Bresnan & Kanerva 1989; Butt 2014, among others). Third, discourse pragmatics: for instance, TOPIC > non-TOP (Arka 2017; Sells 2001: 360).

applicable to Indonesian (Arka & Manning 2008).[10] An argument in the a-structure is represented as ARG or simply as "_" within angle brackets. For example, the verbal root *kena* is represented as having a compact lexical entry, as shown in (9).

(9) *kena* V (↑PRED) = 'BE.HIT<ARG_1 , (ARG_2)>'
(goal) (th)

The root *kena* (9)a is a semi-transitive verb (V) carrying an obligatory goal argument (ARG1) and an optional displaced theme argument, also thematically interpreted as an instrument (ARG_2). The verb has a passive-like and goal-oriented meaning, captured by the notation 'BE.HIT'. Assuming the GF(Grammatical Function)-linking principles that are further discussed below in §4.2, the goal (ARG_1) is the most prominent argument in the argument structure, outranking ARG2, and therefore selected as SUBJ. Thus, given the lexical entry of the root *kena* in (9), we can account for data points as in (10) where the NP 'a friend' is linked to SUBJ, and the displaced theme is possibly absent.

(10)	*Seorang*	*sahabat*	***kena***	(*panah*	*mereka*)	*hingga*	*tewas*.
	ART.INDEF	friend	be hit	arrow	3PL.POSS	until	dead

'A friend *got hit* (with their arrow) until (s)he is dead.' (194)

Voice prefixes also carry their own lexical entries; the AV and PASS entries are given in (11)a and (11)b, respectively. These affixes are analysed as carrying their own argument structures, and voice affixation involves predicate composition and argument fusion, following general voice-related linking principles discussed in §4.2. The fusion of the matrix and embedded arguments of the stem's predicate is indicated by the connecting lines. The effect of fusion captures the effect of voice alternation in terms of prominence alternation and SUBJ selection. That is, the AV results in the fusion between the stem's actor (A) ARG_1 and the matrix ARG_1, which is therefore selected as SUBJ. In contrast, PASS fuses the stem's patient ARG_2 with the matrix's passive (P) ARG_1 and is therefore selected as SUBJ.

(11) a. *meN-* PREF (↑PRED) = 'AV<ARG_1, ARG_2, 'STEM_PRED< ARG_1, ARG_2 >'>'
(A) (P)

b. *di-* PREF (↑PRED) = 'PASS< ARG_1, 'STEM_PRED< ARG_1, ARG_2 >' | (_)>'
(P) (A)

[10] There are different versions of prominence-based linking or mapping theory in LFG (Bresnan & Kanerva 1989; Falk 2001; Butt 2014, among others); see Butt (2006) for an overview.

The suffixes *-i/-kan* carry their own predicate argument structures (Arka et al. 2009). The entries in (12) represent the general information of these transitivisers and demonstrate two important points. First, the two suffixes represent matrix predicates of AFFECT and capture the highly salient and conceptual semantic units of transitive events (Jackendoff 1990) in which A affects P resulting in some kind of change as depicted by the meaning of the stem/root.

(12) a. *-i* SUFF ($\uparrow$PRED) = 'AFFECT < ARG_1, ARG_2, 'STEM_PRED<__ , (__)>'>'

(A) (P:goal/loc)

b. *-kan* SUFF ($\uparrow$PRED) = 'AFFECT < ARG_1, ARG_2 'STEM_PRED<__, (__)>'>'

(A) (P)

Second, the entries also show the main distinction between the two transitivisers. The suffix *-i* specifies that the fused patient-like (ARG_2) arguments must be associated to goal/locative roles, thus capturing the locative applicative/causative function of *-i*. The suffix *-kan* has no such thematic restriction, which accounts for its more general function including benefactive/instrumental/theme applicatives as well as general non-locative causatives. There is also some overlap between both suffixes as they involve patient-like argument fusion (Arka et al. 2009). As we shall see in §4.3, there are different fusion options for actor ARG_1 and patient ARG_2 arguments, which give rise to different realisations of arguments for the stem *kena*.

4.2 Markedness and voice selection

In the linking mechanism adopted here, arguments in the (syntacticised) argument structure are ranked in terms of their prominence, as outlined in §4.1 (e.g. actor ARG_1 outranks non-actor ARG_2). In addition, GFs are also ranked (e.g. SUBJ>OBJ>OBL) (Bresnan et al. 2015; Arka 2003). Arguments compete for their SUBJ linking; broadly speaking, the most prominent argument (typically actor ARG_1) is mapped onto SUBJ (see Arka 2003:151-156 for details). This linking is unmarked, in which case the (transitive) verb appears in its bare form. This can be seen in colloquial Indonesian in example (13), where the AV structure occurs without AV (SUBJ-selecting) morphology.

(13) *Untung* *saya* ***bawa*** *tustel*
lucky 1SG bring camera
'Luckily I *bring* a camera' (3774)

(14) a. *Untung* *saya* ***mem-bawa*** *tustel*
lucky 1SG AV-bring camera
'Luckily I *bring* a camera' (3774)

b. SUBJ OBJ

meN- PREF $(\uparrow \text{PRED}) = \text{'AV<ARG}_1, \text{ARG}_2, \text{'BRING< ARG}_1, \text{ARG}_2 \text{>'>'}$

(A) (P)

However, Indonesian exhibits a symmetrical voice system in which both AV and PASS voice selections are equally morphologically marked (§1).[11] This voice symmetricality is straightforwardly captured in our analysis by specifying that both AV and PASS prefixes have their own argument structures, as shown in (11). For example, the boldfaced verbal root in (13) can be morphologically marked for its AV type, as shown in (14)a. The argument structure of the verb *mem-bawa* 'AV-bring' is shown in (14)b. The AV marking results in the same linking as that in (13), in which the A ARG_1 and P ARG_2 are linked to SUBJ and OBJ respectively.

4.3 The dynamics of meaning interaction: **-i** *vs.* **-kan**

We are now ready to account for the preferential usage of voice selection (PASS vs. AV) associated with certain senses of *kena*. We begin by outlining the dynamics of meaning interaction due to the morphological derivation. We demonstrate that our analysis can capture complex cases explicitly. This includes how senses carried by voice and transitivisers potentially interact to construct new senses, which then impose collocational constraints – and hence, meaning constraints – on the derived verbs.

4.3.1 Evaluative meaning of -i *and* -kan

The two transitivisers carry different evaluative meanings, arguably due to the different thematic roles associated with their P argument. As mentioned earlier, the P of the transitiviser *-i* is semantically goal-oriented. The locative/goal P is therefore conceptually the target (i.e. end point) of the impact denoted by the *-i* verb. This property appears to be responsible for the strong negative, evaluative meaning associated with *-i*. Consequently, *-i* is not used to construct the 'wear' sense (that is only expressed by *-kan*; see §4.3.3 below). The negative affectedness sense of *-i* is incompatible with the essential socio-cultural meaning of 'wear', which is typically used in Indonesian for positive, artistic body decoration.

Unlike *-i* (which focuses on the goal/loc affectedness), *-kan* introduces and focuses on the displacement process associated with the <theme> role (cf. Arka et al. 2009; Kroeger 2007). This is clear in the instrumental applicative use of *-kan,* where the instrument role must be understood as an entity undergoing some kind of motion (15):

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[11] For simplicity, we do not discuss Undergoer voice (UV) (Arka 2017: 116–119) in this paper.

(15) *Hamid (...) hendak* ***mem-(p)ukul-kan*** *kayu ke moncong buaya*
NAME intend AV-hit-CAUS.LOC wood to mouth crocodile
'Hamid (…) intends to *smash* the wood to the crocodile's mouth' (10274)

In addition, *-kan* is associated with neutral or positive evaluative meaning. For example, only *-kan* is used in the benefactive structure (i.e. with positive evaluative meaning), as shown by example (16).

(16) *ia pernah mem-bawa-kan saya kaligrafi Arab*
3SG ever AV-bring-APPL 1SG calligraphy Arabic
'He once *brought* me Arabic calligraphy.' (524017)

In short, while having some overlap (discussed in §4.1), the *-i* and *-kan* suffixes have different semantics that are arguably related to the difference in thematic focus (goal/loc vs. displaced theme). The suffix *-i*, not *-kan*, is highly compatible with the negative core sense of *kena* 'be.hit'; cf. Figure 1). Affixing *kena* with *-i* consequently augments the negative affectedness of the root *kena*. The corpus provides evidence in support of this argument given that a high proportion of *-i* verbs are attested in constructions expressing a negative impact (see §3.1). For this reason, we represent *-i* and *-kan* with different superscripts, $\text{AFFECT}^{\text{NEG}}$ and $\text{AFFECT}^{\text{(POS)}}$, respectively.

4.3.2 PASS only/Dominant PASS: 'imposed, subjected to' sense

Recall that an important finding of our study is that AV-PASS voice alternations do not always preserve meaning, and that there is evidence that certain dominant senses of verbs derived from *kena* correlate with particular voice types. We have seen that the negative 'imposed, subjected to' sense of *kenai* is attested only in the passive *dikenai* (Figure 2). This sense is also statistically more significant in PASS than in AV for the stem, *kenakan* (Figure 3). The proposed LFG-based analysis for this phenomenon is informally sketched out below. In addition, the following section discusses the formation of *dikenai* 'be imposed, subjected to'; for this, however, a detailed specification of the verbal root *kena* is in order first.

The lexical entry of *kena* in (9) is repeated in (17) below alongside a complete set of specifications that constrain its combination with *-i/-kan*, which in turn gives rise to certain senses. The entry comes with conditional 'if-then' rules (indicated by ⇒) when *kena* is affixed with *-i* (a), or when it is affixed with *-kan* (b). The entry also shows that the *-i/-kan* affixation results in predicate compositions, in which there are complex inter-related constraints represented by template calls (indicated by @) in the rules.

(17) *kena* V (↑PRED) = 'BE.HIT<ARG_1 , (ARG_2)>'
(goal) (th)
(a) {(↑TR.SUFF_FORM)= I ⇒
@PRED.COMPOSITION_I |
(b) (↑TR.SUFF_FORM)=KAN ⇒
@PRED.COMPOSITION_KAN }.

For ease of exposition - as the constraints apply and interact across different levels in the grammar in an intricate way - we formulate the set of constraints imposed in the predicate composition informally in the prose of (18) and (19) for *-i* and *-kan*, respectively. All of the constraints in (18) and (19) have a strong empirical basis (§3). They consist of a similar/overlapping and distinct set of constraints; the distinct ones are represented in bold: part (i) specifies argument fusion types at the level of argument structure, and part (ii) specifies the semantic nature of nominal types of ARG_2 at the level of semantic structure, both of which appear to constrain voice selections. Each part is further discussed briefly below, with reference to a specific example.

(18) Constraints of PRED.COMPOSITION_I:

i) Argument Fusion Type Constraint:
the goal ARG_1 of *kena* is fused with the **goal/locative** ARG_2 of the matrix PRED *-i* whereas **the displaced theme ARG_2 of *kena* can fuse with the matrix ARG_1**, or fuse with no matrix ARG, and it can constitute ARG_3 in the matrix argument structure of *-i*.

ii) Nominal Type Semantic and Voice/SUBJ-linking Constraints:
(a) If the displaced theme ARG_2 of *kena* is semantically 'abstract', and its goal ARG_1 is understood as **highly negatively affected**, then either ARG_1 or ARG_2 of *kena* is **obligatorily** linked to SUBJ (i.e. the matrix PRED is **obligatory in PASS)**; or else,
(b) if the displaced ARG_2 of *kena* is fused with matrix ARG_1, and it is of the 'concrete' type, it also has to be of **the 'non-wearable' type**, and it is **highly preferred to be linked to SUBJ** with the matrix PRED appearing in AV.

(19) Constraints of PRED.COMPOSITION_KAN:

i) Argument Fusion Type Constraint:
the goal ARG_1 of *kena* is fused with the **patient** ARG_2 of the matrix PRED *-kan* whereas the **displaced theme ARG_2 of *kena* does not fuse with either matrix ARG_1 or ARG_2;** it constitutes ARG_3 in the matrix argument structure of *-kan*.

ii) Nominal Type Semantic and Voice/SUBJ-linking Constraints:
(a) If the displaced theme ARG_2 of *kena* is semantically 'abstract', then its realisation as SUBJ **is highly preferred to its realisation as non-SUBJ** (i.e. **the matrix PRED in PASS is not obligatory**); or else
(b) if ARG_2 is of the 'concrete' type, then it also has to be of **the 'wearable' type**, and it is **not preferred to be linked to SUBJ** as actor/goal ARG_1 is the preferred SUBJ with the matrix verb appearing in AV.

We are ready to discuss the derivation of the synonymous verbs *dikenai/dikenakan* 'be subject to' with their usage properties as attested in the corpus. The relevant example is (4)b, repeated in (20) with annotations of roles and GFs. The argument fusion of *dikenai* with the syntactic-semantic properties of ‘be.imposed’ is given in (21). The subject ‘motor bike’ is ARG1 of *kena* and fused with ARG2 of *-i*, which is then selected as ARG1 by the passive *di-* and gives rise to the ‘be imposed/subject to’ sense. That is, this sense is constructed at the passive *di-* word level, which is an instance of morphological construction (Booij 2010). This word-level meaning construction is informally indicated by the horizontal curly bracket covering the whole morphological unit. The word-level constructed meaning of *dikenai* is semantically motivated by the highly-negative affectedness of the event (cf. line (18)ii.a, captured by AFFECT^{NEG} in (21)). Its construction is further motivated by the related semantic nominal type specific to *-i*, namely the theme ‘tax’ being something abstract/nonwearable. The agent ARG$_1$ of the stem *kenai* (i.e. the first argument in the inner argument structure list) is demoted and suppressed, indicated by a line connecting to ∅ in (21). While suppressed, its associated agentivity semantics (i.e. the event being volitionally imposed) remains.

(20) *motor kedua akan* ***di-kena-i/di-kena-kan*** *pajak sebesar 2 persen.*
motor second FUT PASS-be hit-APPL/-CAUS tax as.large 2 percent
SUBJ:goal OBJ:theme
‘…the second motorbike will be *subject to/charged with* 2% tax.’ (296558)

(21) SUBJ OBJ
di- ‘PASS< ARG$_1$, ‘AFFECT^{NEG} < ARG$_1$, ARG$_2$ ‘BE.HIT< ARG$_1$ ARG$_2$>’>’| ∅ >’
(agent) (goal/loc) (goal) (theme)
‘motor bike’ ‘tax’
‘abstract’

The volitional ‘be.imposed’ sense is morphologically constructed at the level of the PASS formation *dikenai*, as no AV counterpart is possible.

Turning to *kena+kan*, we observe a slightly different pattern giving rise to a case of synonymy with the ‘impose/subject to’ sense as seen in (20). This is because the constraint of *-kan* in (18)ii.a overlaps with that of *-i* (19)ii.a. However, as seen in §3.2, the ‘impose/subject to’ sense for *kenakan* allows AV and PASS. Its occurrences in PASS are significantly more than those in AV. It should be noted that the proportion of PASS involing *kenakan* with this ‘impose/subject to’ meaning is lower than the PASS of *kenai*, suggesting that *-kan*, in contrast to *-i*, is neutral in terms of its affectedness evaluation. In other terms, *-kan* simply foregoes negative affectedness of the root *kena*.

(22) SUBJ OBJ
di- ‘PASS< ARG$_1$, ‘AFFECT < ARG$_1$, ARG$_2$ ‘BE.HIT< ARG$_1$ ARG$_2$>’>’| ∅ >’
(agent) (patient) (goal) (theme)
‘motor bike’ ‘tax’
‘abstract’

The volitional ‘impose/subject to’ sense is morphologically constructed at the level of the stem formation of *kenakan*, as the AV counterpart is possible.

The fact that the AV/PASS alternation is allowed with *kenakan* suggests that this 'impose/subject to' sense is constructed at the level of stem before voice morphology is added. Nevertheless, the stem still carries a prominent affected meaning because its PASS occurrences are more common than the AV counterparts. This empirical point is captured the 'preference' constraint when *kena* is affixed with *-kan,* as formulated in (19)ii.b. We do not attempt to formalise this preference constraint in this paper, but it can perhaps be done by incorporating ideas from Optimality Theory (see Sells 2001, and the references therein). The representation of the predicate composition in *di+kena+kan,* as shown in (22), is just like *di+kena+I,* as shown in (21). The only exception is that its AFFECT predicate is neutral (having no NEG superscript) and the volitional 'impose' meaning is constructed at the level of the the stem, which is denoted by the horizontal curly bracket partially covering the argument structure space.

4.3.3 The 'wear' sense of kenakan

The 'wear' sense is only available for the composition of *kena* with *-kan* and not with *-i*. In addition, this sense is more dominant in AV than in PASS (§3.2). The relevant AV example shown in (1) is repeated here in (23):

(23) *murid* *Go bie-pay* *yang* ***meng-(k)ena-kan*** *baju* *warna* *hitam*.
pupil NAME REL AV-hit-CAUS shirt colour black
SUBJ:agent/goal OBJ:theme
'Go bie-pay's student who *wears/puts on* a black shirt.' (755227)

The derivation and distribution of *kenakan* 'wear' with its preferred AV voice can be accounted for by the predicate composition constraints given in (19)i-ii.b. The AV *mengenakan* in sentence (23) can be analysed as having the predicate composition demonstrated in (24). The following points should be noted. First, the identified displaced theme 'shirt' meets the 'concrete'/'wearable' requirement of the constraint, which triggers the preference for AV selection, as specified in (19)ii.b. The sense of 'concrete'/'physical contact', which is central in the event conception of *kena* 'hit', is also salient; that is, the theme (i.e. shirt) ends up being located in the agent's own body.

