Proceedings of the 27th International Conference on Head-Driven Phrase Structure Grammar

Online (Berlin/Seattle)

Stefan Müller, Anke Holler (Editors)

2020

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Contents

Editor's note

The 27th International Conference on Head-Driven Phrase Structure Grammar (2020) was planned to take place in Leuven (organized by Frank Van Eynde and Liesbeth Augustinus), but due to the Corona pandemic it was organized online by Stefan Müller (Humboldt Universität zu Berlin) and Olga Zamaraeva (University of Washington, Seattle).

The conference featured 3 invited talks and 11 papers selected by the program committee (Anne Abeillé, Doug Arnold, Emily Bender, Felix Bildhauer, Hans Boas, Olivier Bonami, Francis Bond, Gosse Bouma, Antonio Branco, Rui Chaves, Philippa Cook, Berthold Crysmann, Dan Flickinger, Antske Fokkens, Petter Haugereid, Fabiola Henri, Thomas Hoffmann, Anke Holler (chair), Gianina Iordăchioaia, Paul Kay, Jong-Bok Kim, Jean-Pierre Koenig, David Lahm, Bob Levine, Nurit Melnik, Laura Michaelis, Philip Miller, Stefan Müller, Tsuneko Nakazawa, Petya Osenova, Rainer Osswald, Gerald Penn, Frank Richter, Louisa Sadler, Manfred Sailer, Pollet Samvellian, Jesse Tseng, Stephen Wechsler, Eun-Jung Yoo, Shûichi Yatabe).

We want to thank the program committee for putting this nice program together.

As in the past years the contributions to the conference proceedings are based on the five page abstract that was reviewed by the program committee, but there is no additional reviewing of the longer contribution to the proceedings. To ensure easy access and fast publication we have chosen an electronic format.

The proceedings include all the papers of the conference except the ones by Liesbeth Augustinus, Gosse Bouma, Frank Van Eynde & Jong-Bok Kim, Gert Webelhuth and Shûichi Yatabe.

An inside-out approach to French causatives

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Abstract

In this paper[1], we provide a novel account of French causatives that crucially derives the core properties of the construction inside-out from the downstairs lexical verb to the causative verb, rather than outside-in, as is commonly assumed by argument composition (Miller & Sag, 1997; Abeillé et al., 1997; Abeillé et al., 1998). We shall argue on the basis of clitic trapping (Miller & Sag, 1997), as well as marking of the downstairs subject (Koenig, 1998) that the downstairs verb assumes a more active role than what is suggested by an argument composition approach and, conversely, we shall show that argument composition leads to problems with coordination and with en-cliticisation. The analysis we are going to propose combines an inversion analysis of the downstairs subject as a downstairs complement, accounting for scrambling and case marking, with an analysis of clitic climbing in terms of inflectional periphrasis (Aguila-Multner & Crysmann, 2020).

Clitic climbing, defined in Romance as the non-local realisation of clitic or affixal pronominal arguments, is limited in modern French to four cases: tense auxiliaries *avoir* and *être*, copular *être* and other predicative constructions, causative *faire* ("make") and *laisser* ("let"), and certain perception verbs like *voir* ("see"). Examples (1–4) illustrate the phenomenon in the four classes of constructions, respectively.

(1) a. Le chat l' a cassé.
the cat DO.SG have.PRS.3SG broken
'The cat broke it.'

b. Le chat y est allé.
the cat LOC be.PRS.3SG gone
'The cat went there.'

(2) a. Un chat leur sera donné.
a cat IO.PL be.FUT.3SG given
'A cat will be given to them.'

b. Le chat nous restera fidèle.
the cat 1PL remain.FUT.3SG loyal
'The cat will remain loyal to us.'

(3) a. Je le ferai manger au chat.
I DO.SG.M make.FUT.1SG eat to.the cat
'I will make the cat eat it.'

b. Je le laisserai manger au chat.
I DO.SG.M let.FUT.1SG eat to.the cat
'I will let the cat eat it.'

[1]We would like to thank the audience at HPSG 2020 for their comments and discussion, in particular Anne Abeillé, Olivier Bonami, Danièle Godard, Jean-Pierre Koenig, and Laura Michaelis. The research reported here has been supported by a doctoral grant from U Paris to Gabriel Aguila-Multner and also benefitted from a public grant overseen by the French National Research Agency (ANR) as part of the program "Investissements d'Avenir" (reference: ANR-10-LABX-0083). It contributes to the IdEx Université de Paris - ANR-18-IDEX-0001. Authors' names are listed in alphabetical order.

(4) Je l' ai vu casser par le chat.
I DO.SG have.PRS.3SG seen break by the cat
'I saw the cat break it.'

Within Head-driven Phrase Structure Grammar (HPSG, Pollard & Sag, 1994), French clitic climbing has been analysed (Abeillé & Godard, 2002; Abeillé et al., 1997; Abeillé et al., 1998) as a case of argument composition (Hinrichs & Nakazawa, 1990), i.e. generalised raising of the downstairs verb's arguments by the auxiliary. In a more recent proposal (Aguila-Multner & Crysmann, 2020), we suggested an alternative approach to clitic climbing, building on the model of inflectional periphrasis in HPSG by Bonami & Webelhuth (2013); Bonami (2015). However, this analysis so far only accounts for temporal, passive and predicative constructions. In this paper we extend the periphrasis approach to the causative construction.

We follow Abeillé et al. (1998) (after Hyman & Zimmer, 1976) in assuming two types of causative constructions in French, a generalisation summarised in the following section. The proposals based on argument composition by Abeillé & Godard (2002); Abeillé et al. (1998) are then presented in Section 2. Section 3 argues for an inside-out approach that gives more control to the downstairs verb, while a critical discussion of the argument composition approach is provided in Section 4. After an interim summary in Section 5, a new analysis based on periphrasis is laid out in Section 6.

1 Two types of French causatives

When *faire* is followed by an infinitive, it can give rise to two sorts of causative meanings. One takes the form of a three-place predicate assigning roles to a causer, a causee, and a caused event; the first corresponds to the subject of *faire*, the second to an object of *faire* co-indexed with the downstairs verb's subject in a control construction, and the third argument corresponds to the verb phrase. We call this type of *faire* "control *faire*". The other *faire* only assigns two roles: a causer and a caused event. This type of *faire*, which we call "non-control *faire*", contrasts with control *faire* in the semantic inferences it gives rise to: since a causee role is assigned by control *faire*, this kind of causation is generally interpreted as being direct, while non-control *faire* does not license such inferences (Abeillé et al., 1997, pp 66-67). This difference in semantics leads to verbs with experiencer subjects such as *aimer* (to like) being dispreferred in the control construction, as experiencers are not expected to have control over the caused event and are therefore incompatible with the causee role. This is illustrated in example (5), where the only compatible causative meaning is the non-control one (5b).

(5) a. # Faites-les aimer Proust !
make-DO.3PL love Proust
'Make them like Proust.'

b. Faites-leur aimer Proust !
make-IO.3PL love Proust
'Make them like Proust.'

Several syntactic properties correlate with this distinction. Control *faire* invariably realises the (controller of the) downstairs subject as an accusative pronominal affix, as opposed to a phrase:

(6) Je l' ai fait manger des épinards.
I DO.3SG have made eat INDEF.PL spinach
'I made him eat spinach.'

(7) * J'ai fait manger des épinards les enfants.

Furthermore, clitic climbing is impossible with control *faire*:

(8) Je l' ai fait en manger.
I DO.3SG have made DO.INDEF eat
'I have made him eat some.'

(9) * Je l'en ai fait manger.

In the non-control construction, however, the realisation of the downstairs subject varies according to the transitivity of the infinitive: transitives give rise to a dative pronominal or an NP[à], while intransitives lead to an accusative pronominal or a bare NP.

(10) J' ai fait manger des épinards aux enfants.
I have made eat INDEF.PL spinach to.the children
'I made the children eat spinach.'

(11) J' ai fait dormir les enfants.
I have made sleep the children
'I have made the children sleep.'

This construction does license clitic climbing to *faire* (subject to some constraints, cf. Section 3.1):

(12) Je lui en ai fait manger
I IO.3SG DO.INDEF have made eat
'I have made him eat some.'

Finally, the downstairs subject in the non-control construction displays a peculiar pattern of realisation: when realised pronominally, it is always attached to *faire*. In case of phrasal realisation, however, the downstairs subject may scramble with other downstairs complements (or adjuncts for that matter), as illustrated by the following example.

(13) a. J' ai fait manger aux enfants des épinards.
I have made eat to.the children INDEF.PL spinach
'I had the children eat spinach.'

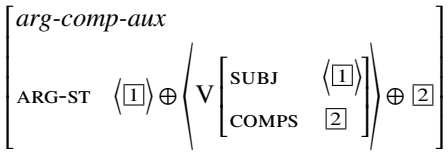

Figure 1: Argument composition

Thus, both marking and linearisation properties suggest that the logical subject of the downstairs verb enjoys the syntactic status of a non-subject complement.

2 Argument composition

Argument composition approaches to clitic climbing (Abeillé & Godard, 2002; Abeillé et al., 1997; Abeillé et al., 1998) rely on raising of the entirety of the downstairs verb's argument structure (and/or valence lists) by the upstairs verb. Arguments that are inherited in this way are naturally predicted to be hosted by the upstairs verb whenever they are affixal. In the case of causatives, non-control *faire* is then analysed as an argument composition verb. Figure 1 gives a schematic representation of such verbs.

Miller (1992) gives several arguments in defence of the flat structure of causatives. First, the free position of the downstairs subject relative to the complements of the infinitive is taken as evidence that the latter cannot form a VP with its complements alone. This does not rule out the possibility of a VP incorporating the downstairs subject, which we will explore in the analysis.

(14) Pierre a fait échanger les jouets aux enfants contre des livres.
Pierre has made exchange the toys to.the children against some books
'Pierre made the children swap the toys for books.' (Miller, 1992, 238)

Secondly, he draws an argument from the ungrammaticality of embedding of tense auxiliaries under a causative. He however admits that this ungrammaticality could be due to "some sort of independent semantico-pragmatic restriction" (p. 240 fn. 6), which is confirmed by the felicitous examples provided by Abeillé & Godard (1996, 38).

(15) a. Leur flair et leur ambition ont fait avoir fréquenté les
their intuition and their ambition have made have socialised.with the
gens qu' il fallait *(à) notre nouveau ministre et à sa femme.
people that EXPL had.to to our new minister and to his wife
'Their intuition and their ambition have made the new minister and his wife have been acquainted with the people that they needed to.'

b. La frugalité fait avoir vécu jusqu'à 110 ans (*à) notre fameuse
the frugality makes have lived until 110 years to our famous
concitoyenne, et la fera vivre encore longtemps.
copatriot and 3SG.ACC.F make live again a.long.time

'Frugality makes our famous copatriot have lived 110 years and will make her live an even longer time.'

(Abeillé & Godard, 1996, glossing and translation ours)

Thirdly, preverbal negation in the form of *ne pas* is impossible before the infinitive in the non-control case, which can easily be captured under the flat structure hypothesis, given that there is no infinitive VP for the negation to attach to. We return to this argument in the analysis.

(16) * Pierre fera ne pas rire Marie.
Pierre will make NEG not laugh Mary

(Miller, 1992, 240)

3 Restrictions imposed downstairs

As we have seen above, argument composition manages to reconcile climbing with a lexical perspective on pronominal affixation by means of giving the upstairs verb (*faire*) full control over the argument structure of the downstairs verb. In the *faire*-construction, however, there are still several cases where the downstairs verb maintains control over construction-specific aspects of realisation.

3.1 Trapping

With non-control *faire*, we typically observe climbing, i.e. upstairs realisation of all pronominal affixes of the downstairs verb. However, there are several exceptions: intrinsic arguments, medio-passive *se* and for most speakers even reflexive *se* resist climbing, as shown in (17).

(17) a. Le snobisme fait se vendre bien les classiques.
the snobism makes self sell well the classics
'Snobism makes the classics sell well.'

b. La chaleur a fait s'évanouir Paul.
the heat has made self.faint Paul
'The heat made Paul faint.'

c. (*) Marie a fait se laver les enfants.
Marie has made self wash the children
'Marie has made the children wash themselves.' (Abeillé et al., 1998, 24)

What is more, these intrinsic arguments also prevent any other pronominal affixes from being realised upstairs, with the exception of the downstairs subject.

(18) a. * Tout leur en fait vouloir à Paul.
everything IO.PL EN make angry to Paul
'Everything makes them/Paul angry at Paul/them.

b. Tout leur fait en vouloir à Paul.
everything IO.PL make EN angry to Paul
'Everything makes them angry at Paul.

c. Tout leur fait vous en vouloir.
everything IO.PL make 2.PL EN angry
'Everything makes them angry at you.'
(Miller & Sag, 1997, 609–610)

3.2 Subjects marked with *de/par*

Koenig (1998) notes another peculiarity of French *faire* construction which suggests that the downstairs verb plays a more active role with respect to argument realisation than what would be expected under an argument composition approach.

Agents of French passives can be expressed by either a *par*-phrase, or a *de*-phrase, the choice depending on the lexical aspect of the verb, i.e. whether it is dynamic (*par*) or stative *de*.

(19) Jean a été suivi *de / par Paul.
Jean has been followed of / by Paul
'Jean has been followed by Paul.'

(20) Le poisson a été suivi de / *par des rôtis.
the fish has been followed of / by INDEF.PL roasts
'The fish has been followed by a roast.'

In the *faire*-construction, realisation of the agent of the downstairs verb by an oblique by-phrase is equally possible, and we still observe sensitivity to the lexical aspect of the downstairs verb.

(21) Marc a fait suivre Jean *de / par Paul.
Marc has made follow Jean of / by Paul
'Marc had Jean followed by Paul.'

(22) Marc a fait suivre le poisson de / *par des rôtis.
Marc has made follow the fish of / by INDEF.PL roasts
'Marc had the fish be followed by a roast.'

With infinitives, however, realisation as a by-phrase is not a standard option. Koenig (1998) concludes that the grammatical function change must take effect on the downstairs verb, yet be conditioned inside-out on embedding in the causative construction.

4 Problems with argument composition

4.1 Controlling affixal realisation

The way argument composition is implemented in terms of structure sharing of ARG-ST lists, and therefore, structure sharing of the lists' elements, entails that any

constraint applied upstairs will also hold downstairs (and vice versa). If an upstairs *affixal-synsem* implies pronominal affixation, we would expect, *ceteris paribus*, that the same should hold downstairs. With auxiliary-participle constructions, this is a non-issue in French, since participles may not host pronominal affixes at all. French infinitives, however, can generally host pronominal affixes, so argument composition *per se* would predict affixal realisation to feature simultaneously on the upstairs and the downstairs verb. However, this expectation is not borne out, thereby weakening the appeal of argument composition.

Miller & Sag (1997, 609) work around the technical side of this problem by distinguishing the HEAD values of verbs into *bas(ic)-v(er)b* and *red(uced)-v(er)b*, where the former is the value for plain verbs without pronominal affixes, while the latter is the *default* value for verbs hosting pronominal affixes. This default is overridden with the value *bas-vb* in the case of verbs with intrinsic clitics (see section 3.1 on trapping), leading to the paradoxical situation that even the presence of regular, valence-reducing argument clitics does not imply the value *red-vb*. While the head types *bas-vb* and *red-vb* appear to be little more than diacritic features, their specific use in connection with trapping reveals their *ad hoc* nature.

4.2 Coordination

One key characteristic of argument composition is that gives it rise to a flat verb phrase structure that complicates the treatment of VP coordination: i.e. the lexical non-finite verb figures as a direct complement of *faire* and does not itself combine with its own complements to project a VP. Thus, what looks like a case of ordinary constituent coordination, as indicated by the bracketing in (23), must be analysed as a case of non-constituent coordination.

(23) a. Elle la leur a fait [apprendre par cœur] et [réciter le
she DO.SG.F IO.PL have.3SG.PRS made learn by heart and recite the
lendemain].
next.day
'She made them learn it by heart and recite it the next day.'

b. Elle a fait [lire Sartre par les garçons] et [réciter Prévert
she have.3SG.PRS made read Sartre by the boys and recite Prévert
aux filles].
to.the girls
'She made the boys read Sartre and the girls recite Prévert.'

Under a traditional layered VP structure non-finite VP coordination an analysis in terms of conventional VP coordination is possible, as has been pointed out for tense constructions already by Manning (1997) and Aguila-Multner & Crysmann (2020).

4.3 en-cliticisation

Another piece of evidence that challenges the argument composition approach is contributed by *en*-cliticisation in conjunction with trapping.

The relevant contrasts are given in (24) below: non-local *en*-cliticisation is subject to the same trapping effect as ordinary argument clitics.

(24) a. Je leur ai fait s' en rappeler la fin.
I IO.SG have.PRS.1SG make.PTCP REFL.3 EN remember.INF the end
'I have made them remember the end of it.'

b. * je leur en ai fait se rappeler la fin
I IO.SG EN have.PRS.1SG make.PTCP REFL.3 remember.INF the end

(25) Voici le roman dont je leur ai fait se rappeler la fin.
here's the novel OF.WHICH I IO.PL have made REFL.3 remember.INF the end.
'Here's the novel I made them remember the end of.'

With argument composition, the above contrast is actually quite surprising: as discussed by Miller & Sag (1997), *dont*-relativisation and *en*-cliticisation are non-local in that they refer to a *de*-NP that can be arbitrarily deeply embedded within a complement of the host. To capture this, they argue that *en*-cliticisation goes piggy-back on the unbounded dependency independently needed for *dont*-relativisation, and propose a lexical rule that inserts an affixal synsem to bind the *de*-NP SLASH value of the verb's *canonical* complement. Given argument composition, this lexical rule should be able to apply not only to the lexical verb, but also to *faire*, in which case upstairs realisation will be predicted where only downstairs trapping should be possible.