(24) SUBJ OBJ
meN- 'AV< ARG_1, ARG_2 'AFFECT^{POS} < ARG_1, ARG_2 'BE.HIT< ARG_1 ARG_2>'>' >'
(agent) (patient) (goal) (theme)
'student' 'shirt'
'concrete'
'wearable'

The 'wear' sense is morphologically constructed at the level of the stem *kenakan* since AV/PASS counterpart is possible.

Second, the argument fusion shows harmonious fusion throughout the derivation processes, with higher arguments of the root and stem, ARG_1 and ARG_2, identified with matrix ARG_1 and ARG_2 respectively. This gives rise to a 'reflexive meaning' effect: the volitional agent (i.e. ARG_1) of *-kan*, which is also ARG_1 of AV, identified with the 'student' in example (23), is also the goal or locational target of the displaced theme 'shirt'.

Third, the 'wear' sense is morphologically constructed at the [*kena+kan*] stem level, indicated by the horizontal curly bracket in (24). It allows AV/PASS alternation, with PASS permitted but not preferred (Figure 3).

4.3.4 The preference constraint, morphological construction and the Pāṇinian 'elsewhere' blocking effect

In this section, we address the issue of constraint interaction that was informally formulated in (18)-(19) and which specifies a 'preference' constraint to account for different kinds of 'blocking': strong and partial/weak blocking. We discuss the strong blocking in AV/PASS alternation, and relate it to the notion of morphological construction (Booij 2010) whereby a particular sense is paired with (or constructed by) a specific morphological pattern.

A clear blocking effect is observed in the case of verbs that display a very strong preference for a particular form-meaning pairing (e.g. *di+kena+i* 'be.imposed'). This has the effect of blocking other logical form-meaning pairing (e.g. to express 'impose' in the AV form). In other words, while the Indonesian morphological derivation rule can produce AV/PASS forms *meng+(k)ena+i/di+kena+i,* the 'impose' sense with *kena+i* is strongly preferred in the PASS alternation, which blocks the AV alternation.

The strong preference constraint can also be understood as part of the broader constraint in rule competition, which is traditionally discussed under the rubric of the 'elsewhere' condition or Pāṇinian Determinism (Arregi & Nevins 2013). Such conditions state that a more specific rule or form-meaning pairing constraint in rule competition has a priority over a more general one within the same paradigmatic domain. The more specific rule therefore blocks the more general one. For example, the form-meaning pairing of {*went*: {GO, PAST}} in English is lexically specific; it blocks the application of the regular English past tense formation with the suffix *-ed*: *{[*go+ed*]: {GO, PAST}}. The non-existence of the form *meng+(k)ena+i* to express the 'impose' sense (in the AV form) can also be accounted for in terms of blocking with reference to specific morphological form-meaning pairing. That is, the form-meaning pairing of {*dikenai*: {IMPOSE, $AFFECT^{NEG}$, ABSTRACT.THEME}} is specific in expressing the 'impose' sense in its negatively affected meaning such that it blocks other forms from expressing the same meaning, including *meng-(k)enai*.

Also, of particular interest in the context of blocking is the fact that only the AV verb *meng(k)enai* (4)a, including its root *kena* (cf. (3) and (10)a), can express the negative 'physical contact/hit' sense; the PASS form *di-kena-i* cannot. Under Pāṇinian Determinism, *dikenai* is generated by a general PASS rule; it is blocked by the more lexically-specific form, *kena*. That is, the root *kena* specifically expresses the same passive-like meaning of negative 'physically be.hit'.

Our study also reveals an instance of blocking that involves a grammaticalisation dimension in the pairing of {[*meng+(k)ena+i*]: 'concern'}. The form-meaning pairing has undergone grammaticalisation into a preposition-like word (Rajeg, Rajeg & Arka 2020a). The absence of the PASS *dikenai* to express 'concern' can be thought of as a blocking effect because the AV form {[*meng+(k)ena+i*]: 'concern'} is morpho-constructionally specific (and fixed) for this form-meaning pairing such that a regular PASS is unable to express the same meaning.

Turning to partial/weak blocking, we revisit the AV/PASS alternation in the stem *kenakan* with the 'impose/subject to' sense. This sense is available for both PASS and AV forms, but it is more predominant in PASS than in AV. We could say that PASS partially blocks AV. Furthermore, it should be noted that 'impose' is also expressed by [*di+kena+i*] and hence, *(di)kenai* also competes with verbs derived from [*kena+kan*] in the same semantic space of 'impose'. These facts highlight the well-known cross-linguistic pattern that there is no one-to-one pairing between form and meaning. Our statistical corpus-based evidence has revealed that the order of preference is *di+kena+i* in first place, followed by *di+kena+kan* and *meng+(k)ena+kan* in the second and third place, respectively. The graded preference of this kind can be thought of as an instance of 'partial' blocking. Issues of blocking in complex webs of form-meaning pairings across different paradigmatic domains appear to involve complex interactions of underlying constraints; this is an understudied area that needs further investigation.

5 Conclusion

The main goal of this paper was to discuss the meaning-preserving hypothesis in voice alternation (cf. §1). Using quantitative corpus linguistic techniques, we argue that the meaning-preserving hypothesis needs to be relativised to (i) the lexical meaning potential of the verbal stem in combination with voice morphologies (see the LFG analyses in §4.3), and (ii) (statistical) usage constraints of the verb's semantics in certain voices (see §3). The basis of this argument is that a given verb can be polysemous where (i) a given sense of the verb can be significantly associated with one voice form than its voice-counterpart (cf. point (a) in §1), and (ii) a certain sense for the same verb can be directly constructed in a certain voice type (point (b) in §1), namely passive, without any evidence for the sense's usage in active (hence, no evidence of voice alternation, let alone the meaning-preserving of that particular sense in a different voice (cf. §3.1 and Footnote 6)). We also demonstrate that such empirical, quantitative findings on voice-meaning association can be captured using the constraint-based formalisms in LFG (i.e., lexical entry specification, predicate composition, argument-fusion and preference constraints for voice selection). Moreover, the statistical preference that we report can also be framed within the classic idea of the *Elsewhere Principle* of blocking effect proposed by Pāṇini (§4.3.4), even though there remain issues of different degrees of (partial) blocking that need further analytical exploration.

Indeed, our conclusion is based on only one verbal root *kena*, with its derivation in different voice prefixes and two applicative/causative suffixes (i.e. -*i* and -*kan*). Be that as it may, our study supports few related works that demonstrate the statistical tendencies of voice-specific, usage-preferences for a given verb(al root) (see, in particular, McDonnell 2016; Gries & Stefanowitsch 2004), as well as the statistical association between certain senses and certain voice morphologies (Rajeg & Rajeg 2019; Rajeg, Rajeg & Arka 2020c; cf. Bernolet & Colleman 2016, for Dative Alternation). Our quantitative approach contributes nuance to the meaning-preserving hypothesis in such a way that real usage preference is captured. This point is essential in usage-based linguistics (Diessel 2017), which (i) considers the importance of frequency in the emergence, representation, and processing of linguistic units, and (ii) views linguistic knowledge as varying along different continuum, such as conventionality and entrenchment. Further study is needed to experimentally assess how strong the statistical tendency reported in this paper is represented in the speakers' mind: do speakers also store in their linguistic repertoire such form-meaning pairing between a given voice form of a (morphologically complex) verb and its predominant meaning? A related corpus-based and experimental study using sentence-production tasks in Indonesian CAUSED MOTION verbs reveals some convergence between participants' usage of the target verbs in certain voices and the corpus findings (Rajeg, Rajeg & Arka 2020c). This indicates that speakers may store statistical patterns of association between morphologically complex verbs and their predominant meanings. Our findings call into question the (implicitly presumed) equal status of PASS and AV alternation for a given verb stem, in terms of the conventionality and usage frequency in conveying certain senses in all voice types. We instead show the asymmetry in the expression of meaning by a given voice form.

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Creating and exploring LFG treebanks

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Abstract

While corpora are increasingly used in grammar studies, LFG treebanks have been underused, despite their high level of detail and solid theoretical grounding. The INESS platform provides access to LFG treebanks for several languages, as well as tools to construct and explore LFG treebanks. We present the main features of treebank building and search in INESS and end with a comparison of search in LFG and Universal Dependencies treebanks.

1 Introduction

Research in linguistics is informed by a variety of data, increasingly in digital form. Corpora annotated at the syntactic level, also called treebanks, have been used in many grammar studies. Treebanks come, however, in different varieties, depending on the grammar formalisms that are the basis for their annotation. LFG treebanks are essentially collections of LFG analyses, which means they have at least c-structures and f-structures for a number of sentences.

In our experience, LFG treebanks are instrumental in grammar development and testing, and they are also very useful for quantitative syntactic studies and applications such as lexicography. There are, however, few studies that exploit LFG treebanks and the computational LFG grammars that these are based on. This is perhaps because most existing LFG treebanks are still limited in size, and because researchers have been familiar neither with LFG treebanks nor with tools to search them efficiently. As a case in point, the introductory textbook on LFG by Börjars et al. (2019) has less than two pages on computational work, including only one sentence on treebank-based work.

The main aim of this paper is therefore to provide some guidance to linguists—especially but not exclusively linguists working with LFG—regarding access to treebanks and their potential for grammar research. We will approach this aim by describing INESS (the Infrastructure for the Exploration of Syntax and Semantics), which is currently the largest treebanking platform with extensive support for LFG treebanks.[1] While various design aspects of this infrastructure have been described in the literature (for an overview, see Rosén et al. 2012), the current paper will focus on the available treebanks and tools, and will demonstrate some of the potential for exploring them.

2 LFG treebanks accessible in INESS

INESS hosts approximately 700 treebanks of different types for more than 90 languages. These include LFG treebanks for English, Georgian, German, Hungarian, Indonesian, Norwegian, Polish, Portuguese, Tamil, Turkish, Urdu and Wolof, among others. Some of these are substantial treebanks, while others are test suites for grammar development.

[1] https://clarino.uib.no/iness; INESS is offered as a service of the CLARINO Bergen Center.

The Treebank Selection page on the INESS website gives an overview of available treebanks in INESS, as shown in Figure 1. Treebanks are grouped according to three criteria: language, collection and type. A collection is a group of treebanks which have something in common. It could be that they were constructed from the same grammar, such as the *POLFIE* collection, a group of treebanks that were parsed with POLFIE, the Polish LFG grammar (Patejuk and Przepiórkowski 2014). Another type of collection is exemplified by *Sofie*, which consists of translations of the first part of the novel *Sophie's World* by Jostein Gaarder; this is a parallel treebank, with the component treebanks pairwise aligned for various languages.

Figure 1: Treebank selection page with LFG treebanks chosen

Treebanks are selected by clicking on languages, collections or types. The screenshot in Figure 1 shows the Treebank Selection page after the user has clicked on *lfg* under *Treebank Types*; this choice results in only the languages and collections with LFG treebanks being displayed in boldface. The numbers in parentheses show how many treebanks there are per language, collection and type. The number before the slash gives the number of chosen treebanks, and the number after the slash, the total number of treebanks. For instance, *English (6/39)* means that of the 39 English treebanks in INESS, six are LFG treebanks and are part of the current selection. There are 118 LFG treebanks for 18 different languages.

The largest LFG treebanks are the Norwegian NorGramBank (Dyvik et al. 2016), the LFG Structure Bank of Polish (Patejuk and Przepiórkowski 2014), and the LFG TIGER treebank for German (Brants et al. 2002). Most of the others are small test suites created for parallel grammar development. As far as we know, all LFG treebanks hosted in INESS are corpora parsed with manually constructed LFG grammars. An example analysis from the TIGER treebank for the sentence in (1) is shown in Figure 2.

(1) *Kambodscha hat Beobachterstatus.*
Cambodia has observer status
'Cambodia has observer status.'

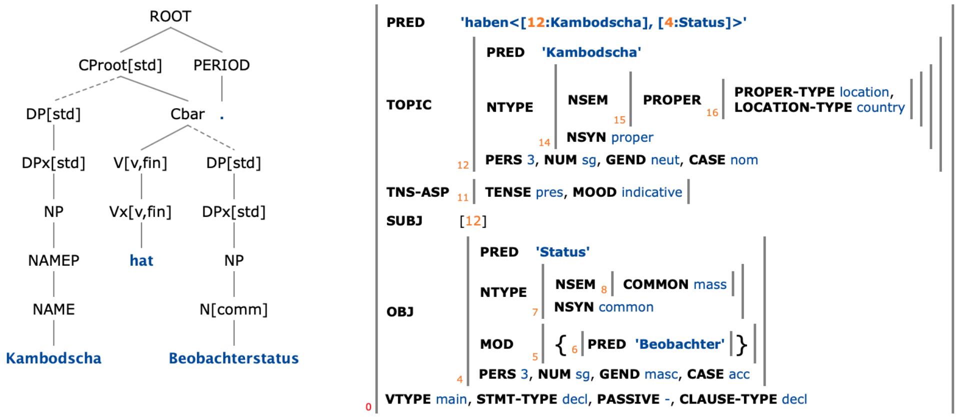

Figure 2: Analysis of the sentence in (1) from the LFG TIGER treebank for German

An example analysis from the Polish treebank for the sentence in (2) is shown in Figure 3. The Polish c-structure follows different principles than the German c-structure—note that the German tree exhibits extensive unary branching—but the buildup of both f-structures is quite similar. The visualizations help us to quickly inspect examples which illustrate similarities and differences in descriptive approaches.[2]

(2) *Ciągle popijali kawę.*
continuously sip.3PL.M1 coffee.ACC
'They were sipping (their) coffee all the time.'

The Parallel Grammar Project (ParGram) has been involved in the development of parallel LFG grammars for more than twenty years (Butt et al. 1999, 2002). The aim has been to build grammars based on common principles, so that, ideally, language-specific characteristics of grammatical structure stand out from quasi-universal ones. The parallelism is mainly on the level of f-structure. Initially the languages involved were English, French and German. Later other languages

[2]For more on visualization in INESS, see Meurer et al. (2020).

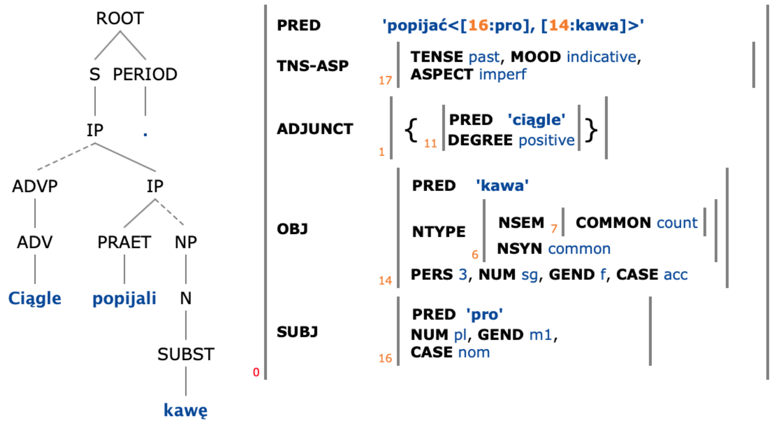

Figure 3: Analysis of the sentence in (2) from the LFG Structure Bank of Polish

joined the project: Georgian, Hungarian, Indonesian, Japanese, Norwegian, Polish, Tamil, Turkish, Urdu and Wolof, among others.

Two sets of parallel test suites in INESS have been developed by ParGram participants: the ParGram collection (Sulger et al. 2013) and the ParTMA collection. These test suites consist of sentences translated from English to the other ParGram languages. The sentences chosen illustrate important linguistic phenomena such as transitivity, voice alternations, interrogatives, copula constructions, etc.

An example of aligned sentences from the ParGram collection is shown in Figure 4, with analyses of the English sentence *Did the farmer sell his tractor?* and its translation into Norwegian *Solgte bonden traktoren sin?* The Norwegian c-structure is displayed to the right of the English c-structure, and the Norwegian f-structure is shown below the English one. The f-structures are displayed in the simplified 'PREDs only' mode, where only attributes related to PREDs are included, in order to make the structures more compact. Both the c-structures and the f-structures are aligned according to the principles developed in the XPAR project (Dyvik et al. 2009), whereby the alignment of c-structures is automatically derived from aligned f-structures. The alignment is done on the level of f-structure. When two f-structures fulfill certain requirements, they may be manually aligned by the user dragging the index of one f-structure onto the corresponding index of another f-structure. The alignment of the f-structures is shown in the indices, where the index of one f-structure points to the index of the other f-structure with an arrow. Once f-structure nodes have been aligned, the corresponding c-structure nodes are automatically aligned by the system, and the c-structure alignment is shown by the green lines between nodes. These alignments are intended to support cross-linguistic studies of grammatical structure.