5 Summary

In the previous sections, we have observed that the downstairs verb plays a more prominent role in the French causative construction than an argument composition approach would suggest: most notably the realisation of the downstairs subject, i.e. whether it surfaces as a bare NP or an indirect object, is a property decided by the transitivity of the downstairs verb. Furthermore, as discussed by Koenig (1998), the choice between *par* and *de* as an alternate marking for the subject of a transitive is determined by the lexical aspect of the downstairs verb. As for clitic climbing, trapping also militates for a position that grants the downstairs verb more active control over the construction.

In the remainder of this paper, we shall present a novel approach to the grammar of French causatives that does away with argument composition and derives the core properties of the construction inside-out from the downstairs lexical verb. In essence we shall generalise the inside-out dependence of *par/de* marking on an embedding causative verb and suggest that realisation as a direct or indirect object is equally an instance of demotion of the downstairs subject valency to a complement.

This "inversion" approach shall prove capable of deriving a number of core facts of the construction without having to rely on argument composition: if the downstairs subject is demoted to COMPS, scrambling with other complements of the downstairs verb is expected, cf. (13). Similarly, indirect object marking with transitives can equally be motivated by a ban on double accusatives as a constraint on the COMPS list of the downstairs verb. Finally, the perspective of representing all arguments of the downstairs verb as its complements provides for a straightforward account of VP coordination, including mixed subject marking, as shown in (23b).

Turning to clitic climbing, we have suggested in recent work (Aguila-Multner & Crysmann, 2020) that climbing with tense auxiliaries is best understood as an instance of periphrastic inflection (Bonami, 2015), arguing more specifically that delegation of pronominal affixation to the auxiliary is parasitic on an existing morphological inside-out dependency, namely tense periphrasis. Here, we shall extend our approach and suggest that clitic climbing in causatives equally relies on an independently motivated inside-out dependency (Koenig, 1998).

The analysis we are going to propose improves over the argument composition approach also in the area of *en*-cliticisation: given that there is no argument composition, *en*, just as all other clitics, can only ever originate on the downstairs verb. With intrinsic clitics, *en* will then be trapped, while it can climb otherwise, the decision being ultimately made by the downstairs verb.

6 Analysis

We have seen in Section 3 that the downstairs verb in constructions with non-control *faire* exerts a significant amount of control on argument realisation, both in terms of the realisation of the downstairs subject and in terms of the possibility vs. impossibility of clitic climbing. Rather than using argument composition to make as much information as possible available to the causative verb, we shall build on the work on clitic climbing via periphrasis by Aguila-Multner & Crysmann (2020) and place the various constraints associated with this construction on the downstairs verb.

6.1 Clitic climbing as periphrastic morphology

In our analysis of clitic climbing in French tense constructions (Aguila-Multner & Crysmann, 2020), we built on Bonami (2015)'s theory of inflectional periphrasis to reduce clitic climbing to a case of periphrastic exponence. Bonami's theory relies on reverse selection, a form of inside-out constraint, to allow the lexical element in a periphrase to impose morphological constraints to the auxiliary that syntactically selects for it, effectively creating a dependency that can convey information output by the inflectional component, i.e. periphrastic exponence. Since pronominal clitics in French are best analysed as lexical affixes (Miller, 1992), their non-locality in tense periphrases with clitic climbing can be accounted for as a form of periphrastic exponence, reverse-selected for by the downstairs verb to the auxiliary; in other words,

realisation of pronominal arguments is just another property that is realised upstairs in a French tense auxiliary construction, along with TAM and subject agreement.

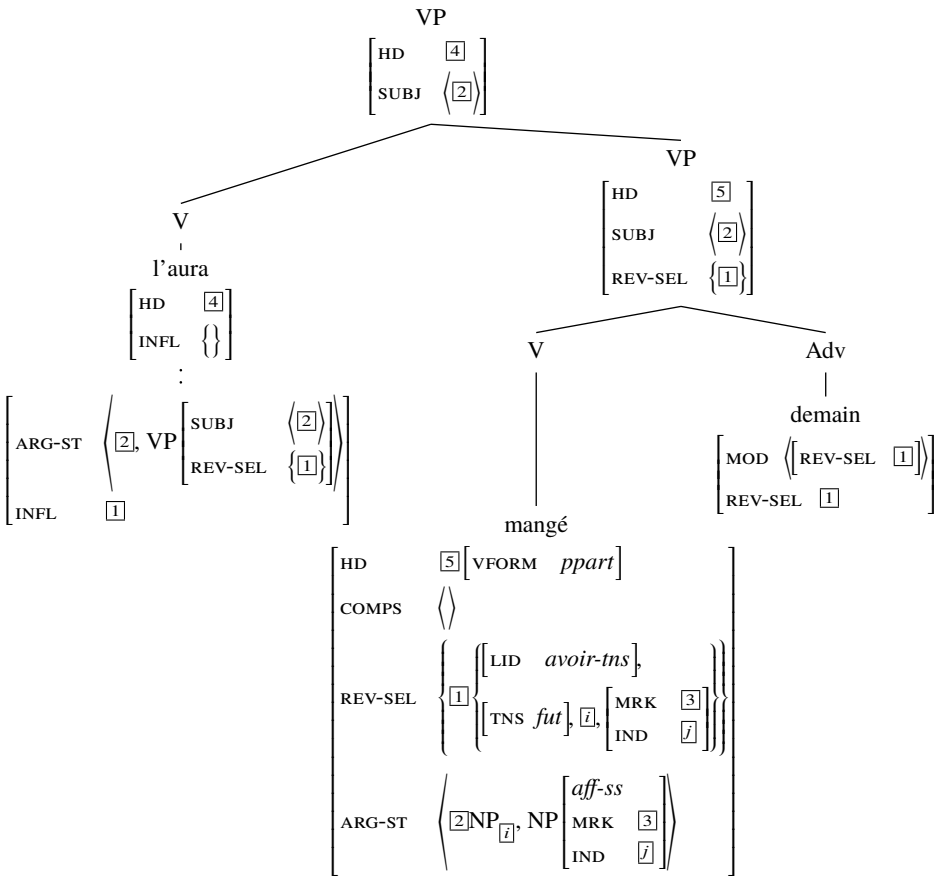

Figure 2: Percolation of periphrastic pronominal affixation

Figure 2 summarises the analysis of periphrastic realisation of pronominal affixes with a sample derivation of clitic climbing in periphrastic tenses. In essence, the lexical verb places its morphological requirements for the ancillary element in a feature REV(ERSE)-SEL(ECTION), which is passed up along the head projection path. The ancillary element, in this case a head governing the VP projection, lexically equates the requirements of its complement with its own INFL value, which defines the input for morphological realisation rules.

We define REV-SEL as a set-valued[2] feature located under CAT. The percolation mechanism of this feature is made explicit in Figure 3: ancillary lexemes subcategorise for an element with a non-empty REV-SEL set, one element of which they check against their INFL feature, while the rest is passed up to the ancillary lexeme's own REV-SEL. Non ancillary elements do not combine with elements carrying re-

[2]The REV-SEL feature was originally defined as list-valued by Aguila-Multner & Crysmann (2020), but we do not find any use for ordering of multiple reverse selection dependencies.

verse selection dependencies. Inheritance of REV-SEL by phrases proceeds simply from the head in head-valence phrases, and from both heads in coordinated phrases.

$$\textit{non-anc-hd-lex} \rightarrow \left[\begin{array}{ll} \textsc{ss} & \left[\begin{array}{ll} \textsc{loc} & \left[\textsc{cat.rev-sel} \quad \{\}\right] \\ \textsc{arg-st} & \left\langle \left[\textsc{loc.cat.rev-sel} \{\}\right] \ldots \left[\textsc{loc.cat.rev-sel} \{\}\right] \right\rangle \end{array}\right] \end{array}\right]$$

(a) Non-ancillary head

$$\textit{anc-hd-lex} \rightarrow \left[\begin{array}{ll} \textsc{ss} & \left[\begin{array}{ll} \textsc{loc} & \left[\textsc{cat.rev-sel} \quad \boxed{2}\right] \\ \textsc{arg-st} & \left\langle \ldots \left[\textsc{loc.cat.rev-sel} \{\boxed{1}\} \cup \boxed{2}\right] \ldots \right\rangle \end{array}\right] \\ \textsc{infl} & \boxed{1} \cup \textit{set} \end{array}\right]$$

(b) Ancillary head

Figure 3: Constraints on saturation of REV-SEL

6.2 Realisation of pronominal affixes

As stated in Aguila-Multner & Crysmann (2020), we assume argument mapping rules that type elements of ARG-ST with one of three synsem types (*canon-ss, gap-ss, praf-ss*) and insert them to the relevant features accordingly: canonical elements are left on valence lists, gap elements are tied to non-local features, and most relevantly here pronominal affixes are added to the inflectional agenda INFL as structures of type *praf*, containing case/marking and an index value. This is illustrated in Figure 4.

$$\left[\begin{array}{ll} \textsc{comps} & \boxed{2}\ \textit{list(canon)} \\ \textsc{infl} & \boxed{3} \cup \left\{\left[\begin{array}{lll} \textit{praf} & & \\ \textsc{mrk} & \boxed{m_1} & \\ \textsc{ind} & \boxed{i_1} & \end{array}\right] \ldots \left[\begin{array}{lll} \textit{praf} & & \\ \textsc{mrk} & \boxed{m_n} & \\ \textsc{ind} & \boxed{i_n} & \end{array}\right]\right\} \\ \textsc{dtr} & \left[\begin{array}{ll} \textsc{arg-st} & \left\langle \boxed{1}, \left[\begin{array}{lll} \textit{aff-ss} & & \\ \textsc{head}|\textsc{mrk} & \boxed{m_1} & \\ \textsc{cont}|\textsc{ind} & \boxed{i_1} & \end{array}\right] \ldots \left[\begin{array}{lll} \textit{aff-ss} & & \\ \textsc{head}|\textsc{mrk} & \boxed{m_n} & \\ \textsc{cont}|\textsc{ind} & \boxed{i_n} & \end{array}\right] \right\rangle \circ \textit{list(gap)} \circ \boxed{2} \\ \textsc{infl} & \boxed{3} \end{array}\right] \end{array}\right]$$

Figure 4: Mapping of pronominal arguments

Our implementation of the inflectional component is a set-valued feature INFL that acts as an agenda of morphosyntactic properties to be realised; realisation rules (synthetic and periphrastic) empty its contents and an empty INFL set is a requirement for entering syntax. A derivation for a simple tensed verb with local pronominal affixation is given in Figure 5 as an illustration of this morphology-syntax inter-

face: the verbal lexeme undergoes the mapping rule which adds a *praf* to its INFL, and inflectional rules symbolised by the dotted line realise it (along with TAM and agreement properties) accordingly with the form *les mangera*. Such rules can realise properties inherited by an ancillary element from their complement's REV-SEL, since their inheritance is mediated by INFL, as illustrated by the pronominalisation rule that applies to *l'aura* in Figure 2.

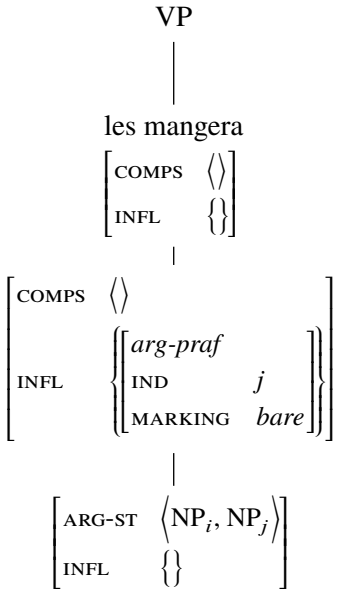

Figure 5: Synthetic pronominalisation

6.3 Realisation of the downstairs subject

All that is required now in order to model clitic climbing in causatives is a lexical rule to introduce the reverse-selection for *faire*. As argued by Koenig (1998), causativised infinitives independently need to carry an inside-out constraint for their licensor (causative *faire*) to properly constrain realisation of their subject as a *par* or *de*-phrase. I.e. the downstairs verb's subject is demoted to an oblique complement, contingent on the embedding under the causative verb. Our analysis goes piggyback on this independently required inside-out dependency (Koenig actually assumes argument composition together with a flat structure of VP): on the one side, we shall generalise realisation of the downstairs subject as an oblique complement to the case of realisation by an indirect object (transitives) or a direct object (intransitives). On the other hand, we shall argue that if there is already an inside-out dependency on a causative predicate, an analysis of clitic climbing as periphrasis will come at little extra cost. This is highly similar to the case of tense auxiliaries (Aguila-Multner & Crysmann, 2020) where periphrastic realisation of pronominal affixation depends on an already existing periphrastic relation between the participle and the auxiliary

for the expression of tense.

The relevant lexical rule is given in Figure 6, using the feature LID for identification of the causative verb. Generalising the case of oblique by-phrase realisation of the downstairs subject to direct and indirect objects, we suggest to extend the COMPS list of the downstairs verb with an NP co-indexed with the first element of ARG-ST. I.e. we essentially entertain an inversion analysis for downstairs NP subjects. Subtypes of this rule select the appropriate marking value on this inverted NP, sensitive to the argument structure and/or lexical semantics of the verb.

This rule only creates causative infinitive verbal lexemes, and given that French lacks a synthetic way of realising causative voice, these lexemes need a periphrasis rule to delegate their morphosyntactic properties to the relevant ancillary element (*faire*). As given in Figure 7, this rule not only delegates the realisation of causative voice, but also delegates expression of any *praf* specifications.

Finally, an entry for the causative verb is given in Figure 8. As was the case with *avoir*, *faire* inherits part of its inflection from its verbal complement's REV-SEL set, including any pronominal affixes delegated by the periphrasis rule.

The tree in Figure 9 summarises the analysis in the simple case of an intransitive verb (*dormir*) with an affixal subject. The one in Figure 10 features clitic climbing of the downstairs object.

$$\begin{bmatrix} \textsc{head} & \left[\textsc{vform} \quad \textit{nonfinite}\right] \\ \textsc{infl} & \left\{\left[\textsc{lid} \quad \textit{faire-lid}\right]\right\} \\ \textsc{subj} & \langle\rangle \\ \textsc{comps} & \boxed{1} \oplus \left\langle \mathrm{NP}_i \left[\textsc{marking} \quad \textit{bare} \vee \textit{à} \vee \textit{par} \vee \textit{de}\right]\right\rangle \\ \textsc{dtr} & \begin{bmatrix} \textsc{infl} & \{\} \\ \textsc{subj} & \langle \mathrm{NP}_i \rangle \\ \textsc{comps} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

Figure 6: Lexical rule for causativised verbs

$$\begin{bmatrix} \textsc{head} & \left[\textsc{vform} \quad \textit{nonfinite}\right] \\ \textsc{rev-sel} & \left\{\boxed{1} \cup \boxed{2}\ \textit{set}\left(\left[\textit{praf}\right]\right)\right\} \cup \boxed{3} \\ \textsc{infl} & \{\} \\ \textsc{dtr} & \begin{bmatrix} \textsc{rev-sel} & \boxed{3} \\ \textsc{infl} & \boxed{1}\left\{\left[\textsc{lid} \quad \textit{faire-lid}\right]\right\} \cup \boxed{2} \end{bmatrix} \end{bmatrix}$$

Figure 7: Lexical rule for causative periphrasis

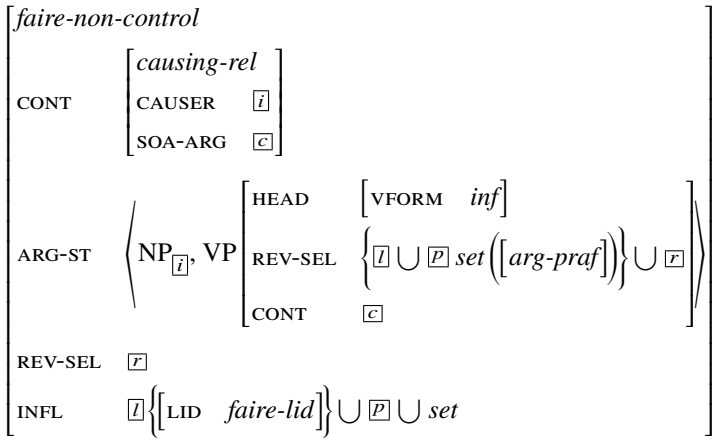

Figure 8: Non-control *faire*

6.4 Intrinsic arguments and trapping

Having laid out the basic line of analysis, we shall now turn to the treatment of trapping. As described in Section 3.1, trapping is triggered by lexically specified intrinsic arguments as well as inherent, medio-passive, and, for most speakers, reflexive *se*, so an important question is how such arguments are represented as part of the lexical entry of the verb. There are two basic observations regarding all these arguments: first, they are always realised affixally (cf. Abeillé et al., 1998), and second, intrinsic arguments, including inherent *se*, are not assigned a thematic role. This observation already carries over to medio-passive *se*, which is best understood as an exponent of grammatical function change (Grimshaw, 1982; Wehrli, 1986). Following Crysmann (2003), we shall therefore assume that intrinsic arguments and reflexives can be represented on ARG-ST as *aff-ss* objects whose CONT value is either *expl*, as is the case of intrinsic arguments, or else *refl*.

Given such an explicit representation of argument type, we shall always be able to detect the presence of intrinsic arguments and enforce their local realisation prior to the application of the causative lexical rule. This can be ensured by augmenting the description of non-control *faire* with a type constraint on the set of *praf* elements it may inherit as *arg(umental)-pr(onominal)af(fixes)*. This is exemplified in Figure 8. Figure 11 illustrates the derivation of a sentence with trapping of intrinsic *en* (*en vouloir* "to be angry with").