INESS also offers XLE-Web, which is an online version of XLE (the Xerox Linguistic Environment) for sentence analysis with LFG grammars (Crouch et al. 2011). XLE-Web hosts grammars for the following languages: English, French,

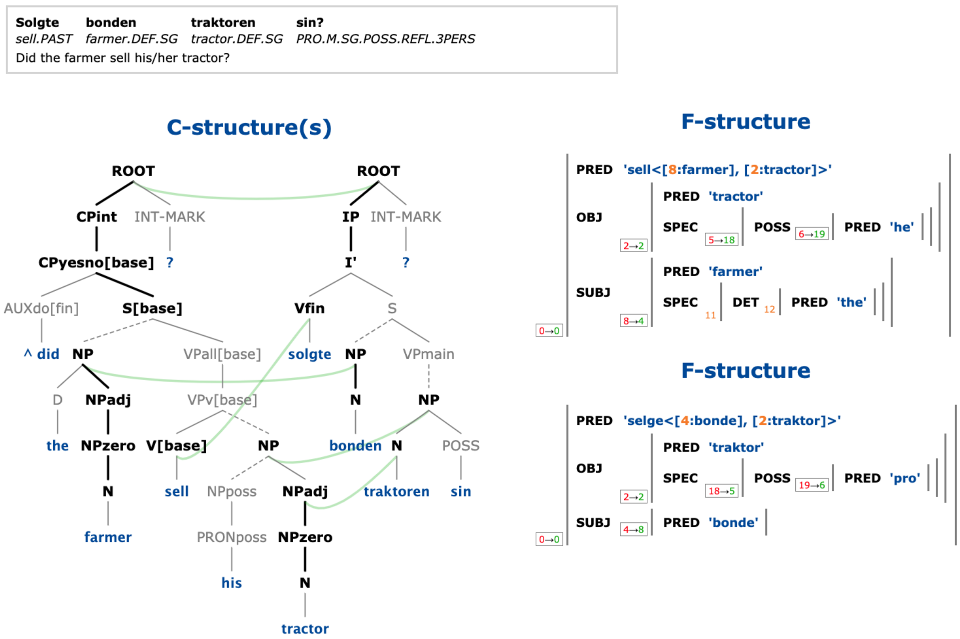

Figure 4: Aligned c- and f-structures for English (left and top) and Norwegian (right and bottom)

German, Georgian, Indonesian, Malagasy, Norwegian, Polish, Tamil, Turkish, Urdu and Wolof. These grammars have been used to create treebanks by parsing corpora and test suites, including the abovementioned ParGram treebanks. XLE-Web offers discriminant disambiguation as described below.

3 Building LFG treebanks

Building an LFG treebank as a parsebank, i.e. by parsing a corpus, is an excellent way of testing the correctness and coverage of a grammar. Assuming a full-coverage grammar and lexicon, as well as perfect disambiguation preferences, parsing a corpus should result in a treebank with correct LFG analyses. In practice, the grammar and lexicon will need to be incrementally revised, and regular reparsing of the corpus should be undertaken in tandem with these revisions. Eventually, stochastic disambiguation can be trained on a gold standard treebank in order to parse and disambiguate a larger corpus fully automatically.

The LFG Parsebanker in INESS is a platform for parsing and disambiguating LFG treebanks (Rosén et al. 2007, 2009). Since sentences tend to receive multiple analyses, sometimes in the thousands, manual disambiguation is supported by the automatic identification of discriminants, which are minimal differences between analyses. Annotators disambiguate manually with discriminants, and the intended analysis is saved in the treebank. If the intended analysis is not present, this may be corrected by making changes to the lexicon and/or the grammar. The corpus can then be reparsed and earlier disambiguation choices can be automatically reused.

Such a method has been followed in the construction of several treebanks, including the largest one, NorGramBank (Dyvik et al. 2016), which was constructed by means of the XLE-based LFG Parsebanker (Rosén et al. 2009) with discriminant disambiguation in INESS. The LFG Structure Bank of Polish (Patejuk and Przepiórkowski 2014) has also been developed using INESS, while the LFG TIGER Treebank (Brants et al. 2002) was constructed through similar parsebanking with XLE and disambiguation, but in a different environment.

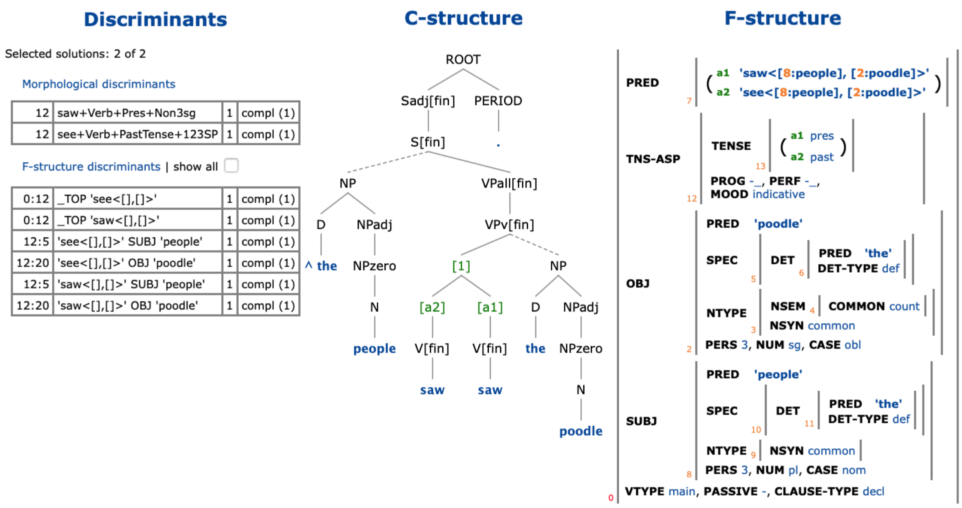

Figure 5: Discriminants for the sentence *The people saw the poodle.*

An illustration of discriminant disambiguation is provided in Figure 5 for the sentence *The people saw the poodle.* This sentence has been parsed on XLE-Web with the English grammar. It gets two analyses, or solutions, meaning either 'The people observed the poodle' or 'The people cut the poodle with a saw'. Note that both the c-structure and the f-structure are packed, which means that they include all alternative c- and f-structure analyses, with choice points indicated (King et al. 2004, Meurer et al. 2020, pp. 63–65). On the left there is a table of discriminants before disambiguation. Discriminants are properties of analyses computed from the different solutions. They make it possible for the user to choose a property that the analysis should have, or reject a property that it shouldn't have. Eight different discriminants are displayed for this sentence, all of which are related to the choice between the verbs *saw* and *see*. In this case disambiguation can be achieved by choosing either a morphological discriminant or an f-structure discriminant. Clicking on any of the discriminants which mention the predicate 'see' will result in complete disambiguation and display of the correct c- and f-structures, as shown in Figure 6.

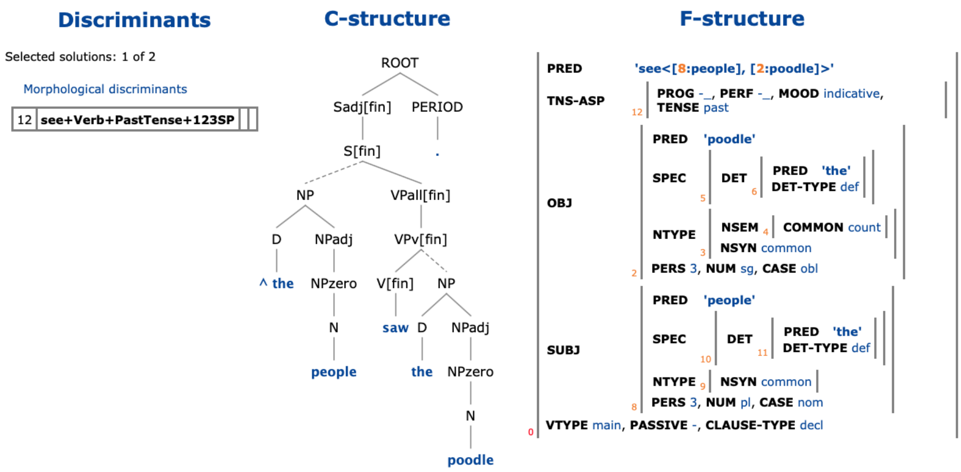

Figure 6: Completed disambiguation for the sentence *The people saw the poodle*.

4 Searching LFG treebanks

Some phenomena are difficult to search for in corpora that lack detailed syntactic annotation, for instance, inversion, passives, clefts, and dependent clauses without complementizers. Such phenomena should be more easily retrievable from treebanks, but that presupposes a powerful and insightful search facility.

INESS Search (Meurer 2012) is a reimplemented, expanded and syntactically simplified online version of TIGERSearch (Lezius 2002). It allows search in different formalisms, including LFG c- and f-structures and their interrelations. INESS Search supports existential and universal quantification as well as negation (with some restrictions concerning universal quantification over disjunctions). This means that it is possible to search for all sentences for which something is the case, and something else at the same time is not the case—for instance, noun phrases where the head noun is not elided (i.e. a noun phrase whose PRED is not 'pro') or dependent clauses without complementizers.

INESS offers two modes for the display and further exploration of search results. In sentence overview mode, a list of sentences that match the query can be displayed and the user can click on sentences to display their structures. In tabular mode, a table is displayed where values of selected query parameters are aggregated with their frequencies, so that quantitative studies are facilitated.

Formulating search expressions obviously requires some knowledge of the annotation in the treebank.[3] XLE-Web can be useful in this respect; you can type in a sentence with the phenomenon you are interested in, and study the analysis showing the structural characteristics of the phenomenon. These structural charac-

[3]For NorGramBank, the documentation (in Norwegian) can be consulted on the INESS website.

teristics can then be specified in a query expression for searching treebanks which were created with the same grammar.

Two examples from NorGramBank will serve to illustrate how easily some structural characteristics may be found in a treebank. In the ParGram grammars, clefts receive the feature VCONSTR with the value *cleft*, so searching for this feature will identify all cleft sentences in the treebank. The search expression in (3) may be read 'There is an f-structure $\#x$ that has an attribute VCONSTR with the value $\#y$ = *cleft*.' One of the matches is the cleft sentence in (4), and its analysis is given in Figure 7. When we specify values with variables such as $\#x$ and $\#y$ in the search expression, these are marked in red in the results.

(3) `#x >VCONSTR #y:'cleft'`

(4) *Det var bussen som kom.*
it was the bus that came
'It was the bus that came.'

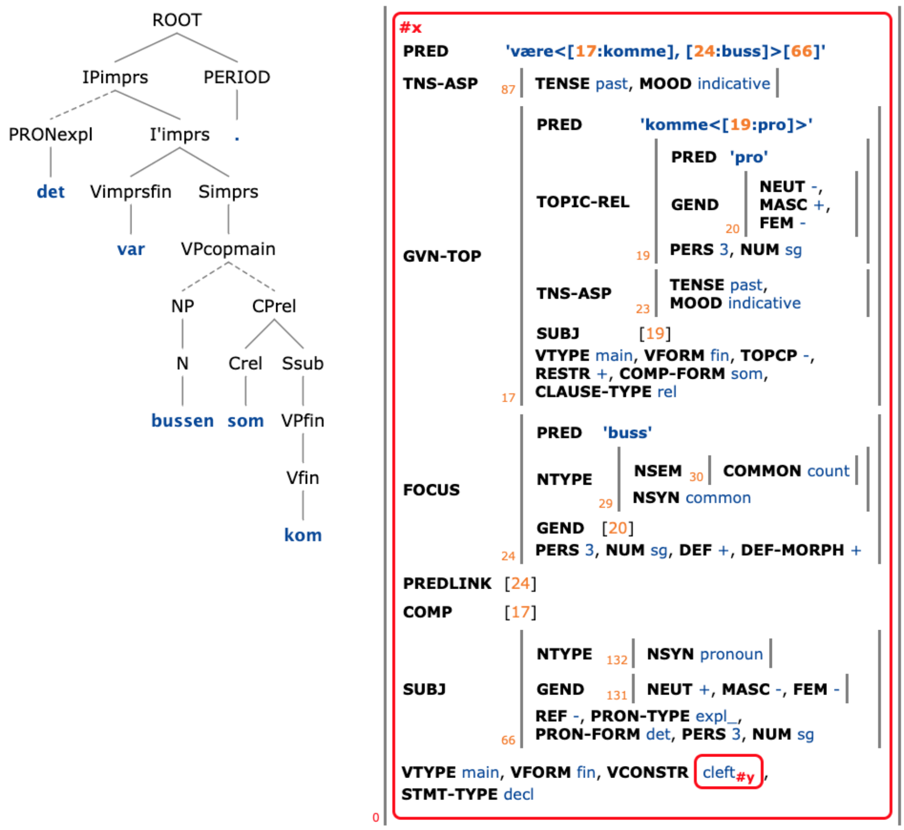

Figure 7: C- and f-structures for the sentence in (4)

A second example involves searching for *that*-clauses without complementizers, for which (5) shows a suitable query. This expression searches for an f-structure $\#x$ which has the attribute CLAUSE-TYPE with the value *nominal*, and which, crucially, does not have an attribute COMP-FORM. For this, we need the negation operator, which is the exclamation point. One of the matches is the sentence in (6); its analysis is shown in Figure 8.

(5) `#x >CLAUSE-TYPE 'nominal' & !(#x >COMP-FORM)`

(6) *Jeg trur han fleipa.*
I think he kidded
'I think he was kidding.'

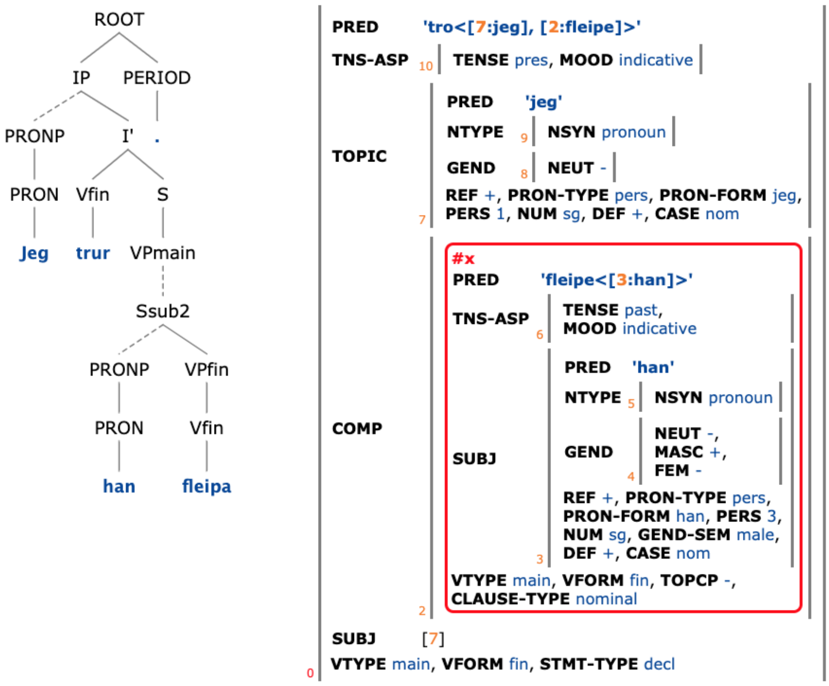

Figure 8: C- and f-structures for the sentence in (6)

Not all query expressions are so simple, however; some can be quite complex. Suppose that we want to find all the different argument frames of a given verb, e.g. Norwegian *overlate* 'leave something to someone', and list them with the lexical categories that fill each argument position. The expression in (7) will accomplish this search. Note that ARG1, ARG2, etc. are not explicit attributes in an f-structure. INESS Search introduces them as a way to refer to the elements in the argument list of the PRED value. The reason (7) is quite complex is that many disjunctions are necessary in order to find all the possible argument frames.

(7)
```
#f_ >PRED #a:'overlate' & #f_ >VFORM &
(   (#f_ >(ARG1 NTYPE NSYN) #arg1
    | #f_ >(ARG1 VFORM) #arg1) &
    !(#f_ >ARG2)
|   (#f_ >(ARG1 NTYPE NSYN) #arg1
    | #f_ >(ARG1 VFORM) #arg1
    | !(#f_ >ARG1)) &
    (#f_ >(ARG2 NTYPE NSYN) #arg2
    | #f_ >(ARG2 VFORM) #arg2) &
    !(#f_ >ARG3)
|   (#f_ >(ARG1 NTYPE NSYN) #arg1
    | #f_ >(ARG1 VFORM) #arg1
    | !(#f_ >ARG1)) &
    (#f_ >(ARG2 NTYPE NSYN) #arg2
    | #f_ >(ARG2 VFORM) #arg2) &
    (#f_ >(ARG3 NTYPE NSYN) #arg3
    | #f_ >(ARG3 VFORM) #arg3) )
```

The richness of the syntactic annotation may lead to query expressions of forbidding complexity for many users. A recent development to overcome this problem consists in templates which can be filled in online.[4] A query template is a parameterized query expression in which some values (e.g. word or lemma forms, predicates, or feature values) are represented by placeholders. It typically represents a technically complex query, and is accompanied by a description of its function and possible parameter values. Upon choosing a template from a menu, the user simply supplies values for the parameters and activates the search.