6.5 Interaction with tense auxiliaries

With at least two separate constructions (*faire* and *avoir/être*) entering a reverse selection dependency, the question arises what their possible combinations are and whether the analysis adequately generates them. A first combination is the possibility for *avoir* to embed a causative construction headed by *fait* (PTCP). In this case, any climbing from the downstairs infinitive to *faire* is simply further deferred to the

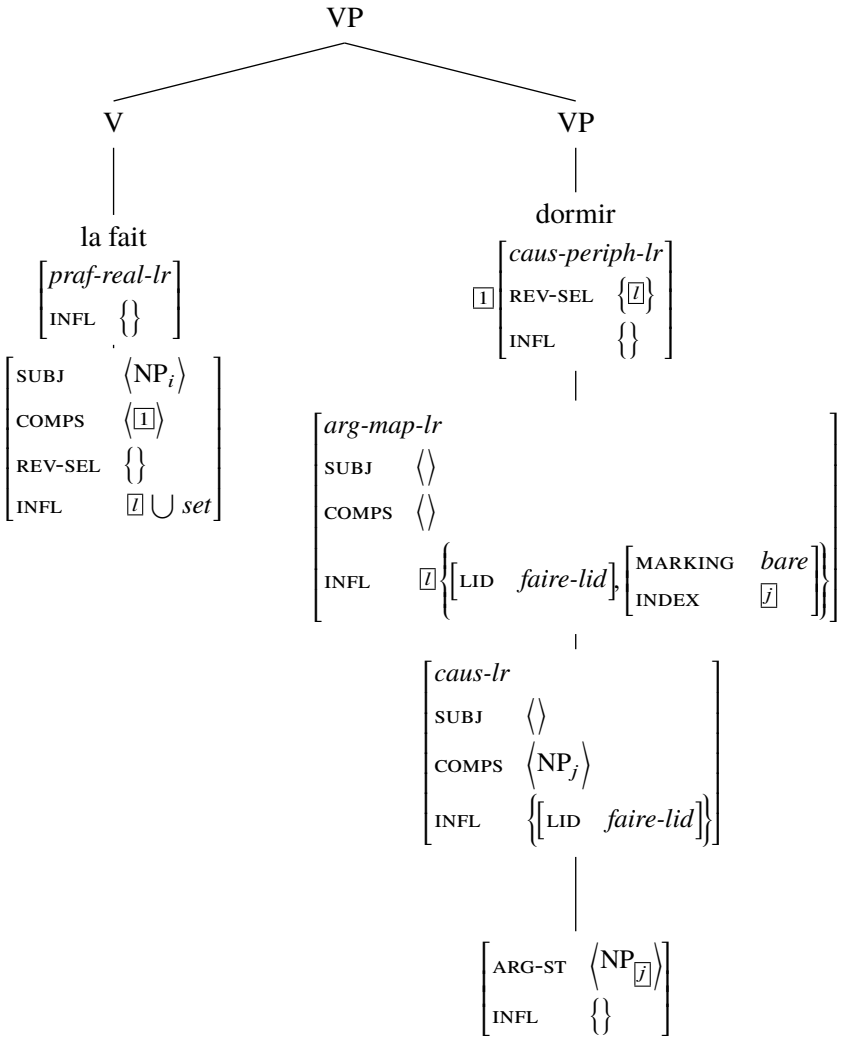

Figure 9: Sample derivation with affixal subject

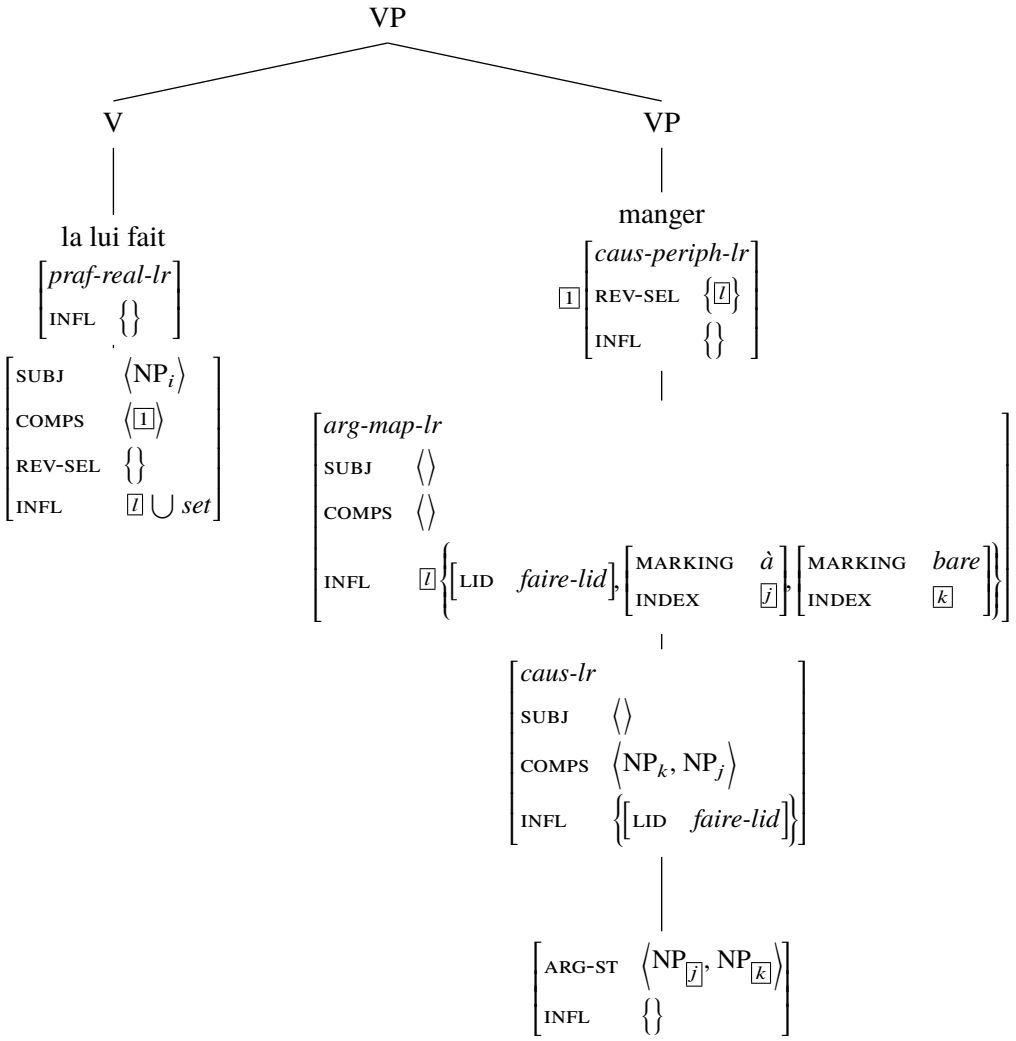

Figure 10: Sample derivation with affixal subject and climbing

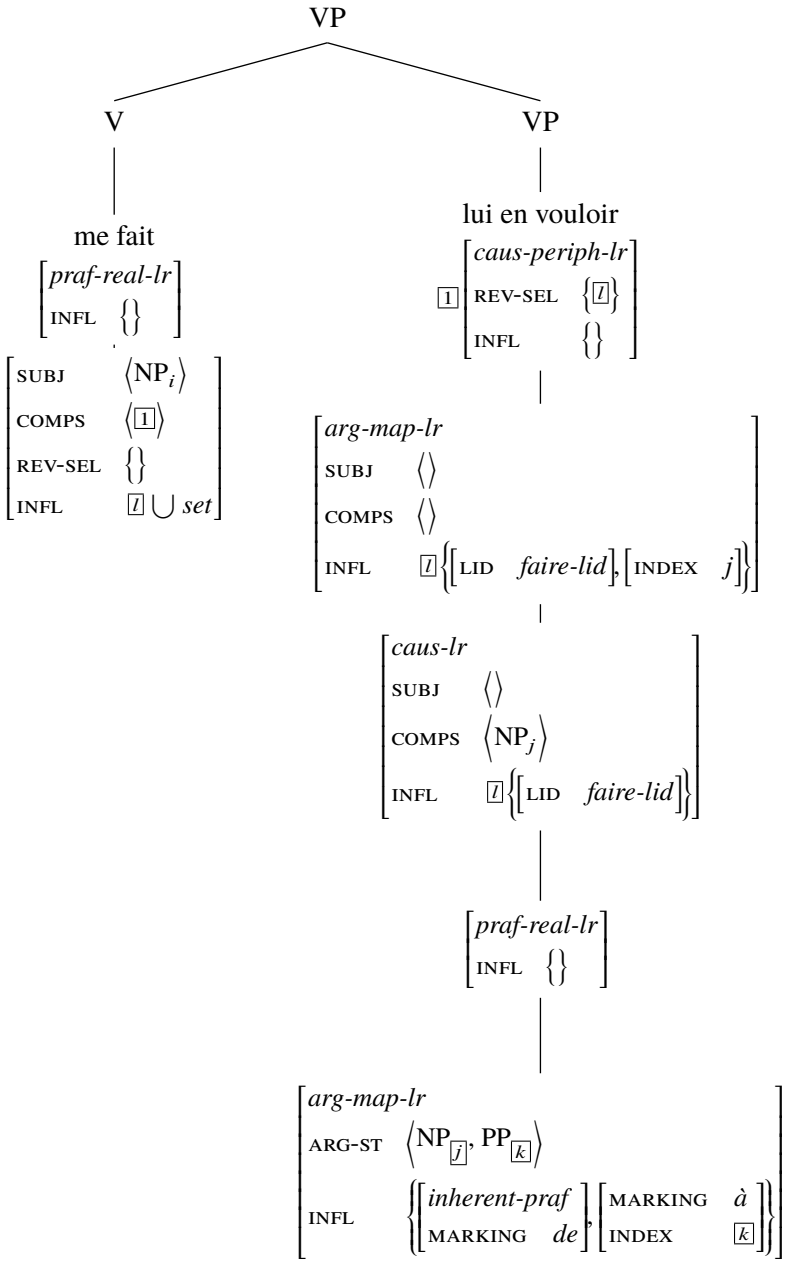

Figure 11: Sample derivation with affixal subject and trapping

tense auxiliaries, consistent with the rule of obligatory climbing from participles. Our approach readily captures this given the rules and lexical entries previously given: climbing from the infinitive is covered regardless of the particular form of *faire*, and the *praf* objects will be inherited by *fait*'s lexical entry on INFL. Participle periphrasis rules such as given in Aguila-Multner & Crysmann (2020) operate on a verb's INFL (and not e.g. directly on ARG-ST), and will appropriately create a new REV-SEL dependency with a tense auxiliary (in this case *avoir*) which contains all pronominal affixes inherited from the previous dependency.

More challenging is the second possible combination: a perfective periphrase can be embedded under *faire* (15). Again climbing of all affixes is obligatory from the participle to *avoir/être*, but further climbing to *faire* is limited to the downstairs subject in the presence of an intrinsic affix, following the trapping rule described in Section 3.1. Our approach as previously stated however suffices to produce the desired outcome, on the assumption that in the sequence of inflection rules aspect periphrasis precedes causativisation. This way the trapping case is covered by the early application of the mapping rule, after which all pronominal affixes will be inserted into the REV-SEL dependency by the aspect periphrasis rule, with the exception of the subject, which has not yet been inverted and is therefore not available to mapping. The affixal subject can only be mapped after the causativisation rule instead, and therefore after the aspect periphrasis rule; as a consequence its only possibility of realisation is to enter the REV-SEL dependency established by the causative periphrasis rule, which in the full climbing case will also contain all other pronominal affixes (Figure 7), effectively climbing from the participle to *faire* in one go.

Before closing, a remark is due concerning negation with non-control *faire*: as observed by Miller (1992), the downstairs infinitive cannot be modified by *ne pas*, unlike standard VPs. One way to capture this constraint is to ensure that negative modifiers cannot disrupt morphological periphrasis, e.g. by requiring that these modifiers select for a head whose REV-SEL value of the head is the empty set.

6.6 Control *faire*

To complement our analysis of French non-control *faire*, a brief remark is due to its counterpart, control *faire*: essentially, we shall follow Abeillé et al. (1998) in assuming that control *faire* is a standard object equi verb that assigns the thematic role of causee to its affixal direct object complement, the controller of the downstairs subject. Cf. Figure 12 for a sample lexical entry.

7 Conclusion

In this paper we have provided an analysis of clitic climbing in French causatives that is based on reverse selection from the downstairs infinitive to the causative verb. Building on Koenig (1998)'s argument for an inside-out view of such constructions

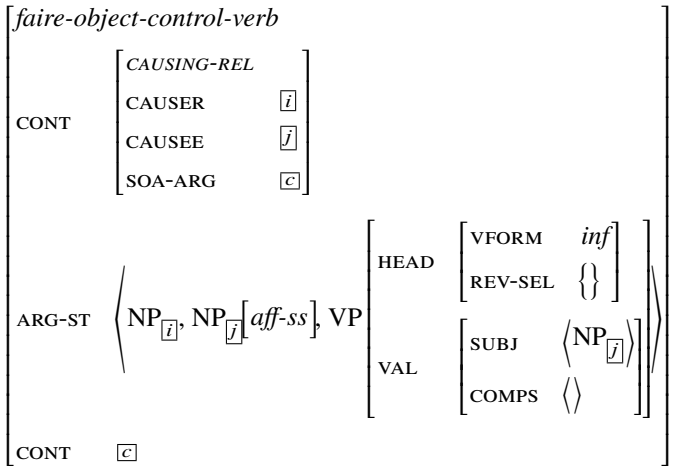

Figure 12: Control *faire*

and on Aguila-Multner & Crysmann (2020)'s proposal for clitic climbing by periphrasis with French tense auxiliaries and predicatives, this approach disposes with the need for argument composition and the concomitant flat structure of the VP. Instead, by giving the downstairs verb not just partial (Koenig, 1998) but full control over the realisation of its arguments, it covers the possibilities of climbing or trapping of arguments, the possible realisations of the subject including their dependence on lexical aspect, and the two possible realisations of the subject as either a climbing affix or a local phrasal complement. Moreover, the present approach to non-control *faire* is highly parallel to the periphrastic approach to climbing advanced by Aguila-Multner & Crysmann (2020): in both cases, morphological periphrasis goes piggyback on an independently required inside-out dependency, and in both cases, the syntax-semantics mismatch entailed by argument composition has been resolved in favour of syntax-semantics alignment. It is furthermore fully compatible with the approach to tense periphrasis in the interaction of the two phenomena. Finally, the present approach provides the missing piece towards a morphological theory of clitic climbing, showing that the periphrasis approach does scale up from auxiliary constructions to the full range of climbing phenomena.

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On a family of Welsh constructions

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Abstract

Research on unbounded dependency constructions (UDCs) has focused mainly on the properties that are shared by all UDCs, but a satisfactory theory of syntax also needs to capture the properties that distinguish specific UDCs and the properties that are shared by some but not all of them. Three Welsh unbounded dependency constructions – *wh*-interrogatives, free relatives, and cleft sentences – are of interest here because they show a challenging array of similarities and the differences. However, given a slightly expanded hierarchy of phrase types, HPSG can capture both the similarities and the differences in this area.

1. Introduction

A satisfactory theory of syntax needs to be able to capture the properties that are shared by all members of a family of related constructions, but it also needs to be able to deal with the properties that distinguish specific members of the family and the properties that are shared by a subset of them. Particularly interesting in this context are unbounded dependency constructions (UDCs), which have been a major focus of research since Ross (1967) and Chomsky (1977). Research into these constructions has naturally concentrated on their shared properties, especially island phenomena, and, in some languages, resumptive pronouns. However, it is also necessary to capture the properties of specific UDCs and the properties that characterize some but not all of them. Building on Sag (1997) and Ginzburg and Sag (2000), Sag (2010) shows how an appropriate hierarchy of phrase types allows this to be done within HPSG. In this paper, I will look at three Welsh UDCs, which show a challenging array of similarities and the differences: *wh*-interrogatives, free relatives, and what I will call cleft sentences (although they are superficially rather different from English cleft sentences). I will show that it is not difficult, given a slightly expanded hierarchy of phrase types, to capture the properties which they all have, the properties which two of them have, and the properties which distinguish each from the other two.

The paper is organized as follows. In section 2, I outline the basic facts of the three Welsh UDCs. Then, in section 3, I consider the analytic issues in a preliminary way. Building on this in section 4, I set out basic HPSG analyses for the constructions, and then in section 5, I propose a system of types

* This is a descendant of a paper presented at the Fifth Celtic Linguistics Conference in Gregynog, Mid Wales, in September 2007. An early version was published as Borsley (2008). I am grateful to Bob Morris Jones for help with the data and to the late Ivan Sag for helpful comments. Of course, I alone am responsible for what appears here.

and constraints, which license just the right structures and capture both the similarities and differences among the three constructions. Finally, in section 6, I summarize the paper.

2. Basic data

In this section I will outline the main properties of Welsh *wh*-interrogatives, free relatives, and clefts. They share certain properties. However, they also differ in important and interesting ways.

We can deal with *wh*-interrogatives fairly briefly. They are rather like their counterparts in English and many other languages and involve an initial *wh*-phrase and a following gap, as in (1a), or a resumptive pronoun, as in (1b):[1]

(1) a. Pwy weloch chi?
who see.PAST.2PL you.PL
'Who did you see?'
b. Pa ddynion cytunodd Gwyn â nhw?
Which men agree.PAST.3SG Gwyn with them
'Which men did Gwyn agree with?'

The verb precedes the subject in these examples because Welsh is a VSO language with verb-subject order in all finite clauses. Like their English counterparts, *wh*-interrogatives allow a variety of *wh*-phrases, but, as we would expect, the nature of the *wh*-phrase has no influence on their distribution. A *wh*-interrogative with an adverbial *wh*-phrase has the same distribution as a *wh*-interrogative with a nominal *wh*-phrase:

(2) Gofynodd Gwyn [beth naeth Megan].
ask.PAST.3SG Gwyn what do.PAST.3SG Megan
'Gwyn asked what Megan did.'
(3) Gofynodd Gwyn [lle aeth Megan].
ask.PAST.3SG Gwyn where go.PAST.3SG Megan
'Gwyn asked where Megan went.':

They may be finite, as in (1)–(3), or non-finite, as in (4):

(4) Gofynnodd Gwyn [pa lyfr i 'w ddarllen]
ask.PAST.3SG Gwyn which book to 3SGM read
'Gwyn asked which book to read.'

[1] Roughly gaps appear in more accessible positions and resumptive pronouns in less accessible positions. See Borsley, Tallerman and Willis (2007: chapter 4) for discussion, and Borsley (2013) for an HPSG analysis.

Free relatives are also rather like their English counterparts with a *wh*-word and optionally the element *bynnag* ‘ever’, and a following gap or a resumptive pronoun:

(5) a. Naeth Gwyn [beth (bynnag) naeth Megan].
do.PAST.3SG Gwyn what ever do.PAST.3SG Megan
‘Gwyn did what(ever) Megan did.’

b. Mae o ’n gwneud ffrindiau da efo [pwy
be.PRES.3SG he PROG make friends good with who
(bynnag) mae o ’n gweithio efo nhw].
ever be.PRES.3SG he PROG work with them
‘He makes good friends with whoever he works with.’

The initial constituent may be nominal, as in the examples in (5), or adverbial, as in (6):

(6) Aeth Gwyn [lle (bynnag) aeth Megan].
go. PAST.3SG Gwyn where ever go.PAST.3SG Megan
‘Gwyn went where(ever) Megan went.’

The distribution of free relatives depends on the nature of the initial constituent. A free relative with a nominal initial constituent can only appear in positions where nominal constituents appear, and a free relative with an adverbial initial constituent can only appear in positions where adverbial constituents appear. Thus, the free relatives in (5a) and (6) are not interchangeable:

(7) *Naeth Gwyn [lle (bynnag) aeth Megan].
do.PAST.3SG Gwyn where ever go.PAST.3SG Megan
(8) *Aeth Gwyn [beth (bynnag) naeth Megan].
go.PAST.3SG Gwyn what ever do.PAST.3SG Megan

This makes the initial constituent look like a head. It also has the main properties of the gap like a filler. It is nominal if the gap is nominal and adverbial if the gap is adverbial. Thus, it looks likes both a head and a filler. Unlike *wh*-interrogatives, free relatives are always finite:

(9) *Naeth Gwyn [beth (bynnag) i ’w neud].
do.PAST.3SG Gwyn what ever to 3SGM do

For the sake of completeness, we should note that Welsh also has constituents which look like free relatives with *bynnag* but which are in fact something else. Consider, for example, the following:

(10) Naeth Gwyn ei waith, [beth bynnag naeth
do.PAST.3SG Gwyn 3SGM work what ever do.PAST.3SG
Megan].
Megan
'Gwyn did his work, whatever Megan did.'

Free relatives with *bynnag* can be paraphrased with *unrhyw* 'any'. Thus, the following are paraphrases of the versions of (5a) and (6) with *bynnag*:

(11) a. Naeth Gwyn [unrhyw beth naeth Megan].
do.PAST.3SG Gwyn any thing do.PAST.3SG Megan
'Gwyn did anything Megan did.'
b. Aeth Gwyn [unrhyw lle aeth Megan].
go. PAST.3SG Gwyn any where go.PAST.3SG Megan
'Gwyn went anywhere Megan went.'

(10) cannot be paraphrased in this way:

(12) *Naeth Gwyn ei waith, [unrhyw beth naeth
do.PAST.3SG Gwyn 3SGM work any thing do.PAST.3SG
Megan].
Megan

However, a different type of paraphrase is available:

(13) Naeth Gwyn ei waith, [dim ots beth naeth
do.PAST.3SG Gwyn 3SGM work no odds what do.PAST.3SG
Megan].
Megan
'Gwyn did his work, no matter what Megan did.'

(10) is what the literature on English has called an exhaustive conditional (Huddleston and Pullum 2002: 761-5, 985-91, Arnold and Borsley 2014) or an unconditional (Rawlins 2008, 2013), and like its English counterparts, it appears to be a type of interrogative. I will not offer an analysis of this construction here.

Finally, we turn to cleft sentences. They involve a clause-initial focused constituent and a following gap or a resumptive pronoun.[2]

(14) a. Y dynion welodd ddraig.
the men see.PAST.3SG dragon
'It's the men that saw a dragon.'

[2] This discussion of clefts is largely based on that in Borsley (2015: section 2).

b. Y dynion cytunodd Gwyn â nhw.
the men agree.PAST.3SG Gwyn with them
'It's the men that Gwyn agreed with.'

They look rather like *wh*-interrogatives. This led Tallerman (1996) to propose a transformational analysis in which the initial constituent is the result of movement to Spec CP just like the initial *wh*-phrase in a *wh*-interrogative. However, there is evidence that the initial constituent in a cleft is not a filler. Unlike a filler, it may differ from the gap in important ways.

Firstly, the gap is third person, even when the initial constituent is first or second person. Thus, the examples in (15) have a third person verb form and not the first and second person forms, which appear in the examples in (16):[3]

(15) a. Fi welodd / *welais ddraig.
I see.PAST.3SG see.PAST.1SG dragon
'It was I that saw a dragon.'
b. Ti welodd / *welaist ddraig.
you.SG see.PAST.3SG see.PAST.2SG dragon
'It was you(SG) that saw a dragon.'

(16) a. Gwelais i ddraig.
see.PAST.1SG I dragon
'I saw a dragon.'
b. Gwelaist ti ddraig.
see.PAST.2SG you.SG dragon
'You(SG) saw a dragon.'

Secondly, the gap behaves like a non-pronominal NP, even when the initial constituent is a ponoun. Welsh verbs agree with a pronominal subject but not with a non-pronominal subject. The following illustrate agreement with a following pronominal subject:

(17) a. Gwelodd o.
see.PAST.3SG he
'He saw.'
b. Gwelon nhw.
see.PAST.3PL he
'They saw.'

With a following non-pronominal subject, singular or plural, the third person singular form, which is a default form, appears:[4]

[3] The verbs in (15) lack the initial *g-* as a result of so-called soft mutation, but this is not important in the present context.

[4] For detailed discussion and an analysis of Welsh agreement, see Borsley (2009).

(18) a. Gwelodd y bachgen.
see.PAST.3SG the boy
'The boy saw.'
b. Gwelodd / *Gwelon y bechgyn.
see.PAST.3SG see.PAST.3PL the boys
'The boys saw.'

In a cleft sentence where the initial constituent is understood as a subject, the finite verb is singular**,** whether the initial constituent is pronominal or non-pronominal:

(19) a. Nhw welodd / *welon ddraig.
they see.PAST.3SG see.PAST.3PL dragon
'It was they that saw a dragon.'
b. Y bechgyn welodd / *welon ddraig.
the boys see.PAST.3SG see.PAST.3PL dragon
'It was the boys that saw a dragon.'

It looks, then, as if the gap is non-pronominal, whatever the nature of the associated initial constituent.

Cleft sentences are always finite. This is naturally the case when they are main clauses. But they can also appear as subordinate clauses introduced by a special complementizer *mai* (or *ai* if interrogative), and they are also finite in this situation:

(20) a. Dywedodd Gwyn [mai llyfr (a) ddarllenodd Megan.
say.PAST.3SG Gwyn that book PRT read.PAST.3SG Megan
'Gwyn said that it was a book that Megan read.'
b. *Dywedodd Gwyn [mai llyfr i 'w ddarllen].
say.PAST.3SG Gwyn that book to 3SGM read

Thus, the three constructions are similar in some ways but also show important differences. A satisfactory analysis needs to accomodate both the similarities and the differences.

3. Towards an analysis

We will now consider in a preliminary way what sort of analyses are appropriate for the three constructions. We can deal with *wh*-interrogatives very briefly. Free relatives and clefts require a lengthier discussion.

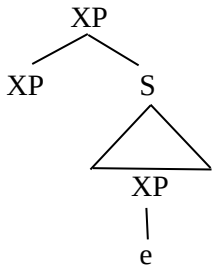
As we have noted, Welsh *wh*-interrogatives are a lot like their counterparts in English and many other languages. They can be analyed in essentially the

same way. Within HPSG, this means that they are fairly ordinary head-filler-phrases.

Turning to free relatives, we have seen that the initial constituent behaves like both a head and a filler. In work on English free relatives, it has commonly been assumed either that it is a head and not a filler or that it is a filler and not a head. Both positions have their drawbacks.

The position that the initial constituent is a head and not a filler goes back at least to Bresnan and Grimshaw (1978). It involves structures of the following form, where XP can be at least NP (or DP in some frameworks) or AdvP:

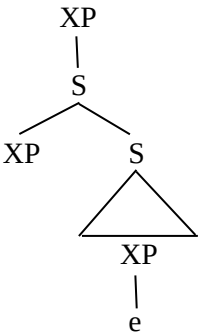
(21)



The drawback of this approach is that it cannot attribute the property sharing between the initial constituent and the gap to the mechanism that is responsible for property sharing between a filler and a gap because the initial constituent is not a filler. Hence, it needs some other mechanism for this purpose. It would not be difficult to provide a mechanism within HPSG, but the fact remains that this would not be necessary if the initial constituent were a filler.[5]

The position that the initial constituent is a filler and not a head was developed by Groos and van Riemsdijk (1981) and Grosu (2003) among others. It involves structures of the following form:

(22)



[5] In a transformational framework, this approach might involve an empty filler (a so-called 'empty operator'). This necessitates a mechanism to ensure that this empty filler shares properties with the preceding head.

Since the initial constituent is a filler, there is no problem about it sharing properties with the gap, but some mechanism is required to ensure that it shares properties with the construction, and this is non-trivial given that the the initial constituent is not a daughter of the construction. In his HPSG analysis of German free relatives, Müller (1999: 94) introduces a special feature RP-HEAD to make information about the initial constituent available in the mother node. This will probably work, but no such feature would be necessary if the initial constituent was a head.[6]

The alternative to these analyses is an analysis in which the initial constituent is both a head and filler, as it appears to be. An analysis of this kind was proposed in Payne, Huddleston, and Pullum (2007: 1.1), and also in Huddleston and Pullum (2002: 1073), and in Citko (2008) within a transformational framework.

In English, certain types of example are problematic for a simple version of this approach. Consider, for example, the following from Wright and Kathol (2002: 374), where both the free relative and its initial constituent are bracketed:

(23) [[Whoever's dogs] are running around in the garden] is in big trouble.

Here, the free relative is singular, but the initial constituent is plural. Rather similar is the following from Grosu (2003: 254):

(24) I will fire [[whoever's signature] appears on this list].

Here, *whoever's signature appears on this list* is understood as *the person whose signature appears on this list*. Examples like (23) and (24) are problematic for the idea that the initial constituent is a head if head and mother must have exactly the same properties. However, there appear to be no Welsh examples like these. As (25) shows, a Welsh sentence resembling (23) means that the dogs are in big trouble, not the owner.

(25) Mae cwn pwy bynnag sy 'n rhedeg
be.PRES.3SG dog who ever be.PRES.3SG PRED run
o gwmpas yn yr ardd mewn trwbl.
around in the garden in trouble
'Whoever's dogs are running around in the garden are in big trouble.'

Similarly, as (26) shows, a Welsh sentence resembling (24) refers to sacking the name, and not the person:

[6] In a transformational framework, this approach might involve an empty head. This requires a mechanism to ensure that this empty head shares properties with the following filler.

(26) Mi na' i roi 'r sac i enw pwy bynnag
PRT do.FUT.1SG I give the sack to name who ever
sydd ar y rhestr.
be.PRES.3SG on the list
'I will fire the name of whoever is on the list.'

Thus, at least in Welsh, an analysis of free relatives in which the initial constituent is both a head and a filler seems the obvious approach.[7]

Turning to clefts, we have seen that the facts suggest that the initial constituent is not a filler. In fact, they suggest that it is not even coindexed with the gap/resumptive pronoun since coindexed elements, e.g. a pronoun and its antecedent, normally have the same person features. Interestingly, the kind of person mismatch that we have in Welsh clefts is also found in English clefts. Consider e.g. the following from Akmajian (1970:150):

(27) It's me who *is* responsible.

Such examples are no problem if we assume that they involve an identity predication since there is no requirement of person identity in identity predications, as the following show:

(28) a. I am the teacher.
b. You are the teacher.

I want to suggest that Welsh clefts are rather like their English counterparts. That is, they involve an identity predication, but one that is associated with the construction and not with any lexical item. In Welsh, as in English, there is no requirement of person identity in identity predications:[8]

(29) a Yr athro ydw i.
the teacher be.PRES.1SG I
'I am the teacher.'
b Yr athro wyt ti.
the teacher be.PRES.2SG you.SG
'You are the teacher.'

[7] Examples like (23) and (24) may be no problem for the idea that the initial constituent is a head within HPSG if one assumes with Ginzburg and Sag (2000: 33) that head and mother have the same syntactic and semantic properties by default but may differ in certain ways if some constraint requires it. But this assumption seems unnecessary in Welsh.

[8] These examples show an unusual word order, but this is not important in the present context. See Borsley (2015: section 3) and especially Borsley (2019: section 6) for disussion.

Some evidence for this approach comes from examples like the following (where *nid* is more formal Welsh, and *dim* more colloquial Welsh):

(30) Nid/dim nhw welodd ddraig.
NEG they see.PAST.3SG dragon
'It wasn't they that saw a dragon.'

Here, it seems that it is the hidden identity predication that is negated. This type of negation is not possible in a *wh*-interrogative. Thus, the following cannot be a *wh*-interrogative, but can only be an echo question based on a cleft:

(31) Nid/dim pwy welodd ddraig?
NEG who see.PAST.3SG dragon
'It wasn't who that saw a dragon?'

It seems then, that the idea that Welsh clefts involve a hidden identity predication is quite well motivated.

Middle Welsh is relevant here. Meelen (2016: 119) notes that early Middle Welsh clefts looked a lot like their Modern English counterparts wth a form of the copula preceding the focused constituent.[9] Here is a relevant example:

(32) Ys mi a 'e heirch.
be.PRES.1SG me PRT 3SGF seek.3SG
'It is me who seeks her'

Thus, in early Middle Welsh, as in English, the identity interpretation could be attributed to a lexical element. Now, however, it must be attributed to the construction.

Having looked more closely at the three constructions, we have the following basic conclusions about their properties:

- *Wh*-interrogatives are head-filler-phrases, in which a phrase which is a filler is followed by a clause containing a gap or a resumption ponoun, and the clause is a head.
- Free relatives are phrases in which a phrase which is a filler is followed by clause containing a gap or a resumption ponoun, but the filler and not the clause is a head.
- Clefts are clauses in which the initial constituent is followed by a clause containing a gap or a resumption ponoun, and the clause is a head, but the initial constituent is not a filler but one term of a hidden identity predication.

[9] The complementizers *mai* and *ai*, mentioned in section 2, derive from forms of the copula.

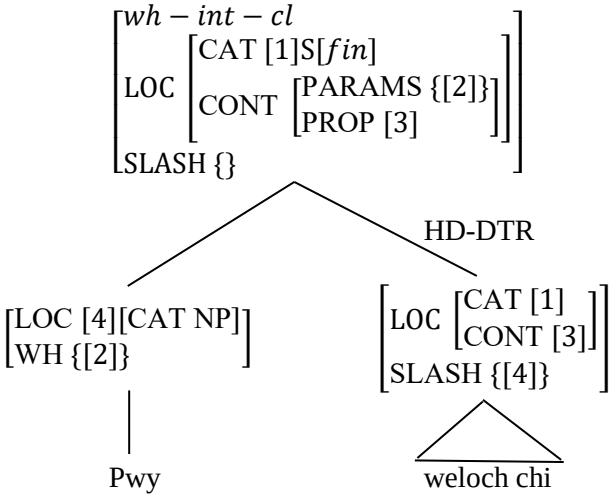
In the next section, I will outline some basic HPSG analyses incorporating these conclusions.

4. Basic HPSG analyses

Welsh *wh*-interrogatives can be analyed in essentially the same way as their English counterparts. Free relatives can be analyed as involving an initial constituent which is both a filler and a head. For clefts we need an analysis in which the initial constituent is not a filler and the two constituents are the two terms of an identity predication.

Assuming the general approach to *wh*-interrogatives developed in Ginzburg and Sag (2000: chapter 4), we can propose an analysis of the following form for (1):[10]

(33)



Here, the first daughter is a filler with a local feature structure which appears in the SLASH value of the second daughter, and the second daughter is a head. The semantic analysis is that developed in Ginzburg and Sag.