An example of a template is `V-argframes(@V)`, shown in the template search interface in Figure 9. This template does the same work as the search expression in (7), but the verb is parameterized so that the template can easily be used to explore the frames of different verbs. After filling in the desired value for the `@V` parameter, i.e. one or more verbs, the user may click on *Run query*.

This search in NorGramBank resulted in a table with 58 frames; the top of the table is displayed in Figure 10. This figure also shows what happens when a particular frame is selected for further inspection. The user has clicked on the sixth line (#arg1: *common*, #arg2: *pronoun*, #arg3: *inf*) to display the examples for that frame, the first of which is the sentence in (8). Search results like these are particularly useful for lexicographers, and, in fact, they are currently being used in the construction and further development of dictionaries for Norwegian.

(8)

Mor	*overlater*	*til*	*meg*	*å*	*lage*	*kveldsmat.*
mother	leaves	to	me	to	make	supper

‘Mother leaves it to me to make supper.’

Templates may have more than one parameter. The template for searching for filler–gap constructions, for instance, requires the user to supply the function of the

[4] https://folk.uib.no/hfohd/INESS-Sketch-veiledning-2020.pdf

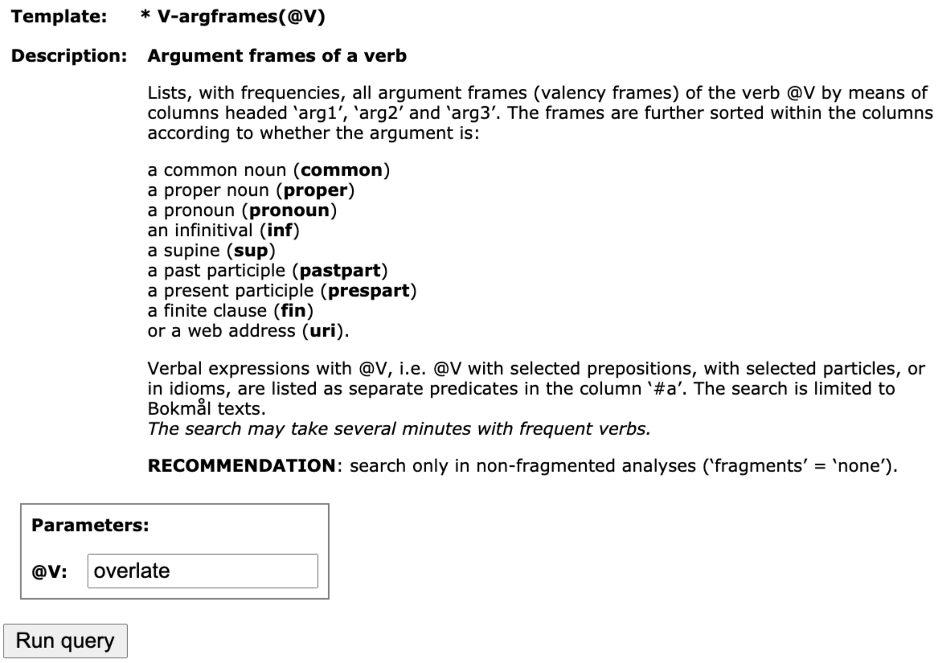

Figure 9: The template `V-argframes(@V)` with a value for the parameter `@V` filled in by the user

Figure 10: Result of clicking on the sixth row in the list of search results for frames of the verb *overlate*

filler, the path of functions between filler and gap, and the function of the gap. Possible parameter settings are illustrated in Figure 11, where (XCOMP)+ means one or more XCOMPs. This query results in 542 matches in NorGramBank, including the sentence in (9).

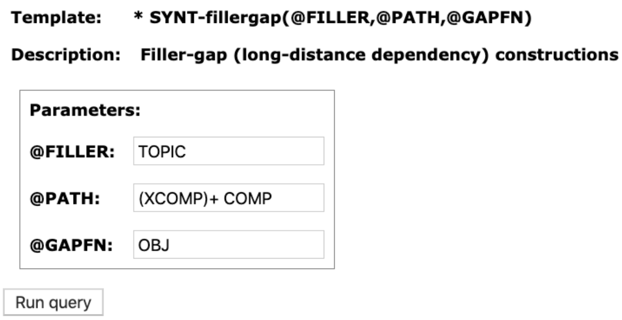

Figure 11: Template for filler–gap constructions with parameter values filled in

(9) *Det vil jeg også tro at de fleste i denne salen faktisk synes.*
that will I also believe that the most in this hall actually think
'That I also believe most people in this room actually think.'

5 Comparison with dependency treebanks

An important development in recent years has been a broad international effort to build treebanks in the Universal Dependency (UD) framework. So far this effort has resulted in more than 150 treebanks for 90 languages, and the list is growing fast (Nivre et al. 2020). Dependency treebanks do not encode phrase structure, but dependencies between words. Given the popularity of UD treebanks, one may wonder if there is a need for LFG treebanks. In this section, we will suggest an answer by comparing how certain phenomena are analyzed, something which directly reflects on their searchability. The texts in the Norwegian UD treebank (Øvrelid and Hohle 2016) are also included in NorGramBank (with about 90% of the sentences analyzed), so that we can make a direct comparison of analyses in both treebanks. We start by comparing the LFG and UD analyses of the Norwegian sentence in (10).

(10) *Familien satt rundt middagsbordet.*
the family sat around the dinner table
'The family was sitting around the dinner table.'

Figure 12 presents the LFG analysis of (10) with fairly detailed c- and f-structure information. The c-structure shows the hierarchical configuration of a rich inventory of syntactic categories, while the corresponding f-structure displays predicate–argument structures, syntactic functions and grammatical features in an attribute–value format which is in some ways comparable to a dependency structure. In the screenshot in Figure 12 an aspect of the projection from c-structure to f-structure has been visualized by mousing over the NP dominating *Familien*. This results in the substructure with index 17 being highlighted, and shows that the NP corresponds to both the TOPIC and the SUBJ in the f-structure.

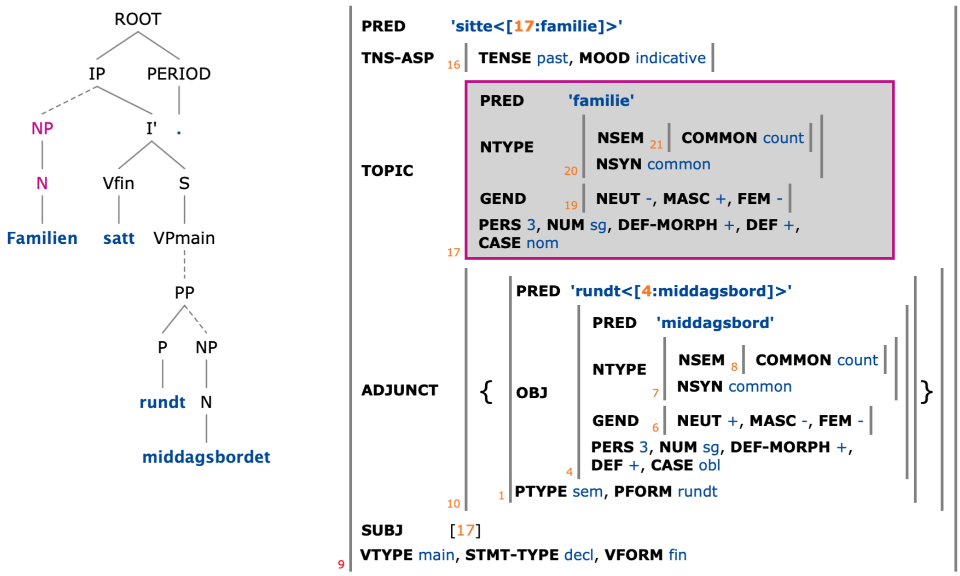

Figure 12: LFG analysis of the sentence in (10)

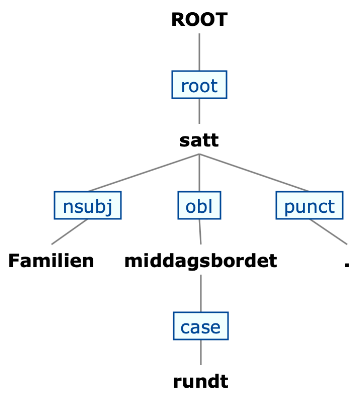

Figure 13: Tree view of the UD analysis of the sentence in (10)

Figure 13 shows the UD representation of the same sentence. The dependencies go from the bottom of one node to the top of another node, with a label on the edge. For instance, there is a dependency from the node *satt* to the node *Familien*, with the label nsubj for subject. This view does not preserve word order, but there is also an alternative linear view of the same analysis, shown in Figure 14, in which the word order is retained, and the dependencies are shown by labeled arrows.

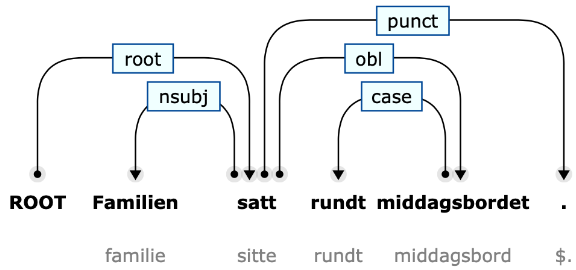

Figure 14: Linear view of the UD analysis of the sentence in (10)

In more complex examples, there can be many arrows entering and leaving nodes. Color coding makes it easier to distinguish arrows at selected nodes. Figure 15 shows the result of mousing over the word *satt*; outgoing dependencies from the selected node are then shown in blue, while incoming dependencies are shown in red. Figure 16 shows the result of mousing over and clicking on the word *Familien*. The lemma, part of speech and morphological features are then displayed.

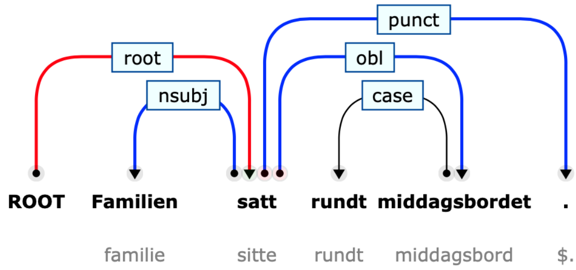

Figure 15: Linear view of the sentence in (10) with highlighting of incoming and outgoing dependencies at the word *satt*

The deeper analysis in an LFG treebank improves the search possibilities as compared to the shallower analysis in a dependency treebank. As an illustration we can look at ways to search for all examples of the first argument of a particular verb. In LFG treebanks the first argument of a verb can be searched for directly, but since there is no direct annotation of the first argument of a verb in UD treebanks, we will need to search for their possible syntactic realizations, as described below.

Assume that we want to find the first argument of the Norwegian verb *dominere* 'to dominate'. In other words, who or what tends to dominate? For NorGramBank the search expression in (11) will basically do the trick.

(11) `#f_ >PRED #x:'dominere' & #f_ >(ARG1 PRED) #p`

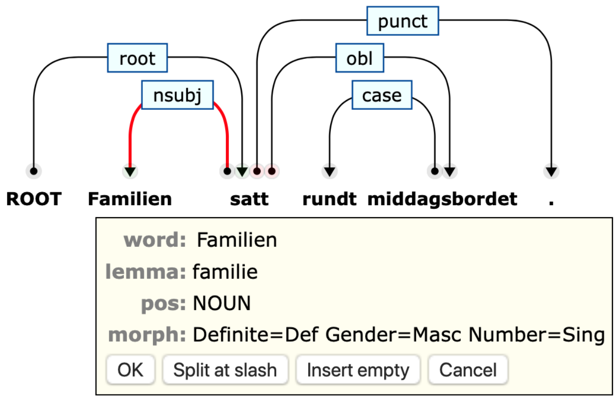

Figure 16: Display of morphological information for *Familien* in sentence (10)

This expression finds each f-structure $\#f\_$ that has a PRED 'dominere' and whose ARG1 has the PRED $\#p$. The search output will list all values of $\#p$, i.e. the ARG1 predicates. In (12) the expression $(\$)*$ has been added to allow ARG1 to be expressed by a coordinated phrase; thus the PRED of each conjunct is retrieved.[5]

(12) `#f_ >PRED #x:'dominere' & #f_ >(ARG1 ($)* PRED) #p`

An example match for the search expression in (12) is the sentence in (13); the PREDs-only version of its f-structure is given in Figure 17. The first position in the argument list of 'dominere' has the index 92, pointing to the value of OBL-AG, which is thus identified as ARG1. The highlighting matches the variables in the search expression. Since the sentence has a coordinated phrase as ARG1, each PRED value is found and highlighted, and listed in the search output.[6]

(13) *Vegetasjonen domineres av småvokste urter, lav og moser.*
the vegetation is dominated by stunted herbs lichen and mosses
'The vegetation is dominated by stunted herbs, lichen and mosses.'

In contrast, the Norwegian UD treebank does not annotate predicate–argument structures, so it is not obvious how to search for the first argument of the verb *dominere* in this treebank. When a property is not annotated in a treebank, the only way to search for it is by specifying all the ways in which the property may be realized in the texts, which will frequently be an insurmountable task for a user. The first argument of a verb can, for instance, be the subject of an active verb, the

[5] $ encodes the set membership operator $\in$, while the Kleene star allows zero or more occurrences of it in order to search within possibly nested sets of f-structures; this is relevant for searches within binary branching coordinations.

[6] In the full NorGramBank (about 160 mill. words, accessed December 15, 2020) there are 5137 matches for the LFG query, with 1818 different ARG1 predicates.

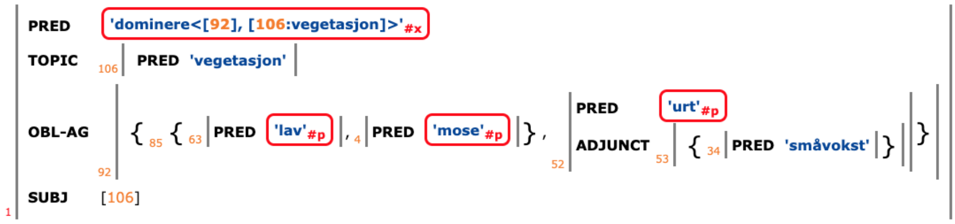

Figure 17: Simplified f-structure for (13), as displayed in results of query (12)

oblique agent of a passive verb, the head of an attributive present participle, or the subject of a predicative present participle. To search for these various possibilities, we need to know how they are annotated. Examining the UD analyses of the sentences found in NorGramBank by the search expression in (12), as well as the documentation,[7] shows that at least the following annotations are possible:

- subjects are coded as *nsubj*;
- agents are coded as *obl*, *obl:agent*, and sometimes *advmod*;
- heads and subjects of participles are coded as taking the participle as an *amod* or an *xcomp*.

An example is the UD treebank analysis of the sentence in (13), given in Figure 18. In this example the first of the coordinated agents, *urter*, is coded as *obl*, while the following agents can be found via *conj* arcs.

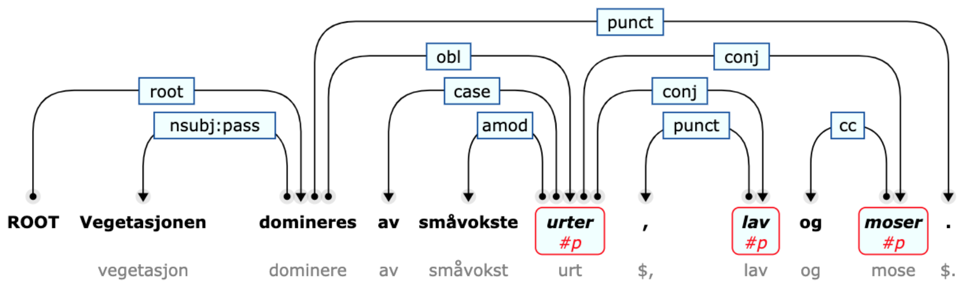

Figure 18: The UD treebank analysis for (13), as displayed in results of query (14)

It is complicated to construct a search expression that captures all possible cases for UD, but a reasonable approximation in INESS Search is provided in (14). The expression tries to restrict search to the relevant contexts for the specified features. For instance, *advmod* and *obl* are not only found with passive agents in the treebank. Lines 6–12 in (14) attempt to restrict their occurrence to analyses

[7]https://universaldependencies.org/guidelines.html

where they do represent passive agent phrases. Also, *amod* and *xcomp* do not only occur with present participles (ending in *-ende/-ande*). Lines 13 and 14 in (14) are meant to restrict the occurrence of these labels to forms that are present participles.

(14)
```
#x_:/dominere(nde)?/ &
( #x_:[morph=".*(Fin|Inf|Degree).*"] >(nsubj (conj)*) #p
| #x_:[morph=".*Part.*"] >(nsubj (conj)*) #p &
      #x_ >aux /ha/
| #x_ >((obl | advmod) (conj)*) #p:[lemma] &
      (#p >case "av"
      | #q_ >case "av" & #q_ >conj #p) &
      (#x_:[morph=".*Pass.*"]
      | #x_:[morph=".*Part.*"] &
         (#x_ >aux:pass
         | #x_ >aux #r_:/være|vere/
         | !(#x_ >aux)))
| #p >amod #x_:".*ende|.*ande"
| #y_ >nsubj #p & #y_ >xcomp #x_:".*ende|.*ande")
```

Querying the UD treebank with (14) finds 19 sentences out of the 20 found by (12) in the LFG analyses of the same texts, with the first arguments identified. The sentence which was not found has *dominere* as a noncontrolled infinitive (a COMP, not an XCOMP, in LFG terms). Such infinitives get no subject in the UD treebank, while LFG assigns 'pro' as a subject, and hence as ARG1.