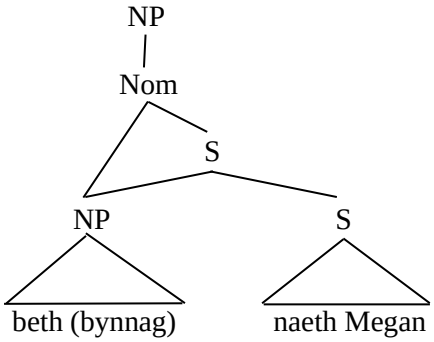
For free relatives, Payne, Huddleston, and Pullum (2007: 1.1) capture the dual nature of the initial constituent by proposing an analysis in which it has two mothers. For the example in (5a), this would mean the following structure:

---

[10] Here and subsequently, I use NP and S[*fin*] as abbreviations as follows:

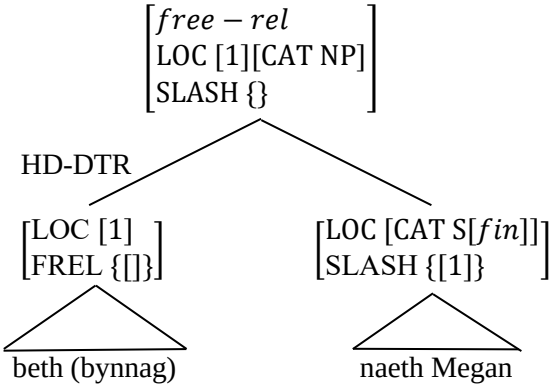
(i) NP = $\begin{bmatrix} cat \\ \text{HEAD } noun \\ \text{SUBJ } <> \\ \text{COMPS } <> \end{bmatrix}$ S[*fin*] = $\begin{bmatrix} cat \\ \text{HEAD } \begin{bmatrix} v \\ \text{VFORM } fin \end{bmatrix} \\ \text{SUBJ } <> \\ \text{COMPS } <> \end{bmatrix}$

(34)



Essentially, the initial constituent is a head because it is a daughter of Nom and a filler because it is a daughter of S. It would be not be easy to implement such an analysis in HPSG. But there is no need to. Within HPSG, the initial constituent can be a head and a filler without having two mothers. (5a) can have the following structure:

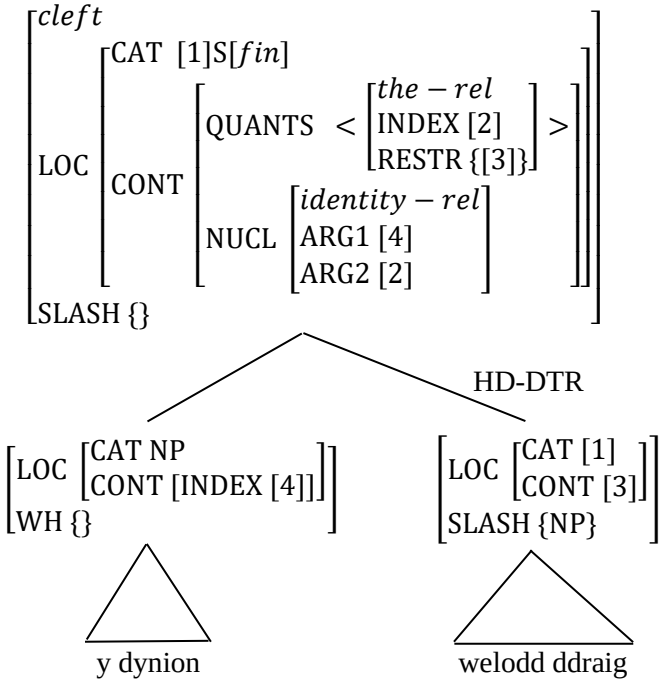
(35)



Here, the first daughter is both a filler and a head. I ignore CONTENT values, but any semantic analysis of free relatives could be included here.

Turning finally to cleft sentences, we can propose the structure in (36) for the example in (14a). Here, the first daughter is a not a filler since its local feature structure does not appear in the SLASH value of the second daughter, but the second daughter is a head, as in (34). The CONTENT value of the mother makes it clear that the second daughter is interpreted as a definite description and identified with the first daughter.

(36)



5. Types and constraints

We now need to develop a system of phrase types and associated constraints which license just the right structures and capture both the similarities and differences among the three constructions.

The main facts about the three constructions are summarized in the following table:

	First daughter		Second daughter	
	Filler	Head	Contains gap/RP	Head
Wh-interrogatives	✓	x	✓	✓
Free relatives	✓	✓	✓	x
Clefts	x	x	✓	✓

Table 1: Properties of the two daughters

We see here the following similarities:

- All three constructions have a gap or resumptive pronoun within the second daughter, whether the second daughter is a head or not.

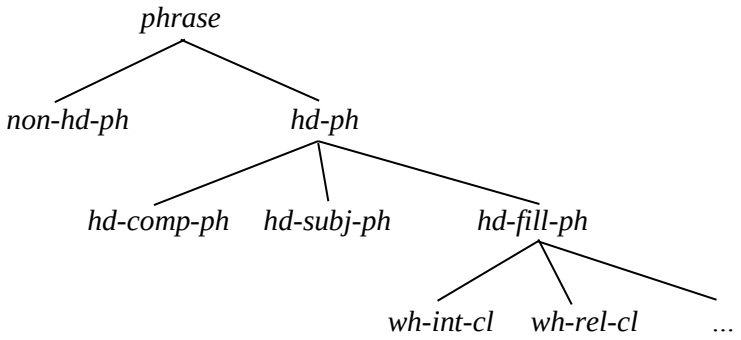
- *Wh*-interrogatives and free relatives are similar in having a first daughter which is a filler.

- *Wh*-interrogatives and clefts are similar in having a second daughter which is a head.

A satisfactory analysis needs to capture these similarities.

To see what is necessary, we can consider the following fairly standard system of phrase types, in which head-filler-phrase is one of a number of subtypes of headed-phrase:

(37)



To accommodate free relatives and clefts, we need *free-relative* and *cleft-clause* types. We might add these as further subtypes of *headed-phrase* with constraints imposing the properties seen in (35) and (36). This would license the right structures, but it would miss the similarities that we have identified. We need something more complex. We can capture the facts if we postulate a type *slashed-daughter-phrase* with subtypes *filler-phrase* and *slashed-head-phrase* giving the system in (38). Ignoring *hd-comp-ph* and *hd-subj-ph*, there are four maximal types here, one for each of the constructions that we are focusing on, and one for *wh*-relative-clauses, which we have not discussed.[11] All four constructions are instances of the type *slashed-daughter-phrase*, and their shared properties can be expressed as a constraint on this type. Clefts and head-filler-phrases are subtypes of the type *slashed-head-phrase*, while head-filler-phrases and free relatives are subtypes of the type *filler-phrase*. Hence,

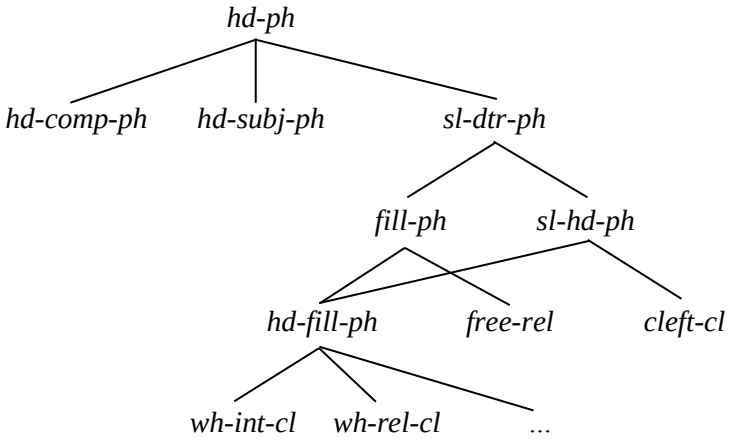
---

[11] Most Welsh relative clauses are not *wh*-relatives and not head-filler phrases. However, Welsh has relative clauses with the *wh*-words *lle* 'where' and *pam* 'why' as fillers. The following from Borsley, Tallerman and Willis (2007: chapter 4) illustrates the first of these:

(i) yr ardal lle gafodd ei fagu
the district where get.PAST.3SG 3SGM raise
'the district where he was brought up'

we have a basis for capturing both the similarities between clefts and *wh*-interrogatives and the similarities between *wh*-interrogatives and free relatives.

(38)



The most basic constraint that we need is the following constraint on slashed-daughter-phrases:

(39) *sl-dtr-ph* $\Rightarrow \begin{bmatrix} \text{SS}\,[\text{SLASH}\,[1]] \\ \text{DTRS} < [phrase], \begin{bmatrix} clause \\ \text{SS|SLASH}\,\{[local]\} \cup [1] \end{bmatrix} > \end{bmatrix}$

This says that a slashed-daughter-phrase has some value for SLASH and that it has two daughters, the first a phrase and the second a clause whose SLASH value is the union of the SLASH value of the phrase and a set containing a single local feature structure. [1] will normally be the empty set, but when there is extraction from one of these constructions it will be non-empty. Crucially, the constraint does not say which daughter is the head and does not impose any restrictions on the first daughter except that it is a phrase. In particular, it does not require it to be a filler. It captures the properties that the three constructions have in common.

For filler-phrases, we need a constraint identifying the first daughter as a filler with a local feature structure which appears in the SLASH value of the second daughter. The following constraint does this:

(40) *fill-ph* $\Rightarrow$ [DTRS $<$ [SS[LOC [1]]], [SS[SLASH $\{[1]\} \cup set$]] $>$]

It captures what *wh*-interrogatives and free relatives have in common.

Finally, for slashed-head-phrases, we need a constraint requiring the second daughter to be a head. The following, simple constraint does this:

(41) *sl-hd-ph* $\Rightarrow \begin{bmatrix} \text{HD-DTR [1]} \\ \text{DTRS} < [], [1][] > \end{bmatrix}$

It captures what *wh*-interrogatives and clefts have in common.

Head-filler-phrases are subject to all these constraints, and thus have the following properties:

(42) $\begin{bmatrix} \text{SLASH [1]} \\ \text{DTRS} < \begin{bmatrix} phrase \\ \text{SS[LOC [2]]} \end{bmatrix}, [3] \begin{bmatrix} clause \\ \text{SS[SLASH } \{[2]\} \cup [1]] \end{bmatrix} > \\ \text{HD-DTR [3]} \end{bmatrix}$

Free relatives are subject to the constraints in (39) and (40), and thus have the properties in (43):

(43) $\begin{bmatrix} \text{SS} \left[\text{SLASH [1]}\right] \\ \text{DTRS} < \begin{bmatrix} phrase \\ \text{SS[LOC [2]]} \end{bmatrix}, \begin{bmatrix} clause \\ \text{SS|SLASH } \{[2]\} \cup [1] \end{bmatrix} > \end{bmatrix}$

Clefts are subject to the constraints in (39) and (41), and hence have the properties in (44):

(44) $\begin{bmatrix} \text{SS} \left[\text{SLASH [1]}\right] \\ \text{DTRS} < [phrase], [2] \begin{bmatrix} clause \\ \text{SS|SLASH } \{[local]\} \cup [1] \end{bmatrix} > \\ \text{HD-DTR [2]} \end{bmatrix}$

There seems to be no need for any special constraint on head-filler-phrases since their properties follow from constraints on supertypes, but each of the three constructions that we are concerned with requires a constraint to account for its distinctive properties. For *wh*-interrogatives, we can propose the following:

(45) *wh-int-cl* $\Rightarrow \begin{bmatrix} \text{SS|LOC|CONT} \begin{bmatrix} \text{PARAMS } \{[1]\} \cup set \\ \text{PROP [2]} \end{bmatrix} \\ \text{DTRS} < [\text{WH } \{[1]\}], \left[\text{CONT [2]}\right] > \end{bmatrix}$

This ensures that the the first daughter is an interrogative *wh*-phrase and that the clause has the appropriate interrogative semantics. It essentially combines two of Ginzburg and Sag's constraints, the Filler Inclusion Constraint and the Propositional Head Constraint (Ginzburg and Sag 2000: 228-9). There is no need to specify here that the first daughter is a filler and the second a head with

a non-empty SLASH value since these properties are a consequence of (39), (40), and (41).

For free relatives, we can propose the following constraint:

(46) *free-rel* $\Rightarrow$

$$\begin{bmatrix} \text{DTRS} < [1][\text{SS|FREL}\,\{[]\}], [\text{SS|LOC|CAT|HEAD|VFORM}\ fin] > \\ \text{HD}-\text{DTR}\,[1] \end{bmatrix}$$

This ensures that the first daughter is a free relative *wh*-phrase and a head, and that the second daughter is finite. There is no need to specify that the first daughter is a filler and that the second has a non-empty SLASH value since these properties follow from (39) and (40). An appropriate semantic analysis could be added to this.

Finally, for clefts, we can propose the following, rather more complex constraint:

(47) *cleft* $\Rightarrow$

$$\begin{bmatrix} \text{SS|LOC} \begin{bmatrix} \text{CONT} \begin{bmatrix} \text{QUANTS} < \begin{bmatrix} the-rel \\ \text{INDEX}\,[1] \\ \text{RESTR}\,\{[2]\} \end{bmatrix} > \oplus \text{L} \\ \text{NUCL} \begin{bmatrix} identity-rel \\ \text{ARG1}\,[3] \\ \text{ARG2}\,[1] \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} < \left[\text{SS|LOC|CONT}\left[\text{INDEX}\,[3]\right]\right], \\ \qquad \left[\text{SS}\left[\text{LOC}\begin{bmatrix} \text{CAT|HEAD|VFORM}\ fin \\ \text{CONT}\,[2] \end{bmatrix}\right]\right] > \end{bmatrix}$$

This ensures that the two daughters are interpreted as the two terms of an identity predication and that the second daughter is finite. There is no need to specify that the second daughter has a non-empty SLASH value and is a head since these properties follow from (39) and (41).

Two further questions arise about clefts. We have seen that the initial constituent can differ from the gap both in person and in whatever features distinguish pronouns and non-pronominal NPs. However, it is not the case that there is no relation between the initial constituent and the gap. It seems in fact that the initial constituent and the gap must be of the same category. Thus, the (a) examples in following, where filler and gap are the same category, are grammatical, but not the (b) examples where they are different categories.

(48) a. Y ferch soniodd Gwyn amdani.
the girl talk.PAST.3SG Gwyn about.3SGF
'It's the girl that Gwyn talked about.'

b. *Am y ferch soniodd Gwyn amdani.
about the girl talk.PAST.3SG Gwyn about.3SGF

(49) a. Am y ferch soniodd Gwyn.
about the girl talk.PAST.3SG Gwyn
'It's about the girl that Gwyn talked.'

b. *Y ferch soniodd Gwyn.
the girl talk.PAST.3SG Gwyn

It seems likely that this is an automatic consequence of the nature of the identity relation. However, if it is not, it would not be difficult to add a stipulation to the constraint on clefts to ensure the identity.

A further important fact about clefts is that in embedded clauses they are introduced by special complementizers, *mai* if declarative or *ai* if interrogative. These complementizers do not appear with simple, verb-initial clauses. This suggests that cleft sentences should have some feature which distinguishes them from simple, verb-initial clauses. Alternatively, it could be that *mai* and *ai* are heads that take two complements which, like the two daughters in a cleft clause, are interpreted as the two terms of an identity predication. This would entail that clefts are really confined to main clauses and they would need to be marked as [ROOT+] or something equivalent. I will not try to decide which of these approaches should be preferred.

There are some lose ends here, but I have now developed a fairly full analysis of the three Welsh UDCs, which captures both the similarities and differences among the three constructions.

6. Concluding remarks

In the preceding pages, I have investigated the properties of three Welsh UDCs: *wh*-interrogatives, free relatives, and clefts, and I have sought to develop an analysis which captures both the similarities and the differences in this area. I have shown that an analysis of the constructions with a type *slashed-daughter-phrase* with subtypes *filler-phrase* and *slashed-head-phrase* can capture the properties that they all have, the properties that just two of them have, and their distinctive properties. There are of course other Welsh UDCs, e.g. relative clauses mentioned in fn.8, and exhaustive conditionals, discussed briefly in section 2. But they pose no obvious problems, and it should not be difficult to extend the basic approach adopted here to accommodate them. Thus, there is further evidence here that HPSG with its system of types and constraints is well equipped to capture the similarities and differences in families of related constructions.

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Unrealized arguments in SBCG

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Abstract

In null instantiation (NI) an optionally unexpressed argument receives either anaphoric or existential interpretation (Fillmore, 1986; Mauner & Koenig, 2000; Kay, 2002; Ruppenhofer & Michaelis, 2010, 2014). Examples include Lexically licensed NI (*Nixon resigned* ∅), Contextual accessibility NI (*Can I see* ∅*?*), Labelese (∅ *contains alcohol*), Diary NI (∅ *got up,* ∅ *got out of bed,* ∅ *dragged a comb across my head*), Generic-habitual NI (*The police only arrest* (*people*) *when there's probable cause*). We think of a predicator as having NI potential when one or more of its frame elements may remain unexpressed under certain conditions. One cannot accurately predict a predicator's NI potential based either on semantic factors (e.g., Aktionsart class of the verb, as in Hovav & Levin (1998)) or pragmatic factors (e.g., relative discourse prominence of arguments, as in Goldberg (2006)), but NI potential, while highly constrained, is not simply lexical idiosyncrasy. It is instead the product of both lexical and constructional licensing. In the latter case, a construction can endow a verb with NI potential that it would not otherwise have. Using representational tools of Sign Based Construction Grammar (Sag 2012, a.o), we offer a lexical treatment of null instantiation that covers both distinct patterns of construal of null instantiated arguments and the difference between listeme-based and contextually licensed, thus construction-based, null complementation.

1 Introduction

The basic architecture of Sign-Based Construction Grammar (SBCG) set out in Sag (2012) goes a considerable distance in covering the phenomena of arguments that are not locally realized, but less than the whole way. Our purpose here is to fill out the empirical and theoretical coverage of locally unrealized arguments in SBCG. Sag (2012) briefly mentions the phenomenon of null instantiation (NI), in which an optionally unexpressed argument receives either anaphoric or existential interpretation, citing Fillmore (1986, 86), but does not provide either empirical details or an SBCG implementation.[1] Section 2 provides a lexical treatment of null instantiation that covers both distinct patterns of construal of null instantiated arguments and the difference between listeme-based and contextually licensed, thus construction-based, null complementation. Our treatment does not rely on the sign types *gap* or *pro*, which Sag (2012) lists in the type hierarchy. Neither type is mentioned in that text; *pro* appears once in the representation of a *construct* (a model object). We specify that the members of the VALence list and the GAP list are

[†]We thank the audience of the 2020 HPSG conference for their comments and questions, in particular Emily Bender and Guy Emerson. We are grateful as well to Jean-Pierre Koenig for helpful discussion and comments on an earlier version of this work. As usual, all are exculpated from lingering mistakes and shortcomings.

[1]Prior accounts of argument optionality are generally purely syntactic, saying little about the semantics and pragmatics of NI; see Müller & Ghayoomi (2010) for example.

simply signs. There are also signs that appear on a predicator's ARGument-STructure list that do not appear on the VAL or GAP lists but rather are realized morphologically.[2]

2 Null Instantiation

Fillmore (1986) notes two distinct kinds of null instantiation (NI) of arguments: indefinite null instantiation INI and definite null instantiation DNI. INI may be viewed in the first instance as a kind of lexically constrained convention of existential import. If I say, "I have contributed to the Red Cross", I have said enough to indicate that I contributed **something**, usually a sum of money or goods of some kind, to the Red Cross. I don't have to mention the stuff of any contribution. In effect I have said that there is some stuff x such that I have contributed x to the Red Cross. On the other hand, if I say, "I contributed $25", my utterance is only felicitous in a context in which I can take for granted that my addressee can identify the entity to which I made the contribution. The latter example illustrates DNI.[3] Fillmore emphasizes the lexical idiosyncrasy of null complementation (in English), writing:

> 'It is possible to find closely synonymous words, some of which permit definite null complements while others do not. To mention just one example, we can see that INSIST allows its complement to be absent under the relevant conditions, but many of its near-synonyms do not. Thus, a possible reply to WHY DID YOU MARRY HER? might be (10), but not (11) or (12) [Boldface example numbers are those of the original].
>
> **(10)** BECAUSE MOTHER INSISTED
>
> **(11)** *BECAUSE MOTHER REQUIRED
>
> **(12)** *BECAUSE MOTHER DEMANDED (Fillmore, 1986, 98)

Fillmore (1986, 99) gives an additional dozen or so examples of fairly close synonyms that display conflicting null complementation potentials. However, as Fillmore also notes, semantics is not uniformly uncorrelated with null complement potential. For example, the verb *give* has the null complement potential of *contribute* only when it is employed with the sense of *contribute*. Thus, one can say (13a) but not (13b).

(13) a. I gave to my NPR station this year.

b. *I gave to my niece on her birthday.

[2]For such signs Sag cites the standard treatment of Romance pronominal 'clitics' as verbal affixes (e.g., Miller & Monachesi (2003), and we have no reason to revise that.

[3]It is possible that 'definiteness', in the context of null instantiation at least, is more aptly conceived as gradient than dichotomous. We return to that question below.

Fillmore makes the point that *give* has the same NI potential as *contribute* only when *give* is used in the sense of *contribute*. Lest one conclude from that and similar observations that semantics is a reliable predictor of NI potential, consider the semantically and syntactically related *donate*, *bequeath*, and *bestow*. *Donate* shares with *contribute* the potential of INI for the theme argument but not the DNI potential for the recipient argument. *Bequeath* and *bestow* share none of these NI possibilities.

Fillmore (1986) is concerned exclusively with null complementation that is licensed by particular lexemes. We consider this aspect of the phenomenon first. Null complementation has also been shown to be licensed by certain aspects of discourse context, e.g. genre (Ruppenhofer & Michaelis, 2010, 2014) [R&M], which is considered in Section 2.2.

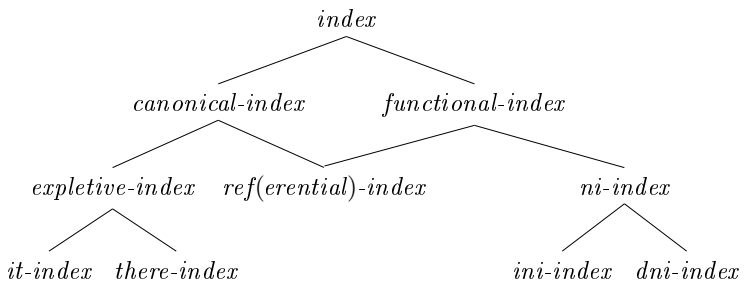
2.1 Lexically Licensed Null Instantiation

Usually or always, lexically licensed null instantiation occurs as an option to overt instantiation.[4] Consider again the English verb contribute. Since the object is optionally subject to INI and the PP complement to DNI, one has paradigmatic examples like (1).

(1) a. I will contribute ten dollars to your campaign.
b. I will contribute _[something] to your campaign.
c. I will contribute ten dollars _[to you know what].
d. I will contribute _[something] _[to you know what].

To account grammatically for the kind of variation displayed in (1) one could posit four distinct listemes *contribute*. That approach would fail to capture the generalization of optionality in an explicit fashion. In order to represent the optionality of NI more perspicuously, we further refine the taxonomy of semantic indices in (2).

(2)

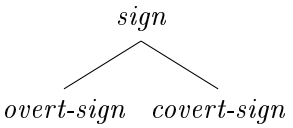


[4]In accordance with FrameNet annotation practice, verbs like *sweat, piss, pee, belch, burb, bleed*, etc. may be considered to represent obligatory, or at least highly preferred, null instantiation of the Excreta frame element. We do not pursue the possibility of truly obligatory null complementation, which in any case would require no analysis beyond that required for the semantic interpretation of the NI option, as proposed in section 2.4.

The interpretation of signs bearing *ini-index* or *dni-index* is discussed in section 2.4. We model an INDEX as a feature structure with an AGReement feature (Pollard & Sag, 1994; Wechsler & Zlatic, 2003)) and, where appropriate, a discourse referent VAR(iable) feature analogous to that of DR in Iordăchioaia & Richter (2015); see also Koenig & Richter (2020). For example, the relevant part of the entry for the pronoun *she* with discourse variable x is represented in (3). The types *expletive-index* are specified as [VAR *none*].

(3)
$$\begin{bmatrix} \text{INDEX} & \begin{bmatrix} \textit{ref-index} & \\ \text{AGR} & \begin{bmatrix} \text{PER} & \textit{3rd} \\ \text{NUM} & \textit{sing} \\ \text{GEN} & \textit{fem} \end{bmatrix} \\ \text{VAR } x & \end{bmatrix} \end{bmatrix}$$

Signs are sorted by the type of index they contain. Consider the type hierarchy in (4) and the constraints in (5). Overt signs contain canonical indices; covert signs may contain a *dni-index*, *ini-index* or *referential-index*.

(4)


(5) a. *overt-sign* ⇒ [SEM [INDEX *canon-index*]]
b. *covert-sign* ⇒ [SEM [INDEX *functional-index*]]

Thus, indices of the type *canonical-index* appear in overt signs, signs that are realized as syntactic daughters. These include signs bearing the two expletive indices *it-index* and *there-index*, as well as the most common index type, *ref(erential)-index*. Functional indices are those that have semantic content; they include in addition to *ref-index*, signs bearing the two null instantiation index types *ini-index* and *dni-index*.

Overt signs have the full set of features introduced in Sag (2012: 180), including the features FORM and PHONology. Covert signs do not.

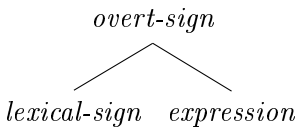
(6) a.
$$\textit{sign} : \begin{bmatrix} \text{SYN} & \textit{syn-object} \\ \text{SEM} & \textit{linguistic-meaning} \\ \text{CNTXT} & \textit{context-object} \end{bmatrix}$$

b.
$$\textit{overt-sign} : \begin{bmatrix} \text{PHON} & \textit{phon-object} \\ \text{FORM} & \textit{morph-object} \end{bmatrix}$$

Sag (2012:178) does not recognize the distinction encoded in (4)-(6) and in the sign hierarchy specifies that *lexical-sign* and *expression* are the immediate subtypes of *sign*. In view of the overt/covert distinction, we amend

the *sign* hierarchy to designate *lexical-sign* and *expression* as the immediate subtypes of *overt-sign*, as seen in (7).

(7)



The daughters of syntactic phrasal constructions in SBCG are required to be typed as *overt-sign*, that is, as words or phrases (Sag 2012:145). Lexemes, therefore, have to undergo inflection, possibly zero inflection, to be expressed as the daughters of phrases, and so play a role in utterances. We reformulate the Argument Realization Principle (ARP) as seen in (8).

(8) **Argument Realization Principle Construction** (↑*lexical-sign*)

$$word \Rightarrow \begin{bmatrix} \textsc{arg-st} & L_1 \bigcirc L_2 \bigcirc list\Big(covert\text{-}sign\big[\textsc{index}\ ni\text{-}index\big]\Big) \\ \textsc{syn} & \begin{bmatrix} \textsc{val} & L_1 \\ \textsc{gap} & L_2 \end{bmatrix} \end{bmatrix}$$

The ARG-ST list is non-deterministically split into three sub-lists using the sequence union relation '◯' (Reape, 1996; Kathol, 2001), each of which may or may not be empty. VAL is the list of locally realized arguments, GAP is the list of extracted arguments, and the third sub-list can only contain null instantiation arguments, which are neither locally realized nor extracted. However, there are no INDEX constraints on either VAL or GAP, which means that it is possible for an *ni-index* sign to appear in either VAL or GAP instead of the third sub-list. Occurrence of an *ni-index* sign in GAP licenses sentences in which the null instantiated sign is extracted (but not realized as a constituent), as in (9a), which we discuss later in §2.3. Analogously, occurrence of a sign typed *covert-sign* and with index *ref-index* sign in VAL licenses cases where valent is controlled, as in the case of the subject valent of the VP *go into a cup* in (9b).[5]

(9) a. $\emptyset_i$ Don't be so hard to get $\__i$, baby.
[Rick James, *You and I*]

b. I [made [the top]$_i$ [$\emptyset_i$ go into a cup]].

If a null instantiation sign appears in VAL it cannot be realized overtly because only *canon-index* signs are allowed to appear in DTRS. To this end, we reformulate Sag's (2012:106) type constraint over constructs as shown in

[5]More specifically, control verbs like *make* will bear the following specification: [ARG-ST ⟨NP[INDEX X], NP[INDEX Y], VP[VAL ⟨*covert-sign*[INDEX Y]⟩]⟩].

(10).[6] This type declaration ensures that all overt phrases in English are canonical, that is, either *referential, it*, or *there*.

(10) **Type declaration for** *construct*

$$\textit{construct} : \begin{bmatrix} \text{MTR} & \textit{overt-sign} \\ \text{DTRS} & \textit{ne-list}(\textit{overt-sign}) \end{bmatrix}$$

The constraints in (8) and (10) interact to prevent any *ini-index* or *dni-index* sign from being discharged from either VAL or GAP as a member of DTRS. In this indirect sense, *ni-index* signs are not viable members of VAL. Thus, the word *contribute* will be compatible with the four uses that appear in (1a-d), which correspond to the argument structures appearing in (11a-d).

(11) a. [ARG-ST ⟨NP[INDEX *ref-index*], NP[INDEX *ref-index*], PP[INDEX *ref-index*]⟩]
b. [ARG-ST ⟨NP[INDEX *ref-index*], NP[INDEX *ini-index*], PP[INDEX *ref-index*]⟩]
c. [ARG-ST ⟨NP[INDEX *ref-index*], NP[INDEX *ref-index*], PP[INDEX *dni-index*]⟩]
d. [ARG-ST ⟨NP[INDEX *ref-index*], NP[INDEX *ini-index*], PP[INDEX *dni-index*]⟩]

As in HPSG, the members of ARG-ST appear in order of increasing obliqueness, reflecting Keenan and Comrie's Accessibility Hierarchy. In the case of English, the first member of a verbal ARG-ST list is the EXTERNAL ARGUMENT (XARG) (12) and has a number of special properties.

(12) $$\textit{v-lxm} \Rightarrow \begin{bmatrix} \text{ARG-ST} & \langle X, ... \rangle \\ \text{SYN} & \begin{bmatrix} \text{CAT} \begin{bmatrix} \text{XARG } X \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The XARG is the only argument that can bear nominative case, is suppressed in passive although optionally available as an oblique complement headed by the preposition *by*, appears immediately postverbally in inverted clauses, serves as the target of control and raising, binds the pronominal subject of a sentence tag (13a), participates in the binding relation between an absolute subject and an element of the main clause (13b,c), etc. The last two properties illustrate the fact that the XARG is the only argument that can participate in a dependency with an item outside its clause.[7]

(13) a. The guests$_i$ left, didn't they$_i$?

[6] Like HPSG, SBSG distinguishes a *signature*, which sets out the basic types (classes of feature structures) of a grammar, as distinct from the rules or constructions that operate on those types. The decision whether to cast a particular generalization as a type declaration of the signature or as a construction of the *constructicon* (Sag 2012:103 *et passim*) is sometimes a matter of choice. In SBCG, type declarations are expressed with a colon between the name of a type and a constraint that the type must satisfy, analogously to the role of the double-shafted arrow in constructions.

[7] The possible values of XARG are *sign* and *none*. The XARG of an NP, if there is one, is the genitive determiner, which is enforced by a further lexemic constraint.

b. $\emptyset_1$ having caught sight of each other$_i$, the kids$_i$ started laughing.

c. Which kid$_i$ did you say that – with his$_i$ parents out of town – $\_\_i$ would not be too hard to convince $\_\_i$ to host a party?

The ARG-ST feature is restricted to *lexical signs*, that is, *lexemes* and *words*, but the XARG, as a CATegory feature (analogous to the HEAD feature of GPSG/HPSG) is visible at all levels of a headed *phrase*.

We formulate an illustrative lexical entry (listeme) for *contribute* that resolves to just the four possibilities shown in (11). We assume that the frame arguments appear in a list ARGS, instead of the usual features (e.g. a SITuation (event variable) feature, and constituent features DONOR, GIFT, and RECIPIENT). This list encoding is chosen mainly as a convenient way to describe the linkage between ARG-ST members and the NI rules to be described below, though nothing hinges on this.[8] Thus, the *contribute-frame* is encoded as in Predicate Logic, as *contribute*(s,x,y,z), where s is a situation, x is the donor, y is the gift, and z is the recipient, respectively. These arguments will all require their values to bear functional indices, ruling out expletive values. Taking note of that fact, a simplified lexical entry for *contribute* is shown in (14).

(14)
$$\left[\begin{array}{l} \textit{contribute-lexeme} \\ \textsc{form}\ \langle \textit{contribute} \rangle \\ \textsc{sem}\left[\begin{array}{ll} \textsc{index} & s : \textit{ref-index} \\ \textsc{frames} & \left\langle \left[\begin{array}{l} \textit{contribute-fr} \\ \textsc{sit}\quad s \\ \textsc{args}\ \langle\ \textit{ref-index},\ \neg \textit{dni-index},\ \neg \textit{ini-index}\ \rangle \end{array}\right] \right\rangle \end{array}\right] \end{array}\right]$$

We follow Sag et al. (2003, 241) and Ginzburg & Sag (2000, 21) in assuming that the hierarchical lexicon is responsible for instantiating ARG-ST values in lexemes. We also assume that the hierarchical lexicon is responsible for linking the indices in FRAMES to the appropriate arguments, as illustrated in (15), for prepositional transitive verbal lexemes like *contribute* in (14). Standard derivational (lexeme-to-lexeme) rules license derived lexeme uses that belong to different classes and therefore can obtain different values for ARG-ST and for ARGS.

(15)
$$\textit{ptv-lxm} \Rightarrow \left[\begin{array}{l} \textsc{arg-st}\left\langle \mathrm{XP}[\textsc{index}\ X],\ \mathrm{NP}[\textsc{index}\ Y],\ \mathrm{PP}[\textsc{index}\ Z] \right\rangle \\ \textsc{sem} \mid \textsc{frames}\left\langle \left[\textsc{args}\ \langle X, Y, Z \rangle\right] \right\rangle \end{array}\right]$$

[8] An alternative formulation would use variables over constituent features, along the lines of Koenig & Davis (2003).

2.2 NI Licensed by Context

We have so far considered only null instantiation that comes with a listeme. There are also cases in which features of the discourse context, including narrative context and shared background knowledge, allow a predicator to exhibit null-instantiation potential it does not possess inherently. The verb *pull* does not, in general, license DNI, as illustrated in the following excerpt from a hearing of a commission of the U.S. Congress.

(16) Mr. Blanton: Had your little girl pulled this fire-alarm box that you know of?
Mr. Puliam: No, sir; and nobody had seen her pull *(it).
Mr. Blanton: And they just suspected she had pulled *(it)?
Mr. Puliam: The fire-alarm box had been pulled and my children were seen around there.
Mr. Blanton: And the child could have pulled *(it)?
Mr, Pulliam: Yes, sir.
Mr. Blanton: And there are some 66,000 other children in the District who could have pulled *(it)?

However, in a situation of sufficient immediacy and salience, the object of a verb like *pull* or *push*, which does not inherently license DNI, may be implicit. Attested examples (17a-c) illustrate DNI of this kind.