There is, of course, no guarantee that all constructions expressing first arguments of the chosen verb are covered by a search expression like (14) based on a selection of examples from the UD treebank. Some first-argument cases may be irretrievable in UD, or alternatively, retrievable only with noise. Writing the expression (14) for UD presupposes detailed knowledge about the different ways in which the first-argument relation is realized in the UD treebank, whereas (12) for LFG simply mentions ARG1.

6 Conclusion

LFG treebanks constructed as parsebanks are collections of LFG analyses; they show the effects of choices of grammatical analysis when applied to a corpus of authentic sentences or constructed examples. A substantial LFG parsebank can serve as an empirical testing ground in LFG grammar and lexicon development (e.g. Losnegaard et al. 2012, Rosén et al. 2016b) and for a variety of corpus studies (e.g. Rosén and Borthen 2017). LFG treebanks can contribute to a basis for cross-linguistic and cross-theoretic studies of multiword expressions and constructions, both with respect to the distribution of types and the treatment of such constructions across languages and formalisms (Rosén et al. 2016a). LFG treebanks can also be used for grammar induction or treebank conversion (e.g. Meurer 2017). With appropriate search tools, they can provide frequencies and examples of constructions for applications such as lexicography, as mentioned in Section 4.

Although LFG treebanks have so far not been widely exploited, we believe they nevertheless have great potential due to the high level of detail and theoretical grounding that LFG analyses offer as compared to, for instance, those in Universal Dependency treebanks. It would therefore be worthwhile to develop more and larger LFG treebanks for many languages and to promote their use in the LFG and other communities.

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Qualitative comparison in Warlpiri: semantic case, adposition and/or derivational affix?

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Abstract

The Central Australian Pama-Nyungan language Warlpiri has a suffix *–piya* expressing resemblance. Morphologically, it is a semantic case, and not a derivational affix. Semantically it is a two-place predicate. Syntactically, it acts in a similar way to adpositions. As the main predicate of a clause it is subcategorised for SUBJECT and OBJECT. As the predicate of an ADJUNCT it is subcategorised for an OBJECT (at least) and bears a case feature which allows the ADJUNCT to consist of more than one element through agreement. *–piya* takes additional case marking ('case stacking') to indicate which argument or adjunct it is predicated of. In main clause and ADJUNCT use it is prototypically used to compare entities, but it can be used to compare events through pragmatic inference. Rarely, it attaches to verbs (nominalised or finite), and compares events directly. In this latter use it is a discourse particle with no syntactic arguments. Its LFG lexical entry allows a simple representation of the relation between its different functions.

1 Introduction

The Central Australian Pama-Nyungan language Warlpiri has a suffix *–piya* whose meaning covers 'similarity' (1)[1] and 'simulation' (2) (Treis 2018). It attaches to the elements acting as the standard of comparison.

(1)

Jarrurlujarrurlu	ka=rnalu	ngarri-rni	<u>jurlpu</u>
parrot.sp	PRES[2]=we	call-NPST	bird
lapaji-piya	– purturlu	wajirrki-wajirrki.	
parrot.sp-LIKE	back	green	

'Jarrurlujarrurlu is what we call **a bird** which is like <u>the Port Lincoln parrot</u>. Its back is green.' [jarrurlujarrurlu]

(2)

Yiki-nyina-mi	ka=<u>rla</u>	**kurdu**	**wita-piya-ku**.
try.to.warn-NPST	PRES=DAT	child	little-LIKE-DAT

'She tries to dissuade <u>him</u> **as though he's a little child**. [yiki-nyina]

---

[1] Examples are sourced from the Warlpiri Dictionary (Laughren et al, in press) and referred to by the lemma in which they appear, or else from Kenneth Hale's recordings (Hale 1966-67). Warlpiri gloss abbreviations: ASSOC Associative, DAT Dative, E.G. For example, ERG Ergative, FOC Focus, LOC Locative, NOM Nominalising, NPST Nonpast, POSS Possessive, PRES Present, TOP Topic.

In (1) the *–piya*-marked nominal in boldface is used to assert the similarity between the entity denoted by the underlined form (*jurlpu* 'bird') and the entity denoted by the bold-faced form (*lapaji* 'Port Lincoln parrot'). In (2) the clause compares the manner of the action denoted by the verb with the manner of an imagined action on a different type of person (*kurdu wita* 'little child'). Formally the comparee is expressed as the Dative object of the verb (underlined)[3] and the standard of comparison is an expression marked with the ending *–piya* and Dative case (bold-faced).

The goal of this paper is to argue that the ending *–piya* has the following properties:
(i) it expresses semantically a two argument predicate, one argument of which is the comparee, and the other of which is the standard of comparison.
(ii) it can be pragmatically interpreted as comparing some aspect of an event with another event.
(iii) morphologically, the ending *–piya* behaves like a semantic case in Warlpiri, but not like a derivational affix.
(iv) it carries a case feature *PIYA* which allows construal of several nominals as part of the same expression.
(v) syntactically, the ending *–piya* can act as the main predicate of a clause, or as the predicate of an ADJUNCT, or, rarely, as a discourse particle
(vi) it receives additional case marking in agreement with the case of the nominal expression representing the comparee.

2 General properties of *–piya*

Warlpiri has a system of case-marking which is used both to indicate grammatical functions and to indicate what nominals are construed with each other (through agreement) (Hale 1982, Nash 1986, Simpson 1991). Unmarked nominals are interpreted as main predicates or as having Absolutive case[4]. Cases are usually divided into grammatical cases such as Ergative which primarily mark arguments of verbs, and semantic cases such as Allative which play much the same role as adpositions (Simpson, in press).

The form *–piya* has much in common with semantic cases, and is sometimes glossed as the Semblative case. It can attach to nominals, nominalised verbs and, marginally, to finite verbs. In terms of grammatical function, the

[3] The form *rla* is polysemous: *=rla* is a third person Dative clitic on the auxiliary, *-rla* is a Locative semantic case suffix on nominals, and a same subject complementiser on nominalised clauses.

[4] A nominal acting as a predicate agrees in case with its subject. In main clauses, both the subject and the nominal predicate acting as the main predicate are unmarked for case, which can be interpreted as Absolutive case.

nominal marked with *–piya* can act as the main predicate of a clause (1), as an adjunct (2), or, as I will show later, a discourse particle.

Warlpiri freely allows nominals to act as main clause predicates or as adjuncts (Simpson 1991). So it might be argued that *–piya* marked nominals are behaving just like regular nominals, and that *–piya* is a derivational affix comparable to English *dog-like, childlike*. However, while the Warlpiri Dictionary (Laughren et al in press) contains many examples of derived words as sub-entries, it contains no clear examples of lexicalised *–piya* forms[5]. A second argument against treating *–piya* as a derivational affix comes from its attachment to anaphors. (3) and (4) illustrate *–piya* attaching to pronouns, performing a similar function to the preposition *like* in English. This indicates that morphologically *–piya* is not a derivational affix.

(3)	Kardirri=nya	ka	nyina	wiringarri=ji.	Kakutu=ju
	white=FOC	PRES	sit.NPST	barn.owl=TOP	boobook.owl=TOP
	nyanungu-piya=juku=jala,				
	he-LIKE=STILL=ACTUALLY				

‘*The Barn owl is white. The Boobook owl is **just like him** …*’ [kakutu]

(4)	Yangka old man-rli		**ngaju-piya-rlu**	kala	para-ja
	the	old.man-ERG	me-LIKE-ERG	USED.TO	follow-PAST

‘*That old man **like me** followed it.*’ [Hale Tape 2.19 1966]

I suggest that in these examples *–piya* acts similarly to an adposition, taking as one argument the comparee and as the other argument the standard of comparison (Treis 2018). *–piya* is comparable to English ‘like’ in *John is like his mother*. It does not seem to be a nominal, since it cannot occur on its own without a preceding nominal, nominalised verb or finite verb.

In languages like English it has been argued in LFG that one argument of an adposition is realised as a complement, but the other argument is not expressed directly as, say, a subject in main clauses, because there is a mediating copula, and the English PP bears the function PREDLINK:

> (↑PRED) = ‘*be*’ <(↑SUBJ) (↑PREDLINK)>
> where PREDLINK could be a Nominal Phrase, an Adjective Phrase or a Prepositional Phrase (Butt et al 1999) .

[5] I found just two examples: *jalya-kurlu-piya* ‘like healthy’ = used as a predicate to say that someone is not to be messed with, and *ngukunypa ngapa-piya* ‘brains like water’ = ‘careless’.

Warlpiri does have copula uses of stance verbs, as in the first clause in (3), where *nyina* 'sit' acts like a copula, and copula verbs can appear with *–piya* marked nominals as in (5). But copulas are not essential, as in the second clause in (3). Therefore, when the semantically two-place predicate *–piya* is the main predicate it must take both subject and a complement. I will call this complement OBJECT, as is not uncommon in LFG representations of adpositional objects. Its lexical entry can be represented initially as follows

(↑PRED) = '*–piya* <(↑SUBJ), (↑OBJ)>'

Thus, in (3) the *–piya*-marked nominal *nyanungu-piya=juku=jala* 'he-LIKE=STILL=ACTUALLY' contains both the main predicate, *–piya*, and the complement of that predicate, the nominal *nyanungu*.

A possible f-structure follows for the second clause in (3) *Kakutu=ju nyanungu-piya=juku=jala,* 'The Boobook owl is just like him'. I have not included the discourse clitics *=ju*, *=juku* and *=jala*. Note that clauses not headed by finite verbs are tenseless.

F-structure 1 Example (3)

$$\left[\begin{array}{lll}
\text{PRED} & \text{'PIYA <SUBJ, OBJ>'} & \\
 & & \\
\text{SUBJ} & \text{PRED} & \text{'KAKUTU'} \\
 & \text{PERS} & 3 \\
 & \text{CASE} & \text{ABS} \\
 & & \\
\text{OBJ} & \text{PRED} & \text{'PRO'} \\
 & \text{PERS} & 3 \\
 & \text{CASE} & \text{PIYA}
\end{array}\right]$$

The OBJECT *nyanungu* is a type of pronoun. The assignation of a case feature to the OBJECT is required because more than one word ending in *–piya* can act jointly as the nominal predicate. Agreement is discussed in section 4.

3 *–piya* as predicate of an adjunct

We have seen that *–piya* can act like an adposition and be the main predicate of a clause. It can also act as the predicate of an ADJUNCT, as in (4), where the nominal phrase marked with *–piya* occurs inside a nominal phrase preceding the auxiliary marker *kala* 'USED.TO'. Both elements of the nominal phrase are also marked with Ergative case, indicating the function of the nominal phrase as SUBJECT.

(5) provides another example of a *–piya*-marked nominal being predicated of the SUBJECT. In (5) the SUBJECT *yartarali* 'Achilles tendon' is unmarked for case, and is interpreted as Absolutive (*=ji* is a topic marker that is not part of the case-marking system). Both elements of the phrase *pulyku wiri-piya* 'like a big sinew' are unmarked for case, and can be interpreted as Absolutive. The lack of overt case marking on both *pulyku wiri-piya* and *yartarali* allows *pulyku wiri-piya* to be construed as an ADJUNCT modifying *yartarali*.

(5) Luku-ngka ka karri **pulyku wiri-piya** –
heel-LOC PRES stand.NPST sinew big-LIKE
yartarali=ji
Achilles.tendon=TOP
'*In the heel is [something]* ***like a big sinew*** *– the Achilles tendon*.'
[yartarali]

The translation 'something' indicates that the *–piya* word is best interpreted as modifying an understood element. This is quite common.

When the *–piya* marked word is not part of the same nominal phrase as what it modifies, additional case-marking indicates what it is construed with (unless, as in (5) both are unmarked i.e. have Absolutive case). In (2), repeated here as (6), the Dative OBJECT is expressed as a pronominal clitic *=rla*. This Dative OBJECT is modified by the phrase *kurdu wita-piya-ku* 'as though he's a little child' which acts as an ADJUNCT[6]. The PRED of this ADJUNCT is *–piya*, (like an adposition). The complement of *–piya* is *kurdu wita*. The whole phrase *kurdu wita-piya-ku* has Dative case indicating that the ADJUNCT modifies something with Dative case.

(6=2) Yiki-nyina-mi ka=rla **kurdu wita-piya-ku**.
try.to.warn-NPST PRES=DAT child little-LIKE-DAT
'She tries to dissuade him **as though he's a little child**. [yiki-nyina]

We have now seen the *–piya*-marked word acting as ADJUNCT to SUBJECTs, whether Absolutive (3) or Ergative (4), or OBJECTs, whether Absolutive (1) or Dative (6=2). When it modifies an Ergative or Dative case-marked nominal, the *–piya*-marked word receives additional case-marking in agreement. Occasionally a verb can require Locative case of an argument, as

[6] Inside this ADJUNCT, *wita* acts as an ADJUNCT modifying *kurdu*.

the verb *manyu.karri* ‘play’. A *–piya*-marked word can modify such a Locative-marked argument, as in (7).

(7)

kuyukari-kuyukari,	nyurrpukari-nyurrpukari	kala=lu	
same.gen.moiety	opp.gen.moiety	USED.TO=they	
manyu.karri-ja	<u>purlja-ngka</u> –	yangka	**putupurlu-piya-rla**.
play-PAST	hairstring.ball-LOC	the	football-LIKE-LOC

‘One generation moiety against the other, they would play <u>*purlja*</u> **which is like football.**’ [purlja]

Examples such as (2, 4, 6, 7) are typical examples of case-stacking where a grammatical case attaches to a semantic case (used like an adposition).

Warlpiri also allows the stacking of semantic cases used as adpositions. The Locative is most commonly treated as a semantic case, which is used as an adposition, rather than as the case of an argument of the verb as in (7). When it acts as an adposition, its complement can be a *–piya*-marked word. In (8) the nominal phrase *rdakurlpa-rla kurdiji-piya-rla* ‘in the hollow part of what is like a shield’ acts as an ADJUNCT to the main clause. The ADJUNCT predicate is the Locative *-rla*. The semantic head of the complement of the Locative is ‘hollowed.part’, which is modified by the ADJUNCT *kurdiji-piya*.

(8)

Parraja	ngulaji	yangka	kuja=ka=lu=jana	
coolamon	that	the	WHICH=PRES=THEY=THEM	
kurdu-kurdu	ngati-nyanu-rlu		rdakurl-ka-nyi	
child-child	mother-POSS-ERG		carry.around-PRES	
wita-wita	pirltirrka,		<u>rdakurlpa</u>-rla	**kurdiji-piya**-rla.
little-little	baby		hollow-LOC	shield-LIKE-LOC

‘A *parraja* is what mothers carry their little babies around in – in <u>the hollow part</u> **of what is like a shield**. ‘[parraja PPJ <9/86]

A *–piya*-marked word can also act as the ADJUNCT to the complement of another adposition. In (9) the Locative *-rla* acts like an adposition. The sentence contains a topicalised Locative ADJUNCT *yilyampuru-rla yatujumparra* ‘on those sandhills to the north’. It agrees with *nyanungu-piya-rla*, a Locative ADJUNCT.

(9)

<u>Yilyampuru-rla</u>	<u>yatujumparra</u>,		kula=lpa	murdukayi
sandhill-LOC	north		not=PAST	car
nyanungu-piya-rla		ya-ntarla,	lawa.	
it-LIKE-LOC		go-IRREALIS	no	

‘<u>On those sandhills to the north</u>, a car can’t go on such ones.’ [juul nyanyi]

In this example, the understood head of the complement of the Locative in the main clause is null - translated into English as 'ones'. This understood head is further specified by the ADJUNCT *nyanungu-piya* 'ones like it/them'. *nyanungu* is coreferential with the topicalised Locative ADJUNCT *yilyampuru-rla yatujumparra*. (Observe again that *–piya* can attach to an anaphor).

For the main predicate use of *–piya*, I proposed that the semantically two-place predicate is represented with two grammatical functions.

(↑PRED) = '*–piya* < (↑SUBJ), (↑OBJ)>'

For the ADJUNCT predicate use of *–piya*, two possibilities arise. One is to keep the same representation as for main clauses (Simpson 1991). The other is to have two representations, one for main clause uses, and one for ADJUNCTs. The ADJUNCT use then follows common LFG treatments of adpositions as having an complement but no SUBJECT (Butt et al 1999). Additional case-marking, such as Dative case (6=2), Ergative case (4) or Locative case (7-9), links the ADJUNCT to the element it modifies, perhaps by inside-out construction of OBJECT with the case (Nordlinger 1998).

Under the second approach, the semantically two-place adposition predicate is represented as being subcategorised by one grammatical function.

(↑PRED) = '*–piya* < (↑OBJ)>'

The two uses can be collapsed by making the SUBJECT optional, represented by (()).