(17) a. I leaped to my feet and stumbled toward her. My fingers grabbed for the deadly necklace. I pulled with all my strength. Snap! (R.L. Stine. (undated) *Camp Fear Ghouls*. Simon & Schuster: New York: pages unnumbered. [Google Books])
b. Ernesto pointed again to the rocks. "Learn not to push before the right moment," he said. (Sylvester Stein (1958) *Second-Class Taxi*. Africasouth Paperbacks. Cape Town [Google Books].)
c. Suddenly the boulder was rocking and Tola Beg pushed hard, pushed with all the strength he had in his old body and with all the strength he had in his mind. Louis L'Amour (2001) *May there be a road*. Bantam Books: New York. page 36.

We take the key concept at work in licensing this kind of NI to be the *accessibility* of an intended referent (Ariel, 2001; Gregory & Michaelis, 2001). As the name suggests, accessibility is conceived as a gradient property: the degree to which "the speaker can predict or could have predicted that a particular linguistic item will or would occur in a particular position within a sentence" (Prince, 1981, 226). We posit that in any utterance context there is a threshold degree d of accessibility such that when the degree of accessibility of a valent v equals or exceeds d, DNI is licensed for v. The ACCESSIBLE feature, however, is discrete; its value is either the VARiable x of the INDEX of

a valent whose degree of accessibility v equals or exceeds the threshold d of *none*. An index appears on the ACCESSIBLE list iff its degree of accessibility equals or exceeds the threshold.[9] The ACCESSIBLE feature is posited to be one of the CONTEXTUAL-INDEX (C-IND) features (See Sag (2012: 96), Pollard & Sag (1994, 332-335) for discussion of C-INDS). The Accessibility DNI Construction is a derivational construction, mapping lexemes to other lexemes. When the intended referent of a valent is sufficiently accessible in the context, the construction pumps the predicator word in question to an otherwise identical word in which the argument is interpreted as DNI.

The Accessibility DNI Construction is shown in (18). As noted the ACCESSible feature takes a variable as its value when the degree of accessibility exceeds the threshold and *none* otherwise.

(18) **Accessibility DNI Construction** (↑*derivational-cxt*)
accessible-dni-cxt ⇒

$$\left[\begin{array}{l}\textsc{mtr}\ X!\left[\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ L_1\oplus\left\langle X!\left[\textit{dni-index}\right]\right\rangle\oplus L_2\right]\right\rangle\right]\right] \\ \textsc{dtrs}\left\langle X:\left[\begin{array}{l}\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ L_1\oplus\left\langle X:\left[\begin{array}{l}\textit{ref-index}\\ \textsc{var}\ x\end{array}\right]\right\rangle\oplus L_2\right]\right\rangle\right] \\ \textsc{cntxt}\left[\textsc{access}\ x\right]\end{array}\right]\right\rangle\end{array}\right]$$

In construction (18) the value of CNTXT [C-INDS]] specifies that the accessibility of the intended referent of the argument [INDEX [VAR x]] is at or above threshold. Because linking constraints like (15) apply to lexemes, they apply to both the daughter and the mother of (18). Thus, on the daughter's ARG-ST list this sign will have a *ref-index*, while on the mother's ARG-ST list the otherwise identical sign has a *dni-index*. Both signs will have the same [VAR x] specification, since only the index type is altered by (18).

R&M note that generic, including habitual, aspect can license indefinite null instantiation of the direct object of a simple transitive verb, such as *arrest*, while this is not possible under other circumstance.

(19) a. * The cops arrested ∅ last night. [R&M's ex. (1), p. 159]
b. Sure, the cops arrest Ø when they can, but it's always in small amounts. [R&M's ex. (2), p. 159, attested]

Null complementation licensed by generic interpretation as exemplified in (19) is restricted to existence interpretation, INI (R&M: 164), and is

[9] We leave to future research the question whether the threshold of accessibility varies with utterance context or is in some sense constant. Also, it is also an open question whether accessibility is in fact observable independently of its inferred effect on utterances.

also restricted to non-subjects. We model these facts in the Generic INI Construction, formalized in (20).

(20) **Generic INI Construction** (↑ *derivational-cxt*)
generic-ini-cxt ⇒

$$\left[\begin{array}{l}\textsc{mtr}\ X!\left[\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ L_1 \oplus \langle\ \textit{ini-index}\ \rangle \oplus L_2\right], \left[\textit{dispositional-fr}(s)\right]\right\rangle\right]\right] \\ \textsc{dtrs}\left\langle X\!:\left[\textsc{sem}\ \left[\begin{array}{l}\textsc{index}\ s \\ \textsc{frames}\ \left\langle\left[\textsc{args}\ L_1 :\textit{ne-list} \oplus\langle\ \textit{ref-index}\ \rangle \oplus L_2\right]\right\rangle\end{array}\right]\right]\right\rangle\end{array}\right]$$

In (20), a non-subject argument typed as *ref-index* is selected to become *ini-index*, regardless of the initial lexemic specification. The change to a non-canonical index forces the sign bearing it to become *covert-sign*, according to (5). The mother's FRAMES list contains a *dispositional-fr*(*ame*), representing a stativizing operator that takes an event argument and subsumes a quasi-universal operator over instances of a kind (Boneh, 2019). The value of VAR remains unchanged, and linking rules establish what the value of ARG-ST is in the mother lexeme. Linking rules imposing constraints on the ARG-ST and the frame arguments apply to the lexeme in MTR, and establish how the verbal frame arguments link to the signs in ARG-ST.

NI may also be licensed by genre. R&M show that NI is licensed by five distinct genres: instructional imperative, "labelese", dairy style, sports reporting ("match reports"), and certain non-quotative verbs used quotatively (See R&M: 160 for examples). For all five genres NI is of the deictic/anaphoric, i.e. DNI, variety and in some cases targets erstwhile subjects. Two examples of context-induced DNI are what R&M term labelese, e.g. (21a), and diary genre e.g. (21b).[10]

(21) a. ∅ Contains alcohol. (R&M's ex. (4), p. 160)
b. ∅ Read Michelet; ∅ wrote to Desmond about his poetess; ... ∅ played gramophone... (R&M's ex. (5), p. 160)

[10] Although genre-restricted subject ellipsis in languages that, like English, do not allow anaphoric subject ellipsis as a general matter has been well studied in relation to diary corpora (e.g. Haegeman & Ihsane (2001)), the phenomenon is not exclusively restricted to diary contexts. Example (i) is due to Richard Oehrle (p.c., cited in Kay (2002)). We do not attempt here to characterize the full range of conversational contexts permitting subject ellipsis in English, rather restrict the contextual constraint in the SBCG representation of the construction to diary genre, where it has been objectively established.

(i) [Baseball context] Got 'im, struck 'im out!

R&M note that in diary genre DNI involves the definite interpretation of an unrealized potential subject that is necessarily a topic. They propose a phrasal construction for diary genre DNI to license examples like those in (21). Here, we remain with the lexical approach, shown in (22).[11]

(22) **Diary Genre DNI Construction** (↑ *derivational-cxt*)
diary-dni-cxt ⇒

$$\left[\begin{array}{l}\textsc{mtr}\ X!\left[\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ \langle\ \textit{dni-index}\ \rangle \oplus L\right]\right\rangle\right]\right] \\ \textsc{dtrs}\left\langle X\!:\left[\begin{array}{l}\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ \left\langle\begin{bmatrix}\textit{ref-index}\\ \textsc{var}\ x\end{bmatrix}\right\rangle \oplus L\right]\right\rangle\right] \\ \textsc{cntxt}\ \left[\textsc{c-inds}\ \begin{bmatrix}\textsc{topic}\ x\\ \textsc{genre}\ \textit{diary}\end{bmatrix}\right]\end{array}\right]\right\rangle\end{array}\right]$$

In construction (22), the CNTXT value constrains TOPIC and GENRE features. The GENRE value is *diary* and the TOPIC value is identified with the subject referent x. The mother's value differs from that of the daughter in that the subject's index is *ref-index* in the daughter and *dni-index* in the mother.

The Instructional Imperative Construction is of interest because, along with DNI suppression of a non-subject argument, it includes the familiar unexpressed second person subject of imperatives:

(23) a. Method: Blend all the ingredients in an electric blender. Serve ∅ cold. [R&M ex. (3), p. 106]
b. Chill ∅ before serving ∅. [R&M unnumbered, p. 159]

R&M propose a phrasal construction. We continue here to pursue a lexical approach, treating these phenomena as licensed by lexical rules. We analyze the verbs *chill* and *serve* in (23a,b) as first having served as the unique daughter input to an inflectional construction whose mother is an ordinary imperative-verb, morphologically a plain-form (Huddleston & Pullum 2002, 83, [CGEL]) verb, whose XARG appears on neither the VAL nor GAP lists and is interpreted like a second person pronoun, along the lines of (24).

[11] Non-subject examples of Diary Genre NI are exist, but are rare. R&M also make the fact that the denotatum of the ellipted subject is a "volitional participant" a separate part of the representation of the construction. We assume that information is included in the specification of *diary* genre.

(24) **Imperative Construction** (↑ *derivational-cxt*)
imperative-cxt ⇒

$$\left[\begin{array}{l}\textsc{mtr}\ X!\left[\begin{array}{l}\textit{imper-lxm}\\ \textsc{syn}\ \left[\textsc{cat}\ \left[\textsc{vform}\ \textit{plain}\right]\right]\\ \textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ \langle\ Y:\textit{dni-index}\ \rangle\oplus L\right],\ \left[\begin{array}{l}\textit{imper-fr}\\ \textsc{sit}\quad s\\ \textsc{args}\ \langle Y\rangle\end{array}\right]\right\rangle\right]\\ \textsc{arg-st}\ \left\langle \mathrm{NP}\left[\textsc{agr}\ \textit{2nd}\right],\ \ldots\right\rangle\end{array}\right]\\ \textsc{dtrs}\left\langle X:\left[\begin{array}{l}\textsc{syn}\ \left[\textsc{cat}\ \left[\textsc{vform}\ \textit{base}\right]\right]\\ \textsc{sem}\ \left[\begin{array}{l}\textsc{index}\ s\\ \textsc{frames}\ \left\langle\left[\textsc{args}\ \left\langle\left[\begin{array}{l}\textit{ref-index}\\ \textsc{var}\ x\end{array}\right]\right\rangle\oplus L\right]\right\rangle\end{array}\right]\\ \textsc{cntxt}\ \left[\textsc{c-inds}\ \left[\textsc{addressee}\ x\right]\right]\end{array}\right]\right\rangle\end{array}\right]$$

In (24) the subject is changed from referential to DNI, although it has the same variable specification [VAR x]. The definition of construct in (10) prevents the subject from being realized overtly because of its INDEX type, but it remains available on the ARG-ST to bind an anaphor, if necessary, as in (25). We assume imperative semantics consists in a relation between an individual Y (the understood second person subject) and a state of affairs s, as indicated in the mother's FRAMES in (24). Other possibilities exist.

(25) $\emptyset_i$ Protect yourself$_i$ from 5G.

The Instructional Imperative Construction, exemplified in (26) and formalized in (27), is a construction whose daughter is an imperative verb lexeme, that is, the output (MTR) of the Imperative Construction in (24).

(26) a. In a bowl, toss Ø with salt and set Ø aside. (R&M: 72)
b. In a skillet, sauté Ø until browned but not crisp. (R&M: 72)

The MTR in the Instructional Imperative Construction retains the characteristics of an imperative verb word that contains a referential non-subject argument while replacing the index of that argument with *dni-index*. Specifically, in the Instructional Imperative Construction (24); (i) there is a pair of non-XARG ARG-ST members distributed across mother and daughter that are alike in having [VAR x] in their INDEX but differ in their INDEX type, (ii) in the daughter's ARG-ST, the INDEX type of the [VAR x] argument is

ref-index while that in the mother's ARG-ST is *dni-index*, (iii) the x variable is contextually specified to be a TOPIC and (iv) the GENRE is contextually specified to be *instruction*(*al*).

(27) **Instructional Imperative DNI Construction** (↑*derivational-cxt*)
instructional-imperative-dni-cxt ⇒

$$\left[\begin{array}{l}\textsc{mtr}\ X!\left[\textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ L_1 \oplus \langle\ \textit{dni-index}\ \rangle\right], Y\right\rangle\right]\right] \\ \textsc{dtrs}\left\langle X\colon \left[\begin{array}{l}\textit{imper-lxm} \\ \textsc{sem}\ \left[\textsc{frames}\ \left\langle\left[\textsc{args}\ L_1 \oplus \left\langle\begin{bmatrix}\textit{ref-index}\\ \textsc{var}\ x\end{bmatrix}\right\rangle \oplus L_2\right], Y\right\rangle\right] \\ \textsc{cntxt}\ \left[\textsc{c-inds}\ \begin{bmatrix}\textsc{topic}\ x \\ \textsc{genre}\ \textit{instruction}\end{bmatrix}\right]\end{array}\right]\right\rangle\end{array}\right]$$

2.3 NI and Displacement

Not all extraction requires a filler phrase, and thus in some cases the missing argument is simply missing, although it can be co-indexed with another null instantiated phrase. In examples (28a) and (28b) the subject is null and co-indexed with the extracted object.

(28) a. ∅ Don't be so hard to please _.
(Huddleston & Pullum, 2002, 1086)
b. ∅ Being especially easy to talk to _, Pat was able to escape being laid off.

Sag (2012) adopts a feature-based approach to argument realization in which members of ARG-ST are allowed to appear either in VAL(ence) or in GAP. Members of ARG-ST that appear in GAP are percolated in syntactic structure to license potentially long-distance dependencies, whereas those members of ARG-ST that appear in VAL must be locally realized. However, Sag (2012) is not entirely clear about how members of ARG-ST are related to VAL and GAP; in particular, how subjects are mapped into GAP. Sag (2012) cites the Ginzburg & Sag (2000) analysis, which accounts for subject extraction via a different mechanism from that of object extraction, but in the light of Levine & Hukari (2006, 87–109), extraction of subjects and complements should be handled uniformly. Technical details aside, not only does the exact account that Sag (2012) had in mind remain unclear, but it also is not clear how null instantiation may be factored into this picture.

In fact, the construction (29) from Sag (2012, 152), which is responsible for allowing heads to combine with complements (the Predicational Head-Complement Construction PHCC) has a fundamental problem. The PHCC

is dedicated to licensing all phrases in which the non-subject VALence requirements of a predicator are realized as sisters to the head in all VPs and relevant PPs, APs and NPs.

(29) **Predicational Head-Complement Construction** (↑*headed-cxt*) [according to Sag 2012, 152, item (112)]

$$\textit{pred-hd-comp-cxt} \Rightarrow \begin{bmatrix} \textsc{mtr} & \left[\textsc{syn}\ X!\left[\textsc{val}\ \langle X \rangle\right]\right] \\ \textsc{dtrs} & \langle Z \rangle \oplus L : \textit{ne-list} \\ \textsc{hd-dtr}\ Z : & \begin{bmatrix} \textit{word} \\ \textsc{syn}\ X : \begin{bmatrix} \textsc{cat}\ \left[\textsc{xarg}\ Y\right] \\ \textsc{val}\ \langle Y \rangle \oplus L \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

In the head daughter of (29), the external argument, tagged Y, appears on the daughter's VAL list (Sag 2012: 152). Since this sign is also on the VAL list of the mother, it cannot also be a member of the mother's GAP list under any conception of the ARP. So extraction of the external argument and realization of a non-subject complement cannot cooccur, which is problematic. One approach to this problem would be to revert to distinct SUBJ and COMPS features, but since the problem arises only in the operation of the PHCC, parsimony dictates altering only the PHCC itself to allow co-occurring realization of complements and extraction of the subject.

We propose the update of the PHCC seen in (30), to permit co-occurrence of subject extraction and overt realization of non-subject complements.

(30) **Predicational Head-Complement Construction** (↑*headed-cxt*) [revised]

$$\textit{pred-hd-comp-cxt} \Rightarrow \begin{bmatrix} \textsc{mtr} & \left[\textsc{syn}\ X!\left[\textsc{val}\ L_1\right]\right] \\ \textsc{dtrs} & \langle X \rangle \oplus L_2 : \textit{ne-list} \\ \textsc{hd-dtr}\ Z : & \begin{bmatrix} \textit{word} \\ \textsc{syn}\ X : \begin{bmatrix} \textsc{cat}\ \left[\textsc{xarg}\ Y\right] \\ \textsc{val}\ L_1 : \langle (Y) \rangle \oplus L_2 : \textit{list}(\neg Y) \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The revised PHCC in (30) avoids the blocking of XARG extraction, imposed by the unrevised PHCC (29) by specifying the first member of the VAL list of the HD-DTR to be the XARG optionally, as against obligatorily as in (29). In (30) the optionality reappears on the MTR's VAL list, which is consequently specified to be either (i) the singleton list containing the XARG or (ii) the empty list, depending on whether or not the XARG-initial option of the HD-DTR's VAL list is exercised. If the former option is followed the XARG is

realized locally; if the latter, the XARG appears on the MTR's GAP list and is normally realized as the filler constituent in a filler-head-construct.

The further specification of the HD-DTR's VAL list as "$\oplus L_2$*:list*$(\neg Y)$" ensures that when the XARG occurs on the HD-DTR's VAL list it occurs only as the first member, in L_1. The parametric type L_2 *:list*$(\neg Y)$ states that none of the members of the list L_2 can unify with Y. The XARG can thus be mapped to either the VAL list or GAP list, enabling overt realization of one or more non-subject complements to co-occur with either local instantiation of the XARG (e.g. [XARG NP_i, VAL $\langle \text{NP}_i, \text{NP}_j \rangle$, GAP $\langle\rangle$]) or non-local instantiation (e.g. [XARG NP_i, VAL $\langle \text{NP}_j \rangle$, GAP $\langle \text{NP}_i \rangle$]), in *pred-hd-comp-cxt*.