(↑PRED) = '*–piya* <((↑SUBJ)), (↑OBJ)>'

In sum, *–piya* can be the main clause predicate or the predicate for ADJUNCTs that modify SUBJECT, OBJECT or complements to other ADJUNCTs. It can be followed by grammatical or semantic cases which indicate what it modifies.

Two f-structures follow, both showing case agreement. The first f-structure for (4) contains a *–piya*-marked word *ngaju-piya-rlu* modifying an Ergative nominal *Yangka old man-rli* inside a nominal phrase *Yangka old man-rli ngaju-piya-rlu* 'that old man like me'. The second f-structure for (6=2) shows a *–piya*-marked nominal phrase headed by *kurdu* 'child' which contains its own ADJUNCT *wita* 'small'. In turn this *–piya*-marked nominal modifies the understood Dative OBJECT. (In (6=2) neither the SUBJECT nor the OBJECT is overtly realised.)

F-structure 2: Example (4) *Yangka old man-rli ngaju-piya-rlu kala para-ja*. ‘That old man like me followed it.’

PRED	‘PARA- <SUBJ, OBJ>’			
TENSE	REMOTE PAST			
SUBJ	PRED	‘OLD.MAN’		
	PERSON	3		
	SPEC	*yangka*		
	CASE	ERG		
	ADJUNCT	PRED	‘–*piya* <OBJ>’	
		CASE	ERGATIVE	
		OBJ	PRED	‘PRO’
			PERSON	1
			NUMBER	sing
			CASE	PIYA
OBJ	PRED	‘PRO’		
	PERSON	3		
	CASE	ABSOLUTIVE		

F-structure 3: Example (6=2) *Yiki-nyina-mi ka=rla kurdu wita-piya-ku*. ‘She tries to dissuade him as though he’s a little child.’

PRED	‘YIKI-NYINA- <SUBJ, OBJ>’				
TENSE	PRESENT				
SUBJ	PRED	‘PRO’			
	PERSON	3			
	CASE	ABSOLUTIVE			
OBJ	PRED	‘PRO’			
	PERSON	3			
	CASE	DATIVE			
	ADJUNCT	PRED	‘–*piya* <OBJ>’		
		OBJ	PRED	‘KURDU’	
			CASE	PIYA	
			ADJUNCT	PRED ‘WITA’	
				CASE PIYA	
		CASE	DATIVE		

4 *–piya* as adposition and case feature

While *–piya* acts as an adposition, it can also behave like other semantic cases in Warlpiri (Simpson, in press) in taking part in agreement. In (5) and (6), the first element of the nominal phrase is unmarked, and *–piya* only occurs on the rightmost element (right edge-marking). But in (10) *yayirni-piya kardiya-kurlangu-piya* 'like the white man's corrugated iron' is an ADJUNCT modifying the unmarked Absolutive object *ngulanya* 'that'. Both the semantic head *yayirni* 'iron', and the ADJUNCT modifying that head *kardiya-kurlangu* 'white.man-POSS' can both be marked with *–piya*. The OBJECT complement of the *–piya* is *yayirni kardiya-kurlangu* (*kardiya-kurlangu* is an ADJUNCT modifying *yayirni*).

(10)	<u>Ngulanya</u>	kala=lu=nyanu	yujuku-rla	kankarlarni
	that	USED.TO=THEY=SELF	humpy-LOC	top
	yirra-rnu	ngapa-kujaku,	**yayirni-piya**	
	put-PAST	rain-LEST,	iron-LIKE	
	kardiya-kurlangu-piya			
	white.man-POSS-LIKE			

'*<u>That</u> is what they would put over the top of their humpy to keep out the rain –* ***like the white man's corrugated iron***,' [pijipiji]

The possibility of appearing on more than one word in a nominal phrase differentiates Warlpiri cases from their counterparts in neighbouring Pitjantjatjara, which only has right edge marking (Wilmoth and Nordlinger 2019).

Since *–piya*-marked nominals can agree in case, *–piya* must also be a case feature as well as an adposition. But if both *yayirni-piya* 'iron-LIKE' and *kardiya-kurlangu-piya* **'**white.man-POSS-LIKE**'** have PRED values, then these will compete (violating functional uniqueness) So a solution is to allow *–piya* to have a CASE value, (which will enforce consistency of *–piya* marking) and for the PRED value to be optional. This allows both elements to be marked with *–piya* but for only one of them to act as the PRED.

((↑PRED) = '*–piya* <((↑SUBJ)), (↑OBJ)>')
(↑CASE) = PIYA

If the PRED value is absent on both *–piya* marked words, and just a CASE feature remains, then the ADJUNCT will have only the meaning of the nominal (e.g. 'iron') as the PRED. The meaning of comparison will be missing.

The nominal to which *–piya* attaches (its OBJECT complement or an ADJUNCT of that complement) can be a bare nominal or, as in (10) a case-marked nominal. In (10) *kardiya-kurlangu* is an ADJUNCT modifying *yayirni*. It comprises a semantic case affix *-kurlangu* and its OBJECT complement *kardiya*. This is a type of case stacking.

Semantic case stacking of this type cannot be treated simply as stacking of case features (Sadler & Nordlinger 2006), since the semantic cases, like adpositions, take arguments. They are more comparable to the nested PPs of English e.g. *from up above the tree*.

5 Comparing events with *–piya*

We have seen that *–piya* can attach to bare nominals (1-9), and to nominals already marked with an adposition-like semantic case suffix (10). When attached to a nominal, *–piya* often compares one entity with another entity. But, pragmatically, *–piya*-marked nominals can assert similarity between two actions via a participant in an action. In (11) 'water' is not compared with 'tea', even though *–piya* attaches to *nalija* 'tea'. Rather two actions are compared: flood water overflows as boiling tea overflows.

(11) Pupu.wangka ka. **Nalija-piya** ka karlarr.yarnka.
gush.NPST PRES tea-LIKE PRES overflow.NPST
'[It (fast flowing water)] gushes along. It overflows **like (boiling) tea'**. [karlarr-yarnkami]

Assertion of event similarity can be done by attaching *–piya* to a nominal which is a propositional anaphor or textual deictic, as in (12) where the anaphor *ngula-piya* 'that-LIKE' points to the act of grinding mulga seeds.

(12) Yangka kujaka=lu wardiji=rlangu yurrpa-rni,
the when=THEY mulga.seeds=E.G. grind-NPST
ngula-piya=yijala karrawari-warnu=ju ka=rnalu
that-LIKE=ALSO coolibah-ASSOC=TOP PRES=WE
– nga-rni ngurlu=yijala
– eat-NPST seed=ALSO
'Just like when they grind mulga seeds, **in the same way** [the stuff] from the coolibah we – eat the seeds also.' [Hale 1966: 149]

Rarely, the similarity of events or actions is expressed by attaching *–piya* to nominalised verbs (13) as *mapa-rninja-warnu-piya=lku* 'rub-NOM-ASSOC-LIKE=NOW'.

(13) Panjara-yuka-mi ka ngulya-ngka yangka
smearing-enter-NPST PRES burrow-LOC the
ngapa-jangka-rla palya=lku,
water-FROM-LOC dirt=NOW
mapa-rninja-warnu-piya=lku wardapi.
rub-NOM-ASSOC-LIKE=NOW goanna
'[It] enters into a wet burrow and gets coated with dirt, as though rubbed with it, the goanna. [panjara]

In (13) *mapa-rninja-warnu-piya* is an ADJUNCT modifying the matrix SUBJECT *wardapi* 'goanna'. Both ADJUNCT and SUBJECT are unmarked and interpreted as bearing Absolutive case. The PRED of the ADJUNCT is *–piya,* and *–piya'*s complement is *mapa-rninja-warnu* 'having been rubbed'.

In the multiply case-marked example (14), the ADJUNCT consists of a *–piya*-marked nominalised verb which is the complement to the semantic case form *-jangka* 'from'. This ADJUNCT has a Dative case indicating that it is predicated of the main clause's Dative OBJECT.

(14) Ngaju-ku=ju nyampuju wapirdi nyunyurr-nyina-ja
me-DAT=TOP this on.arrival grab.hold-PAST
yinngirri-nya-nja-warnu-piya-jangka-ku,
appearance-see-NOM-ASSOC-LIKE-FROM-DAT
'Well he just came up and grabbed hold of me with no **introduction as if [he] knew [me] already**' [nyunnyurr(pa)]

Very rarely, assertion of similarity between properties of events can be done by attaching *–piya* to finite verbs (15).

(15) Kala – yuka-ja yangka kujaka puluku yangka
AND enter-PAST the when bullock the
yuka-piya – ngula-piya
enter.NPST-LIKE that-LIKE
'There it (kangaroo) would sink **in the way a cow sinks in and gets bogged – like that.**.' [Hale 1966:1102]

Here *–piya* compares two events. The standard of comparison is more than just the verb *yuka* 'enter.NPST'. It is probably the proposition denoted by the clause 'when a cow enters'. In fact, in this example, the standard of comparison is repeated with the anaphor *ngula* 'that' which is used for propositions among other things. When attached to a finite verb, it is hard to claim that *–piya* is an adposition-like semantic case affix with a syntactic complement since semantic case suffixes don't generally attach to finite verbs. Instead, it seems that *–piya* is moving towards becoming an enclitic discourse particle.

However, there are too few examples to analyse this further.

6 Conclusion

Table 1 sums up the possibilities for *-piya*-marked words with their agreement options.

Main predicate.	Adjunct predicated of entities	Adjunct predicated of entities & events	Particle modifying events
on nominal	*on nominal*	*on nominal or nominalised verb*	*on finite verb*
No visible agreement	Agreement Case feature	Agreement Case feature	No visible agreement

The four different functions of *–piya* can be lexically represented in LFG as follows:

- as the predicate of the main clause with syntactically expressed SUBJECT (comparee) and OBJECT (standard of comparison).
  (↑PRED) = '*–piya* <(↑SUBJ), (↑OBJ)>'

- as the predicate of an ADJUNCT with at least a syntactically expressed OBJECT (standard of comparison),
  (↑PRED) = '*–piya* < (↑OBJ)>'
  (↑CASE) = PIYA

- agreeing with the OBJECT of the *-piya* predicate via a case feature PIYA, and making the PRED feature optional.
  ((↑PRED) = '*–piya* <(↑OBJ)>')
  (↑CASE) = PIYA

- as a discourse particle where the standard of comparison is pragmatically inferrable from the nominal to which *-piya* is attached, and the comparee is pragmatically inferrable from the whole context.
  (↑PRED) = '*–piya*'

We do not as yet have the comparative and historical data on the evolution of the form *–piya* as a marker of resemblance, and thus as to which of the uses ADJUNCT or main clause is prior (I assume that the agreement use is secondary, and that the discourse particle use is emerging). But, the LFG lexical representations make it clear how the functions of a semantically two-place predicate like *–piya* could evolve: by allowing one or both arguments to bear grammatical functions, by allowing the presence or absence of a case feature, and by the optionality of the PRED feature itself to express agreement.

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BEI-passive revisited: a constraint-based approach

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Abstract

This paper revisits Chinese BEI-passive constructions by analyzing two less-studied passive structures: the passive in which the patient argument of the passivized verb maps onto a post-verbal position, as well as the passive with intransitive verbs. I claim that there is no subject in these constructions, by showing that the post-V patient, if there is one, is the object and not the dislocated subject of the clause. I propose that BEI is a raising verb and a passive marker in Chinese and that a grammatical subject is not necessary for every clause.

1 Introduction

The topic of this paper is Mandarin Chinese BEI-passive constructions. The paper is organized as follows. In section 2, I introduce basic BEI-passive structures and review current studies of BEI-passives. I will especially concentrate on the analyses of BEI and point out some problems of these analyses by presenting relevant facts. I then propose my own analysis of BEI and BEI-constructions in section 3. The main conclusions are summarized in section 4.

2 Current analyses of BEI and BEI-passive

The patient/theme argument in Mandarin Chinese BEI-passive clauses can appear either in a pre-BEI position or post-verbally. I first introduce the basic passive BEI structures in Mandarin in 2.1 and then review the previous studies, in 2.2. The grammatical function of the post-V argument is discussed in 2.3.

2.1 Basic passive structures in Mandarin Chinese

The commonly known and most studied passive construction in Mandarin Chinese is the passive ordered as NP-BEI(-NP)-V, in which the patient or theme argument maps onto the pre-BEI position, whereas the immediate post-BEI element – if there is one – corresponds to the agent argument. Constructions with and without an overt post-BEI agent are named *long passive* and *short passives* (Huang et al. 2009), respectively. For example:

(1) a. Zhang1 san1 bei4 Li3 si4 da3 le0.
张 三 被 李 四 打 了
Zhangsan BEI Lisi hit PERF
'Zhangsan was hit by Lisi.'

b. Zhang1 san1 bei4 Ø da3 le0.
张 三 被 打 了
Zhangsan BEI hit PERF
'Zhangsan was hit.'

(Huang et al. 2009)

(1a) represents the typical *long passive* construction in Mandarin Chinese. The agent argument (i.e., *Lisi*, the hitter) is overtly expressed and it maps onto the post-BEI position. (1b) represents the typical *short passive* construction, with no agent argument overtly expressed in the clause. In both cases, the patient argument (i.e., *Zhangsan*, the one being hit) is located before BEI.

Apart from the construction represented in (1), in which the patient argument of a passivized transitive verb is located before BEI, the patient argument can also appear post-verbally, as illustrated by (2):

(2) a. Bei4 ta1 pian4 le0 wu3 ge4 da4 huo2 ren2.
被 她 骗 了 五 个 大 活 人
BEI she cheat PERF five CLASS big living man
(Literally) 'There were cheated five living men by her.'
(Lu 2004)

b. Bei4 ta1 cai3 zhao2 she2 le0.
被 她 踩 着 蛇 了
BEI she step-on snake PERF
(Literally) 'There was stepped on a snake by her.'

c. Bei4 feng1 chui1 dao3 le0 yi4 ke1 shu4.
被 风 吹 倒 了 一 棵 树
BEI wind blow down PERF one CLASS tree
(Literally) 'There was blown down a tree by the wind.'

Surprisingly, despite the huge bulk of research on Chinese BEI-passive constructions, with the patient argument mapping onto the pre-BEI position, little attention has been paid to the situation in which the patient argument is not located before BEI, but appears post-verbally, such as the NP *wu3 ge4 da4 huo2 ren2* 'five living men' after the verb *pian4* 'cheat' in (2a), the NP *she2* 'snake' after the verb *cai3* 'step on' in (2b), or the NP *yi4 ke1 shu4* 'a tree' after the verb *chui1 dao3* 'blow-down' in (2c), respectively.[1, 2]

The same order is also widely used in Shanghainese and Cantonese, as is shown in (3) and (4), respectively:

---

[1] Though some studies have mentioned them in passing, as in Yu (1989), Lu (2004), Her (2008), or Huang et al. (2009), among others.

[2] For me, when the patient argument maps onto the post-verbal position, the agent argument should be overtly expressed, such as the *ta1* 'she' in (2a) and (2b), or the agent *feng1* 'wind' in (2c). However, after consulting other native speakers, they pointed out that omitting the agent argument is also acceptable:

(i) Bei4 pian4 le0 wu3 ge4 da4 huo2 ren2.
被 骗 了 五 个 大 活 人
BEI cheat PERF five CLASS big living man
(Literally) 'There were cheated five living men.'

(ii) Bei4 chui1 dao3 le0 yi4 ke2 shu4.
被 吹 倒 了 一 棵 树
BEI blow down PERF one CLASS tree
(Literally) 'There was blown down a tree.'
(https://www.oursteps.com.au/bbs/archiver/?tid-727247.html&page=2, visiting time: 16:32, 05/12/2020.)

(3) a. Bah4 da3 khah4 tsho1 zaon3 wa3 theh4 ih4 khu1 zy3.
拔 大 客 车 撞 坏 脱 一 棵 树
BEI big coach knock broken PERF one CLASS tree
(Literally) 'There was smashed a tree by a big coach.'

b. Bah4 yi1 sah4 theh4 sae1 eh4 nyin1.
拔 伊 杀 脱 三 个 人
BEI she kill PERF three CLASS person
(Literally) 'There were killed three people by her.'

(Yu 1989)

(4) a. Bei2 keoi5 sik6 zo2 jat1 go3 lou5 baak3 gung1.
畀 佢 食 咗 一 个 老 伯 公
BEI it eat PERF one CLASS old uncle
(Literally) 'There was eaten an old man by it.'

b. Bei2 keoi5 sik6 zo2 gei2 go3 lei4.
畀 佢 食 咗 几 个 梨
BEI she eat PERF some CLASS pear
(Literally) 'There were eaten some pears by her.'

(Yu 1989)

Similarly, though BEI is also widely used with intransitive verbs, little attention has been given, either. In such a construction, the sole argument of the intransitive verb maps onto the post-BEI position. Also, when BEI combines with intransitive verbs, only unergatives can appear in this construction, such as *pao3*/*pao3 diao4* 'run/run away', *tao2*/*tao2 zou3*/*tao2 pao3* 'flee/flee away', *cheng2 gong1* 'succeed', etc. For instance:[3]

(5) a. Bei4 ta1 pao3 le0.
被 她 跑 了
BEI she run PERF
(Literally) 'It was run by her. (She ran.)'

b. Bei4 ta1 cheng2 gong1 le0.
被 她 成 功 了
BEI she succeed PERF
'It was succeeded by her. (She succeeded.)'

Unaccusative verbs, such as *dao4* 'arrive', or *diao4* 'fall', cannot appear in the BEI-passive construction:

(6) a. *Bei4 ta1 dao4 le0.
被 她 到 了
BEI she arrive PERF
(Intended) 'It was arrived by her. (She arrived.)'

---

[3] However, when passivizing intransitive – or rather, unergative – verbs, all the native speakers that I consult, including myself, agree that dropping the agent argument does not feel natural.

b. *Bei4 ta1 diao4 le0.
被 她 掉 了
BEI she fall PERF
(Intended) 'It was fallen by her. (She fell.)'

To reorient a bit, BEI-passives can be used with transitive verbs as well as with intransitive verbs in Mandarin Chinese. When used with transitive verbs – as in (1) and (2) –, the agent argument maps onto the post-BEI position, whereas the patient argument can either appear before BEI (as in (1)), or map onto the post-verbal position (as in (2)). When used with intransitive verbs, only unergative verbs make a grammatical construction. This is illustrated by the contrast between the grammatical cases in (5) and the ungrammatical cases in (6), with BEI combining with unergatives and unaccusatives, respectively. A construction with the agent argument not overtly expressed is acceptable when transitive verbs are passivized, but does not feel natural with intransitive verbs.

To give an analysis of the less studied passive constructions with BEI, especially the BEI-passive in which the patient argument of the transitive verb maps onto the post-verbal position, three questions need to be answered. First, about the grammatical function of the post-V NP: is it an object, or a subject that is somehow dislocated? Second, about the grammatical function of the immediate post-BEI NP: is it an object or an oblique? Third, about BEI itself: is it a preposition, a matrix verb taking thematic arguments, or something else?

2.2 Previous analysis of BEI-passive constructions

To solve these puzzles raised in the last paragraph in 2.1, let us first survey some previous analyses of Chinese BEI-passive constructions. Attempts at analyzing Chinese BEI-passives treat BEI either purely as a passive marker (Xiao et al. 2006, Chow 2018, etc.), as a preposition (Zhu 1982, Li 1990, etc.), as a matrix verb taking two or three arguments (Ma 1985, Her 1989, 2009, Guo et al. 2007, etc.), or as a coverb (Kit 1998). Few words can be said about paths that *simply* treat BEI as a passive marker of the clause because they are untenable. In 2.2.1 we give a brief discussion on studies treating BEI as a preposition. In 2.2.2 we review two representative proposals that treat BEI as the matrix verb taking thematic arguments and discuss the problems they may face. 2.2.3 talks about approaches that treat BEI as a coverb and concludes.

2.2.1 BEI as a preposition

Approaches treating BEI as a preposition mainly appear in early studies, such as Zhu (1982) or Li (1990). The claim is made by considering that BEI resembles the English preposition *by* in that both are followed by the agent argument in their respect passive construction.

Now it is generally agreed that classifying BEI into preposition is not appropriate (Hsu 2009, Kit 1998, Guo 2007, Liu 2016, among others), given compelling evidence that preposition stranding is not allowed in Mandarin

Chinese (Huang 1991, Li 1990, among others)[4] and that dropping the post-BEI element – at least in the passivization of transitive verbs – will not cause any ungrammaticality. Example (7) illustrates a case in which the verb *da3 jia4* 'fight' in its active form needs a prepositional complement introduced by *gen1* 'with'. As one can see, the NP *ta1* 'he' following the preposition *gen1* 'with' cannot be dropped. In contrast, in a passive construction in (8), the agent argument following BEI can be freely dropped:

(7) Wo3 mei2 you3 gen1 *(ta1) da3 jia4.
我 没 有 跟 他 打 架
I not with he fight
'I did not fight with him.'

(Huang 1991)

(8) Zhang1 san1 bei4 (Li3 si4) da3 le0.
张 三 被 李 四 打 了
Zhangsan BEI Lisi hit PERF
'Zhangsan was hit (by Lisi).'

Therefore, though the "BEI + NP" sequence seems to resemble the English *by*-phrase in introducing the agent argument of the passivized predicate, it is not logical to analyze BEI as the Chinese counterpart of the English preposition *by*.

2.2.2 BEI as a (thematic) argument-taking predicate

Apart from assuming BEI to be a preposition, most studies adopt the approach of analyzing BEI as the matrix verb of the clause (Ma 1985, Her 1989, 2009, Guo et al. 2007, Hsu 2009, among others). As for the subcategorization of BEI however, no agreement has been reached. Ma (1985), Her (1989, 2009), among others, propose that BEI is a three-place predicate that selects a SUBJ, an OBJ, and a VCOMP (or an XCOMP, depending on different assumptions). For example, Her (1989) assumes that BEI subcategorizes for three functions in its PRED value and that it introduces two control equations. The lexical form of BEI as well as the control equations by Her (1989) are given in (9).

---

[4] Notice that, circumpositions in Mandarin Chinese exist. These are a type of adposition combining a preposition that precedes an NP and a postposition following that NP (Liu 2002). In this case, "circumposition stranding" is allowed. For example:

(i) Wo3 men2 **yong4** qi4 che1 **lai2** jie1 song 4 ke4 ren2.
我 们 用 汽 车 来 接 送 客 人
we with car to pick-up client
'We pick up clients with cars.'

(ii) Qi4 che1 wo3 men2 **yong4** **lai2** jie1 song4 ke4 ren2.
汽 车 我 们 用 来 接 送 客 人
car we with to pick-up client
'As for the car, we use it to pick up clients.'

(Liu 2002)

(ii) without any element inside the circumposition *yong4 lai2* 'with … to' is perfectly acceptable in Mandarin Chinese. However, *pre*position stranding is not allowed, as (7) shows.

(9) BEI, V

$(\uparrow \text{PRED}) = \text{'BEI} <(\uparrow \text{SUBJ}) (\uparrow \text{OBJ}) (\uparrow \text{VCOMP})>\text{'}$

$(\uparrow \text{SUBJ}) = (\uparrow \text{VCOMP OBJ})$

$(\uparrow \text{OBJ}) = (\uparrow \text{VCOMP SUBJ})$

(Her 1989)

The f-structure in (10) gives a straightforward illustration of the control equations proposed by Her (1989):

(10) Zhang1 san3 bei4 Li3 si4 ma4 le0.
张 三 被 李 四 骂 了
Zhangsan BEI Lisi curse PERF
'Zhangsan was cursed by Lisi.'

$$\begin{bmatrix} \text{PRED} & \text{'BEI < SUBJ, OBJ, COMP >'} \\ \text{SUBJ} & [\text{PRED} \quad \text{'Zhangsan}_i\text{'}] \\ \text{OBJ} & [\text{PRED} \quad \text{'Lisi}_k\text{'}] \\ \text{VCOMP} & \begin{bmatrix} \text{PRED} & \text{'ma <SUBJ, OBJ, COMP>'} \\ \text{SUBJ} & [\text{PRED 'PRO}_k\text{'}] \\ \text{OBJ} & [\text{PRED 'Zhangsan'}] \end{bmatrix} \end{bmatrix}$$

(Her 1989)

Concerning the subcategorization of BEI proposed by Her (1989), Hsu (2009) points out that the object-to-subject equi is doubtful within the existing theories of raising (Alsina 1996, Falk 2001, among many others). In addition, one has to explain "why Mandarin in particular allows this sort of object equi construction in addition to more standard cases of equi, and why other languages do not seem to do so at all." Wong and Hancox (1999) in turn observe from the perspective of current Lexical Mapping Theories (LMTs, Bresnan and Kanerva 1989, Bresnan and Moshi 1990, etc.) that, if BEI should be treated as the matrix verb subcategorizing for an OBJ that maps onto the post-BEI position, then a clash would occur because the post-BEI element is both an OBJ (which is classified as [+o]) and an agent (which is intrinsically [-o]).

Apart from the studies that assume BEI to subcategorize for three grammatical functions, some studies also assume that BEI only subcategorizes for a SUBJ and an XCOMP, as Guo et al. (2007) or Hsu (2009), among others. For example, Guo et al. (2007) propose that, for a passive sentence like the one in (11), the lexical form of BEI and the f-structure can be represented as in (12) and (13), respectively:

(11) Zhe4 xie1 shu4 ju4 bei4 wo3 hu1 lve4.
这 些 数 据 被 我 忽 略
these data BEI I ignore
'These data was ignored by me.'

(Guo et al. 2007)

(12) BEI, V
(↑PRED) = 'BEI <(↑SUBJ) (↑COMP)>'
(↑SUBJ) = (↑COMP OBJ)

(Guo et al. 2007)

(13) F-structure for (11)

$$\left[\begin{array}{ll} \text{PRED} & \text{'BEI} \ < \text{SUBJ, COMP} >\text{'} \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{'data'} \\ \text{DET} & [\text{ PRED 'these' }] \end{array}\right] \boxed{1} \\ \text{COMP} & \left[\begin{array}{ll} \text{PRED} & \text{'omit <SUBJ, OBJ>'} \\ \text{SUBJ} & [\text{PRED 'I' }] \\ \text{OBJ} & \boxed{1} \end{array}\right] \end{array}\right]$$

(Guo et al. 2007)

Assuming BEI to only subcategorizes for a SUBJ and a COMP avoids the feature conflicting problem in Her (1989), but still faces the object-to-subject equi problem: as one can see, the OBJ of COMP bears the same tag as the SUBJ of the matrix f-structure in (13) and again, an object-to-subject raising is quite suspicious.

2.2.3 BEI as a coverb

Some words need to be said about previous analyses that treat BEI as a coverb (Li and Thompson 1989, Ramsey 1989, Kit 1998, etc.). Li and Thompson (1989) observe that BEI cannot be a (normal) verb in any context, since it must appear in a passive sentence together with another verb and cannot occur in a sentence alone. (14a) shows a normal passive clause in which BEI combines with a transitive verb *pi1 ping2* 'criticize', whereas (14b) only contains BEI, leading to an ungrammatical construction:

(14) a. Wo3 bei4 ma1 ma1 pi1 ping2 le0.
我 被 妈 妈 批 评 了
I BEI mother criticize PERF
'I was criticized by mom.'

b. * Wo3 bei4 ma1 ma1.
我 被 妈 妈
I BEI mother
(Intended) 'I was done something by mom.'

Li and Thompson (1989:365)

Further evidence supporting the assumption that BEI should not be fully treated as a verb comes from three verb tests in Li (1990:100): first, verbs can be attached to by aspect markers such as LE; second, verbs can appear in "V-not-V" form in wh-questions; third, verbs can be used as a simple answer to a question. (15), (16) and (17) show that BEI behaves differently from normal verbs in that it can only pass the second test (i.e., the V-not-V test):

(15) a. Ta1 mai3 le0 hen3 duo1 shu1.
他 买 了 很 多 书
he buy PERF many book
'He bought many books.'

Li (1990:100)

b.* Zhang1 san1 bei4 le0 Li3 si4 da3.
张 三 被 了 李 四 打
Zhangsan BEI PERF Lisi hit
'Zhangsan was hit by Lisi.'

(16) a. Ta1 mai3 bu4 mai3 shu?
他 买 不 买 书
he buy not buy book
'Is he buying books?'

Li (1990:100)

b. Zhang1 san1 bei4 mei2 bei4 Li3 si4 da3?
张 三 被 没 被 李 四 打
Zhangsan BEI not BEI Lisi hit
(Literally) 'Was Zhangsan hit by Lisi or not?'

(17) a. – Ta1 mai3 shu1 ma0?
他 买 书 吗
he buy book Q-PART
'Is he buying books?'

– Mai3/ Bu4 mai3.
买 / 不 买
buy / not buy
'Yes/No.'

Li (1990:100)

b. – Zhang1 san1 bei4 Li3 si4 da3 le0 ma0?
张 三 被 李 四 打 了 吗
Zhangsan BEI Lisi hit PERF Q-PART
'Was Zhangsan hit by Lisi?'

– *Bei4/ *Mei2 Bei4.
被 没 被
BEI / not BEI
(Intended) 'Yes/No.'

The fact that BEI only shows the second property indicates that it should not be treated as a normal verb denoting action.

Out of such considerations, Kit (1998) proposes that BEI is a coverb that shares properties of both prepositions and verbs. As for its lexical entry, Kit (1998) assumes that it subcategorizes for a SUBJ, an OBJ, and an XCOMP. For a passive clause like (10), the lexical entry of BEI is considered to be:

(18) BEI, CV, PRED 'BEI<(↑ SUBJ) (↑ OBJ) (↑ XCOMP)>'

(Kit 1998)

As one can observe, approaches as such are not essentially different from those that treat BEI as a normal verb (like Her 1989), except that BEI is named as "coverb" to indicate the awareness that BEI has some properties that differentiate itself from normal verbs.

In conclusion, previous studies treating BEI as a pure passive marker, a preposition, or the matrix verb taking thematic arguments all seem to be somehow untenable. First, one can consider BEI to be a passive marker to a certain extent, since it must appear – together with another verb – in a passive sentence. But BEI should not *only* be treated as a passive marker, because it shows partial verbal properties, as observed by Li (1990), Kit (1998), among others. Second, BEI is not a preposition, for the immediate post-BEI NP can be dropped without causing ungrammaticality and that Mandarin Chinese does not allow preposition stranding. Third, assuming BEI to be a (thematic) argument-taking verb also faces some problems: these arguments are in fact the arguments of the verb that BEI combines with, and control equations are needed to identify the functions subcategorized by BEI and the functions subcategorized by the verb combining with BEI. Then an object-to-subject raising is doubtful within existing theories of raising and equi, as in Her (1989) or Guo et al. (2007). Moreover, a SUBJ is assumed in all these studies and it is not clear how this approach would help to analyze the data described in (2)-(5), in which the intuition is that no subject exists. Finally, studies calling BEI as a coverb show the awareness that BEI is not a normal verb, but contribute no essential difference from previous studies that treat it as the matrix verb.

2.3 Grammatical function of the post-V argument

Before giving an analysis of BEI, let us first survey the grammatical function of the patient argument that maps onto the post-verbal position, such as those represented in (2). One may therefore wonder if the post-V NP in (2) is a dislocated subject. Based on a subjecthood test and an objecthood test, I argue that the grammatical function that this patient argument maps onto is an object.

The subjecthood test I adopt is the floating quantifier test. Floating quantifier is a valid subjecthood test for many languages, like Catalan (Alsina 1996) or Tagalog (Kroeger 1993). It is also valid for Mandarin. For instance, the universal quantifier *quan2 bu4/suo3 you3* 'all', when modifying the subject, can appear either before the subject, left-attaching to it, or float to the position before the verb phrase:

(19) a. Quan2 bu4 tong2 xue2 zai4 kan4 shu1.
全 部 同 学 在 看 书
all students PRES read book
'All the students are reading books.'

b. Tong2 xue2 quan2 bu4 zai4 kan4 shu1.
同 学 全 部 在 看 书
students all PRES read book
'The students are all reading books.'

By contrast, when modifying an object, such a quantifier can only appear right before the object that it modifies. Floating it to anywhere else is not allowed:

(20) a. Tong2 xue2 zai4 kan4 quan2 bu4 shu1.
同 学 在 看 全 部 书
students all PRES read book
'The students are reading all the books.'

b. * Tong2 xue2 quan2 bu4 zai4 kan4 shu1.
同 学 全 部 在 看 书
students all PRES read book
(Intended) 'The students are reading all the books.'

As we can see, only (20a) is grammatical. The universal quantifier that modifies the object *shu1* 'book' appears right before it. In (20b), the quantifier floats to a pre-VP position. The sentence is grammatical when meaning "the students are all reading books", as in (19b), but it is not grammatical when meaning "the students are reading all the books".

People may wonder if the phenomenon might be explained in terms of thematic roles – that is, if being patient/theme disallows the floating of its modifier –. For such a discussion, let us see a typical unaccusative clause with *lai2* 'come'. In Mandarin, unaccusative verbs such as *lai2* 'come' allows its patient argument to appear either before or after it,[5] as is shown in (21):

(21) a. Ke4 ren2 lai2 le0.
客 人 来 了
guest come PERF
'Guests came.'

b. Lai2 le0 ke4 ren2.
来 了 客 人
come PERF guest
'Came guests.'

Examples in (22) illustrate the case in which the patient argument of the unaccusative verb *come* appears before the verb and allows quantifier floating:

[5] Whereas the sole argument in unergative clauses can only appear pre-verbally.

(22) a. Quan2 bu4 ke4 ren2 lai2 le0.
全 部 客 人 来 了
all guest come PERF
'All guests came.'

b. Ke4 ren2 quan2 bu4 lai2 le0.
客 人 全 部 来 了
guest all come PERF
'Guests all came.'

However, when the argument appears post-verbally, floating its modifying quantifier to anywhere else is ungrammatical, as (23) shows:

(23) a. Lai2 le0 quan2 bu4 ke4 ren2.
来 了 全 部 客 人
come PERF all guest
'Came all guests.'

b.* Quan2 bu4 lai2 le0 ke4 ren2.
全 部 来 了 客 人
all come PERF guest
(Intended) 'Came all guests.'

The grammaticality of (23) with the patient argument being immediately pre-verbal rejects the assumption that quantifier floating can be settled in terms of thematic roles. A reasonable explanation is that, the patient *ke4 ren2* 'guests', when being pre-verbal, is realized as the subject, thus allowing its quantifier to float. In contrast, when mapping onto the post-verbal position, the same patient NP is realized as the object and to float its quantifier is not allowed.

Therefore, the fact that the pre-verbal patient NP in (24a), i.e., *quan2 bu4 pan4 tu2* 'all traitors' allows its quantifier to float to the pre-verbal position, as in (24b), is evidence that it is the subject of the clause.

(24) a. Quan2 bu4 pan4 tu2 bei4 ta1 dai4 bu3 le0.
全 部 叛 徒 被 他 逮 捕 了
all traitor BEI he arrested PERF
'All traitors were arrested by him.'

b. Pan4 tu2 bei4 ta1 quan2 bu4 dai4 bu3 le0.
叛 徒 被 他 全 部 逮 捕 了
traitor BEI he all arrested PERF
'Traitors were all arrested by him.'

Similarly, the fact that the post-verbal patient NP in (25a), which is also *quan2 bu4 pan4 tu2* 'all traitors', does not allow its quantifier to float, is evidence that it is the object of the clause:

(25) a. Bei4 ta1 dai4 bu3 le0 quan2 bu4 pan4 tu2.
被 他 逮 捕 了 全 部 叛 徒
BEI he arrest PERF all traitor
'All traitors were killed by him.'

b. * Quan2 bu4 bei4 ta1 sha1 le0 pan4 tu2.
全 部 被 他 杀 了 叛 徒
all BEI he kill PERF traitor
'Traitors were all killed by him.'

The second test is proposed by Zhang (2000), and I name it as "focus SHI test". SHI is a multifunctional word with wide use in Mandarin Chinese. When it is used as a focus marker to introduce new information, it appears right before the element that needs to be introduced. (26b) and (26c) illustrate cases in which the SUBJ and the VP are marked as informationally new, respectively:

(26) a. Ta1 xiu1 hao3 le0 zi4 xing2 che1.
他 修 好 了 自 行 车
he repair good PERF bike
'He has repaired bike.'

b. **Shi4** ta1 xiu1 hao3 le0 zi4 xing2 che1.
是 他 修 好 了 自 行 车
SHI he repair good PERF bike
'It is he that has repaired bike.'

c. Ta1 **shi4** xiu1 hao3 le0 zi4 xing2 che1.
他 是 修 好 了 自 行 车
he SHI repair good PERF bike
'What he has done is repair bike.'

However, not all elements can be preceded by SHI, such as the case with objects. By contrast, a subject can be marked by SHI when being introduced as new information, as we have seen above. (27) shows such a case in which SHI precedes the post-verbal object and results in an ungrammatical structure:

(27) Ta1 xiu1 hao3 le0 (***shi4)** zi4 xing2 che1.
他 修 好 了 是 自 行 车
he repair good PERF SHI bike
(Literally) 'What he has repaired is bike.'

(Zhang 2000)[6]

People may wonder if (27) is ungrammatical because the post-verbal element is marked as discourse old via its position and is therefore incompatible with SHI.[7] The fact is that, the post-verbal NP can be either discourse old or new. It is incompatible with SHI even if it is discourse-new, shown in (28):

(28) – Ta2 xiu1 hao3 le0 shen2 me0?
他 修 好 了 什 么
he repair good PERF what
'What has he repaired?'

[6] I have slightly adjusted the form of this example to give a unified presentation for all the examples in this paper.
[7] I thank the anonymous reviewers for bringing this point out.

– Ta1 xiu1 hao3 le0 (***shi4**) zi4 xing2 che1.
他 修 好 了 是 自 行 车
he repair good PERF shi bike
(Literally) 'What he has repaired is bike.'

The same happens with unaccusative constructions. When the patient argument appears pre-verbally, it can be proceeded by SHI. In contrast, when it maps onto the post-verbal position and is proceeded by SHI, the construction is ungrammatical:

(29) a. *Lai2 le0 shi4 ke4 ren2.
来 了 是 客 人
come PERF SHI guest
(Intended) 'It is the guests that came.'

b. Shi4 ke4 ren2 lai2 le0.
是 客 人 来 了
SHI guest come PERF
'It is the guests that came.'

The difference between (29a) and (29b) further confirms our explanation of the quantifier floating contrast between (25a) and (25b). Here in (29b), the patient *ke4 ren2* 'guests', being immediately pre-verbal, is realized as the subject, thus allowing the SHI marker. In (29a), the same patient is realized as the object when mapping onto the post-verbal position, thus the SHI marker is disallowed.

Therefore, the fact that in passive constructions with transitive verbs, in which the patient argument is post-verbal and cannot be marked by SHI, provides evidence that this NP is the object and not the subject of the clause:

(30) a. *Bei4 ta1 pian4 le0 **shi4** wu3 ge4 da4 huo2 ren2.
被 她 骗 了 是 五 个 大 活 人
BEI she cheat PERF SHI five CLASS living man
(Intended) (literally) 'What was cheated by her were five living men.'

b. *Bei4 ta1 cai3 zhao2 **shi4** she2 le0
被 她 踩 着 是 蛇 了
BEI she step-on SHI snake PERF
(Intended) (literally) 'What was stepped on by her was a snake.'

c. * Bei4 feng1 chui1 dao3 le **shi4** yi4 ke1 shu4
被 风 吹 倒 了 是 一 棵 树
BEI wind blow down PERF SHI one CLASS tree
(Intended) (literally) 'What was blown down by the wind was a tree.'

Before concluding this section, some words need to be said about the constructions in which no subject exists, as in (21b), (23a), or (25a), etc. (21b) reminds us of the example given by Kibort (2001), i.e., a locative inversion construction without a locative:

(31) And then, came those visitors. (Kibort 2001)

To account for this, Kibort (2001) proposes a "demotion" approach within LMT.[8] (31) is subjectless because, since there is no locative element, nothing can be "promoted" to the SUBJ. The Subject Condition as an inviolable constraint in traditional LMTs (Bresnan and Kanerva 1989, Bresnan and Moshi 1990, etc.) is thus challenged. If it is so, then it is not so surprising that some Mandarin constructions also lack a subject, as in (21b), (23a), or (25a), etc.

3 A unified approach to BEI constructions

3.1 The lexical entry of BEI

By now it is clear that BEI is not a preposition, nor does it behaves totally like normal verbs. Now it is time to rethink BEI as a coverb, though previous analyses apparently name it as coverb but essentially treat it like other normal verbs (as in Kit 1998). Exploring BEI as a coverb (or, a light verb, in words of But 1993) that forms a complex predicate with the main verb seems to be a viable option.

Light verbs in complex predicate constructions are studied in many languages, such as Catalan (Alsina 1996) or Urdu (Butt 1993). When analyzing Catalan causative constructions as a complex predicate, Alsina (1996) suggests that causative verbs (which equals *light verbs*) have two arguments: a *causer* and a *causee*. The *causee* binds an argument of the base verb (i.e., the main verb with which the light verb forms a complex predicate), mapping together onto the same function. Butt (1993) in turn considers the predicate composition to be a *fusion* process that melds the matrix patient with an argument of the embedded base verb. Once fused, the embedded argument is no longer available for mapping, and linking rules will only be used with the remaining arguments. Though formal representations in these two approaches differ, their essential spirit is the same: both of them assume permissive or causative construction to have a monostratal f-structure involving a single complex predicate formed by a light verb and the main verb, and both imply that predicate composition and argument mapping take place in the syntax, rather than in the lexicon.

Let us see a causative construction in Catalan, represented in (32):

(32) El mestre fa llegir un poema al nen.
the teacher make read a poem to-the boy
'The teacher is making the boy read a poem.'

(Alsina 1996:190)

The corresponding a-structure is:

(33) A-structure of *fa-llegir* 'make-read':

[8] That is, to add the [+o] feature to the theme argument, thus demoting it to OBJ.

'cause < [P-A]$_2$ [P-P]$_1$ read <[P-A]$_1$>>'[9]

(Alsina 1996:191)

One can observe from previous studies on complex predicate – like Alsina (1996) or Butt (1993), etc. – that in these constructions, both the light verb and the main verb contribute their own thematic arguments. Then one can see an essential difference between BEI and light verbs (or coverbs). That is, whereas light verbs are at least partially predicated by taking an external argument, BEI does not have thematic arguments at all. All the thematic arguments one can find in a BEI-passive come from the verb that BEI combines with. This suggests that treating BEI as a coverb or light verb is not appropriate. If no thematic arguments can be contributed by BEI, nothing can be used to bind (in words of Alsina 1996) or to fuse with (in words of Butt 1993) an argument of the main verb.[10] However, this is quite suggestive of raising verbs such as *seem*, which also takes no thematic arguments. For a sentence such as:

(34) The geneticist seemed to clone dinosaurs.

(Falk 2001:128)

The lexical entry for *seem* is suggested to be represented as:

(35) *Seem*: V (↑ PRED) = 'seem <(↑ COMP)> (↑ SUBJ)'

(Falk 2001:128)

This analysis can easily be adapted to the lexical entry of BEI and Mandarin passives. That is, to treat BEI as a raising verb and to treat Chinese passive to be a raising construction. In addition, given that BEI can only occur in passive constructions, and must co-occur with another (normal) verb (Li and Thompson 1989), I propose that BEI should also be the passive marker of the clause. As a raising verb, BEI lexically specifies both the grammatical function and the grammatical category of their single argument: it is an object and a CP:[11]

(36) Lexical entry of BEI:

Bei, < Arg >
|
OBJ
|
CP

As a passive marker, BEI blocks the linkage of the agent argument of the main verb to a direct grammatical function, but allows it to map onto an oblique. The agent argument can either go unexpressed or be expressed as a post-BEI NP. In this paper, I represent the argument-to-function mapping by using the

[9] [P-A] is short for proto-agent, whereas [P-P] is short for proto-patient (Dowty 1991).

[10] By "main verb" I refer to the verb with which BEI combines, for it contributes the semantic content of the clause denoting action.

[11] Here I follow Alsina et al. (2005), Forst (2006), and Patejuk and Przepiórkowski (2016), among others, in not assuming a COMP in the inventory of grammatical functions, and I assume that the syntactic function of the clausal phrase is OBJ, which maps onto the clausal constituent in c-structure.

same subscripted integers. The passivization is indicated by circling the subscripted index of that argument and the raising process is represented by marking two functions with the same tag. Then the f-structures of (1a) and (1b) can be represented as in (37) and (38), respectively:

(37) Zhang1 san1 bei4 Li3 si4 da3 le0.
张 三 被 李 四 打 了
Zhangsan BEI Lisi hit PERF
'Zhangsan was hit by Lisi.'

(repeating (1a)

$$\left[\begin{array}{ll} \text{PRED} & \text{'BEI < Arg}_1\text{ >'} \\ \text{SUBJ} & \boxed{1} \\ \text{OBJ} & \left[\begin{array}{lll} \text{PRED} & & \text{'hit < Arg}_2\text{, Arg}_3\text{ >'} \\ \text{OBL} & & [\text{PRED 'Lisi'}]_2 \\ \text{SUBJ} & \boxed{1} & [\text{PRED 'Zhangsan'}]_3 \end{array}\right]_1 \end{array}\right]$$

(38) Zhang1 san1 bei4 Ø da3 le0.
张 三 被 打 了
Zhangsan BEI hit PERF
'Zhangsan was hit.'

(repeating (1b))

$$\left[\begin{array}{ll} \text{PRED} & \text{'BEI < Arg}_1\text{ >'} \\ \text{SUBJ} & \boxed{1} \\ \text{OBJ} & \left[\begin{array}{lll} \text{PRED} & & \text{'hit < E}_2\text{, I}_3\text{ >'} \\ \text{SUBJ} & \boxed{1} & [\text{PRED 'Zhangsan'}]_3 \end{array}\right]_1 \end{array}\right]$$

In (37) and (38), the mapping of the agent argument of *da3* 'hit' to a direct grammatical function is blocked. However, nothing prevents this argument to optionally be realized as an oblique. In this way, the optionality of the post-BEI patient gets a natural explanation. As for the patient argument of *da3* 'hit', it maps onto the SUBJ of the passivized predicate, which then raises as a *nonthematic* SUBJ of BEI.

Note that here we are assuming an NP to bear the oblique function. This is not a problem for Mandarin Chinese, for obliques do not necessarily require a preposition/postposition in this language, as Ma (1985) and Tan (1987) observe. Evidence for this claim comes from NPs denoting location. That is, both NPs and PPs can be used to denote location in Mandarin Chinese:

(39) a. Yi4 jian1 fang2 zhu4 lia3 ren2.
一 间 房 住 俩 人
one CLASS room live two person
'In one room live two persons.'

b. Zai4 yi4 jian1 fang2 zhu4 lia3 ren2.
在 一 间 房 住 俩 人
in one CLASS room live two person
‘In one room live two persons.’

Therefore, assuming that the post-BEI agent bears the OBL function is not a problem for Mandarin. A similar assumption about the post-BEI agent is also adopted by Chow (2018) for Cantonese.

3.2 Patient in post-V position

Let us then turn to the passive construction in which the patient argument of the transitive verb maps onto the immediate post-V position. I have argued in 2.3 that when appearing post-verbally, the patient argument is the object of the clause. In (39), the internal argument of BEI is expressed as the SUBJ of the passivized transitive verb *cai3* ‘step-on’, but when raising to the matrix f-structure, it is the non-thematic OBJ of BEI:

(40) Bei4 ta1 cai3 zhao2 she2 le0.
被 她 踩 着 蛇 了
BEI she step-on snake PERF
‘A snake was stepped on by her.’

(repeating (2b))

$$\left[\begin{array}{ll} \text{PRED} & \text{`BEI} < \text{Arg}_1 >\text{'} \\ \text{OBJ} & \boxed{1} \\ \text{OBJ} & \left[\begin{array}{lll} \text{PRED} & & \text{`step-on} < \text{Arg}_{2},\ \text{Arg}_3 >\text{'} \\ \text{OBL} & & [\text{PRED `pro'}]_2 \\ \text{SUBJ} & \boxed{1} & [\text{PRED `snake'}]_3 \end{array}\right]_1 \end{array}\right]$$

When BEI combines with intransitive verbs, the linkage of the sole argument is suppressed and it maps onto an oblique function.[12] Then no argument is left to map onto a direct grammatical function, thus no function is raised to the matrix f-structure. The f-structure in (41) illustrates this point.

(41) Bei4 ta1 pao3 le0.
被 她 跑 了
BEI she run PERF
‘She ran.’

(repeating (5a))

[12] Recall that the agent argument in passive constructions with intransitive verbs is always expressed, though theoretically, it is optional. The reason is not clear at the moment. I leave this issue for further study.

$$
\left[\begin{array}{ll}
\text{PRED} & \text{`BEI} < \text{Arg}_1 > \text{'} \\
\text{OBJ} & \left[\begin{array}{ll}
\text{PRED} & \text{`run} < \text{Arg}_{â‘ ¡} > \text{'} \\
\text{OBL} & [\text{PRED `pro'}]_2
\end{array}\right]_1
\end{array}\right]
$$

Recall that, when combining with intransitive verbs, only unergatives make the construction grammatical. Unaccusative verbs cannot be passivized by BEI, which contributes evidence to confirm the Unaccusative Hypothesis. I will not go into details here for the space limitation.

One may wonder if there is a thematic null subject in (40) and (41), as opposed to our assumption that no subject exists in the matrix clause, since "a lot of things called passive in the literature turn out not to be passive in any useful sense. Some so-called subjectless constructions turn out to have thematic null subjects. (Maling 2010)" Yet in the very same paper, the author points out that in real impersonal active constructions, an agentive *by*-phrase is impossible. Here in (40) and (41) however, the agent argument can appear as an oblique,[13] and there are no other thematic arguments left to map onto a "thematic null subjects". Constructions such as (40) and (41) are real subjectless constructions, which implies that a grammatical subject is not necessary for every clause.

4 Conclusions

This paper analyzes the less studied BEI-passive constructions in Mandarin Chinese, i.e., passive constructions in which the patient argument of the transitive verb appears post-verbally, as well as passives with intransitive verbs. BEI is proposed to be a raising verb and the passive marker that blocks the linkage of the agent argument of the verb that it combines. An implication is that a subject is not necessary for every clause. The Subject Condition as an inviolable well-formedness condition in current mapping theories should therefore be reconsidered.

Two points remain unsolved and are left to further studies. First, in passive constructions with unergative verbs, it is not clear why it is obligatory to express the agent argument as an oblique function, which is theoretically an optional operation. Second, it is not clear why a post-V patient in a passive clause (with transitive verbs) maps onto an OBJ whereas a pre-BEI patient maps onto the SUBJ of the construction. Given the importance of word order in analytic languages, the role of word order in the mapping process needs to be further explored to get a better comprehension of argument realization issues in Mandarin Chinese.

[13] And in fact, must appear, in (41), though the reason remains unknown to us at the moment.

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