We now turn to the problem of modeling the interaction between extraction and Null Instantiation. Our grammar predicts the acceptability of (28) without further stipulation. Signs that are of the sort *ni-index* are not allowed in DTRS because of the constraint in (10), but they are allowed in GAP. This predicts that the object of *please* in (28a) can be typed *ni-index* and appear in GAP. The sign is percolated in the sentence structure like any other extracted sign, and is instantiated with the subject of the adjective *hard*. The subject X of the adjective is then raised like any other subject all the way to the auxiliary verb *don't*. At this point, X is instantiated with the first member of ARG-ST. And because X is typed *dni-index*, it is consistent with what the Imperative Construction requires of the first member of ARG-ST of a verb with imperative mood. The same analysis applies to (28b).

Conversely, note that the present account predicts that examples like (31) are not licit. NI signs are banned from DTRS, and thus there is no way to discharge the sign in GAP and saturate the root sign.

(31) a. $*\emptyset_i$ do you think is easy to talk to $\_\_i$?
b. $*\emptyset_i$ I don't think I've met $_i$.

Finally, the existence of passivized NI arguments as in (32) is likewise predicted without stipulations. Here, the prepositional object is co-indexed with the passive subject of *fed*. The lexical rule for passivization promotes the direct object to subject, and so the first member of ARG-ST of the passive form *fed* is the *ni-index* theme.

(32) If $\emptyset$ properly fed, Iguanas can live for a long time.

We propose to model both long and short passives with the lexical rule in (33). If the PP is resolved as an overt sign we obtain a long passive. If the PP is resolved as a covert sign we obtain a short passive.[12]

[12]Recall that covert signs are allowed in VAL in our ARP, but they cannot be discharged because only *overt-sign*s can appear in DTRS.

(33) **Passive Construction** (↑*inflectional-cxt*) [revised]
passive-cxt →

$$\left[\begin{array}{l}
\text{MTR} \left[\begin{array}{ll}
\text{PHON} & f_{pass}(L_3) \\
\text{SYN} & \left[\text{CAT}\left[\text{VFORM} \quad pass\right]\right] \\
\text{SEM} & Z!\left[\text{FRAMES}\left\langle\left[\text{ARGS}\ \langle W\rangle \oplus L_2\right]\right\rangle\right] \\
\text{ARG-ST} & \langle Y\rangle \oplus L_1 \oplus \left\langle \text{PP}\left[\begin{array}{l}\text{MRKG}\ by \\ \text{SEM}\ \left[\text{INDEX}\ W\!:\!\left[\begin{array}{ll} functional\text{-}index \\ \text{VAR} \quad x\end{array}\right]\right]\end{array}\right]\right\rangle
\end{array}\right] \\
\text{DTRS}\left\langle\left[\begin{array}{ll}
\text{PHON} & L_3 \\
\text{SEM} & Z\!:\!\left[\text{FRAMES}\left\langle\left[\text{ARGS}\ \langle X\rangle \oplus L_2\right]\right\rangle\right] \\
\text{ARG-ST} & \left\langle\left[\begin{array}{l} overt\text{-}sign \\ \text{SEM}\ \left[\text{INDEX}\ X\!:\!\left[\begin{array}{ll} ref\text{-}index \\ \text{VAR} \quad x\end{array}\right]\right]\end{array}\right]\right\rangle \oplus \langle Y\rangle \oplus L_1
\end{array}\right]\right\rangle
\end{array}\right]$$

The subject and XARG of the passive form of a transitive verb will be Y, as a consequence of the constraint in (2) above, which states that the first member of ARG-ST is structure-shared with XARG. The actor frame variable x is now linked to the PP argument. Finally, the ARP in (8) above is responsible for resolving the values of VAL and GAP, given the content of ARG-ST.

2.4 Semantics of NI

We now turn to the matter of interpreting referents that undergo null instantiation. One possibility is to postulate closure rules that add quantifiers to any *ni-index* variable, but we believe that this would make the wrong predictions. Adding such covert quantifiers would predict that NI arguments can participate in scope ambiguity, but as the example in (34) suggests, they cannot. The INI referent must exercise narrow scope in the presence of other scopal operators, such as negation and modals.

(34) a. I can't read.
[Impossible reading: there is a particular text which the speaker cannot read]

b. I should not have contributed.
[Impossible reading: there is a particular amount that the speaker should not have contributed]

In other words, the DNI argument is existentially interpreted *in situ*, as

if there were no quantifier. Thus, when the DNI argument obtains a narrow scope under some other operator, cross-sentential anaphora is not possible:

(35) a. I can't read. #It is in Mixtec.
(cf. I can't read this text. It is in Mixtec)
b. I can't read. It's too dark.
c. I shouldn't have contributed. #I should have given more/less.
(cf. I shouldn't have contributed $100. I should have given more.)

The minimal pair in (36) illustrates how the INI obtains narrow scope and suppresses the possibility of anaphora:

(36) a. Every contestant had to eat a burger. It had roaches on it.
b. Every contestant had to eat. #It had roaches on it.

But if there are no scopal operators, the INI referent is accessible to anaphora:

(37) a. He claims he contributed to the Disaster Relief Fund. If that's true, I don't believe it could have been very much.
b. [The] young lady reminded us they close at 4 so we ate quickly and it was good but a little overpriced.
[TripAdvisor]
c. So I ate, and it was as sweet as honey in my mouth.
[Ezekiel 3:3, *New International Version*]
d. Thirteen said, "you gotta give people food, you know? I mean, to be peaceable". Behind him, Smokey, plate just under her chin, ate eagerly. It had meat in it too.
[*Dhalgren*, by Samuel R. Delany]

As it stands, NI arguments are not associated with any quantifier in logical form in our account. Indices typed *ini-index* must be somehow interpreted as existential indefinites, and indices typed as dni-index must be interpreted as definites. We assume that such interpretations are enforced model-theoretically. That is, when the semantic representation of a frame is interpreted against a model, the variables that are associated with *ini-index* and *dni-index* are interpreted as if they had a quantifier. Suppose P is a frame with n arguments, with the typical truth-conditional definition:

(38) $[\![P(x_1, ..., x_i)]\!] = 1$ *iff* $\langle I(x_1), ..., I(x_n)\rangle \in F(P)$

To capture the distinction between INI and DNI, we draw from Gundel et al.'s (1993) implicational Givenness hierarchy for NPs, and assume that an entity e that is the value of a DNI variable must be a uniquely identifiable member of the Dom(ain), in the given context, as shown in (39b). A uniquely-identifiable referent is an entity that is in the set of Given entities and that

has core characteristics which are not shared by any other entity that is also Given. This uniquely-identifiable constraint is independently needed to license the use of definite descriptions (Gundel et al., 1993).

(39) a. $I(\textit{ref-index}\ \textsc{var}\ v) = val(v)$
b. $I(\textit{dni-index}\ \textsc{var}\ v) =$ there is an $e \in$ Dom such that Uniquely-Identifiable$(e) \wedge val(v) = e$
c. $I(\textit{ini-index}\ \textsc{var}\ v) =$ there is an $e \in$ Dom such that Type-Identifiable$(e) \wedge val(v) = e$

We thus overload the standard interpretation function I such that the variables of referential indices are associated with their respective values from the Domain as usual, as in (39a), but the variables of NI indices implicitly introduce a quantifier as in (39b,c). Thus, for NI variables, their value is some entity from the Domain.[13]

In this analysis *dni-index* referents have uniquely identifying properties in the given context, just like those referents that are characterizable with the definite determiner *the*. Conversely, the entity e in (39c) must be type-identifiable, rather than uniquely identifiable. Thus, *ini-index* referents are not assumed to be known by the addressee, just like those referents that are characterizable with indefinite determiner $a(n)$. As in Gundel et al.'s (1993) account of definite and indefinite determiners, the interpretation of DNI and INI variables depends on their cognitive status, not logical form. Once an NI variable is assigned a value by the *val(uation)* function, it becomes indistinguishable from referential and overtly quantified variables, and can be anaphorically bound like any other, as in (37), because they are in the domain of *val*. The construal of implicit arguments as prototypical participants, their failure to behave like regular quantified arguments, and their limited ability to serve as antecedents follows from their status (Mauner & Koenig, 2000).

3 Conclusion

In this work we propose that implicit arguments are not inaudible pieces of syntax but instead arise from a mismatch between a predicator's arguments (as in its ARG-ST and FRAMES list) and its valence (as in its VAL list). NI arguments are signs but not syntactic daughters. Our account encompasses two kinds of unrealized arguments that have not generally been treated as NI: Imperative 'subjects' and null subjects of infinitival (base form and gerundial) verbs, re-envisioning the Imperative rule as a derivational (lexeme-lexeme) construction rather than a phrasal rule (as in the S over VP treatment in Sag et al. 2003). Our treatment does not rely on sign types *gap* or *pro*, which Sag

[13] Constraints such as those imposed in (39b) may be presuppositional in nature, and if so, we could assume they are embedded under Beaver's (1992) ∂-operator, following the analysis of definite descriptions in Coppock & Beaver (2015).

(2012) lists in the type hierarchy. We specify that the members of VAL and GAP are simply signs. Finally, we amend the Predictional Head-Complement Construction, which in Sag (2012: 152) did not allow subject extraction.

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Challenges in Kazakh Auxiliary Selection

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Abstract

This paper accounts for the four auxiliaries in Kazakh that express the imperfective aspect. The main factors – the auxiliary, the main verb, their inflections and the aspectual specifications reveal a complicated system, which can be captured with an appropriate monotonic, multiple inheritance type hierarchy using online-type construction with the implementation of Pāṇinian competition. This analysis sheds light to a very different auxiliary system that we find in Indo-European languages.

1 Factors in interaction – empirical observations

Kazakh[1] is a Turkic language from the Kypchak branch, which like its relatives, has a rich system of auxiliary verbs. There are over 25 auxiliary verbs in Kazakh, each with a number of characteristics in common. They are all morphologically and inflectionally identical with a corresponding lexical verb and they all can be used in finite clauses, acting as lexical verbs on their own. When they participate in an auxiliary verb construction (henceforth AVC, shown in example 1), they combine with a lexical verb. The lexical verb must be in one of two converbial forms (either CVB.A or CVB.B), and the auxiliary is inflected for person, number and tense, or can be of nonfinite categories, such as coordination, relativization or attributivization. The lexical semantics of the entire AVC is determined entirely by the lexical verb. The auxiliary verb contributes aspect or mood-like meanings to the AVC.

Since a number of auxiliaries will be mentioned, and most of them will be very similar in their semantic contribution, I will gloss them with their original lexical meaning for easy identification. When deemed necessary, I will also gloss the overall aspectual meaning of the AVC, following the auxiliary verb. In the example in (1), the auxiliary's original lexical meaning is 'lie' or 'lie down', it is marked for the aorist tense and the overall aspectual meaning of the AVC is progressive.

(1) Toɣžan düken-ge bar-a žatïr
Toɣžan store-DAT go-CVB.A AUX(lie).AOR.3SG (PROG)
'Toɣžan is going to the store (right now).'

This paper focusses on the class of auxiliary verbs that express the imperfective aspect. These are *žat, otïr, tur* and *žür* (their lexical meanings are 'lie, sit,

1 I am grateful for the helpful comments and guidance to Berthold Crysmann, Stefan Müller and the audience of the 2020 HPSG Conference. I have received further help from Oliver Bond and Greville G. Corbett at my home department, and of course, the examples in this paper could not have been valid without the devoted help of my informants, mainly Toɣžan Turɣanbayeva and Aytoša Abdigali.

stand and walk'). The other c. 21 auxiliary verbs are structurally similar, but express the perfective with the addition of modal meanings, and due to the limits of this paper, their analysis has to remain for a future study. Example (2) is just to exemplify the semantic contribution of one of the auxiliaries that will not be examined in this work.

(2) (Muhamedowa 2015:119)

kitap-tï	sömke-ge	sal-a	sal-dï-m
book-ACC	bag-DAT	put-CVB.A	AUX(put)-PST-1SG (INCIDENTALLY)

'I put the book incidentally into the bag.'

The aim is to provide a model of the combinations of auxiliary and lexical verbs, their inflections, and the aspectual specification and the distribution of the entire AVC. The following table illustrates the building blocks that are relevant factors in an AVC. The following sections will introduce the data that Section 1.6 aims to model. The table in (3) is a summary of the components that will be relevant.

(3)

lexical verb	*CVB*	*auxiliary verb*	*inflection of the auxiliary verb*	*resulting aspect*	*meaning*
ayt 'say'	ïp CVB.B	žat AUX(lie)	ïr AOR	PROG	's/he is speaking'
qal 'stay'	a CVB.A	tur AUX(stand)	uw-ïn-a NMLZ-3SG-DAT	IPFV	'[so that s/he] stays [there]'

1.1 Aspect

Following Comrie (1976: 3), aspect specifies 'different ways of viewing the internal temporal constituency of a situation'. In Kazakh, aspect is expressed in analytic constructions, and in AVCs as well. This paper focusses on three aspect values of the imperfective type, that is, 'unbounded and internally homogeneous' events (Langacker 2008: 147).

- *Progressive*: 'a process ongoing at contextual occasion' (Timberlake 2007: 304)
- *Habitual*: 'some regular, repeated activity or event' (Carlson 2012: 829)

- *Incremental*: similar to the progressive, but the process consists of defined units, some of which have been completed, and some have not yet, at a certain reference point.[2]

The aspectual specifications are determined based on descriptions (Muhamedowa 2015; Somfai Kara 2002), as well as adverb compatibility and contextual tests performed during elicitation sessions, some of which will be explicit in the examples.

1.2 The auxiliary lexeme

The four imperfective auxiliaries we focus on, *žat, otïr, tur* and *žür* are similar in many respects, and sometimes they are interchangeable.

(4) (Muhamedowa 2015: 132)

a.	šegirtke	sekir-ip	žatïr/tur/žür
	dragonfly	jump-CVB.B	AUX(lie/stand/walk).AOR.3SG (PROG)
	'The dragonfly is jumping.'		
b.	tamaq	že-p	žatïr/otïr
	food	eat-CVB.B	AUX(lie/sit).AOR.3 (PROG)
	'S/he is eating.'		

The above examples are potential examples of overabundance (Thornton 2011, 2012), but admittedly, there could be factors I am not aware of at the moment. According to Muhamedowa (2015) and to my fieldwork, there is no elicitable difference in syntax, semantics and style. It must be made explicit that as long as there is no evidence for any kind of selectional factor, I will treat examples like (4) as overabundance with the narrower definition that the informants accept all versions without any comment, and they claim they would probably use all of them interchangeably.

1.3 The lexical verb lexeme

The lexical verb's idiosyncratic peculiarities have a key role in determining what structural combinations are possible and what the overall semantics will be. It is clear that aktionsart and other lexeme-internal factors are in play, including semantic class memberships (e.g. motion verbs, internal change verbs etc.), but accounting for these peculiarities has to remain for future research. This paper takes into account a particularly clear phenomenon – a split in the lexicon, whereby the lexemes *come* and *go* group together against

2 Incremental is not usually considered a type of aspect. This typology is data-driven, and the term is based on the discussion in Croft (2012, p. 41).

all other verbs. One of the four imperfective auxiliaries, *žat* 'lie', may only combine with the lexical verbs *come* and *go* when they are in the CVB.A form, while all other lexical verb lexemes must be marked for CVB.B. This distribution results in the progressive aspect, and any other combination will result in either unacceptable structures, or a different aspect.

As shown in example (5), the described combination results in the progressive aspect, while if the lexical verb is marked for CVB.B (6), the resulting aspect is the incremental. The informants, when asked in what sentence they could imagine the combination (*come/go*-CVB.B + AUX(žat)), said that it had to be a process that can be broken down to units, and some of the units have completed an action, while others are still in progress. Let us refer to this as the incremental aspect (Croft 2012; Dowty 1991).

(5) qonaq-tar kel-e žatïr
guest-PL come-CVB.A AUX.(lie).AOR.3 (PROG)
'The guests are coming (and none of them has arrived).'

(6) qonaq-tar kel-ip žatïr
guest-PL come-CVB.B AUX.(lie).AOR.3 (INCR)
'The guests are coming (and some of them have arrived).'

From the other three imperfective auxiliaries *žür* 'walk' freely combines with the lexical verbs *come* and *go*. The auxiliaries *otïr* 'sit' and *tur* 'stand' can also combine with *come* and *go*, however, this combination seems to be slightly more restricted. One example is shown in (7).

(7) Toɣžan düken-ge bar-ïp tur-a-dï.
Toɣžan store-DAT go-CVB.B AUX(stand)-NPST-3SG (HAB)
'Toɣžan usually goes to the store.'

1.4 Inflection of the auxiliary verb

The inflection of the auxiliary verb has an impact on the AVC's distribution, semantics and acceptability. In an AVC the auxiliary bears all the inflectional morphology that a finite verb would in the same distribution, while the lexical verb is marked for one of the converb forms. That is, an AVC's distribution is in general equal to the distribution of main verbs. They both can appear in a range of finite and nonfinite forms: they can be relativized, attributivized, as well as they can appear in co- and subordinations, or in the conditional. As expected, the AVC, when attributivized, changes the aspectual specification. This is illustrated in , where the predicate is attributivized.

(8) a. mektep-te oqi-ɣan bala
school-LOC study-PTCP child
'a child, who studied in school'

b. mektep-te oq-ïp žat-qan bala
school-LOC study-CVB.B AUX(lie)-PTCP (PROG) child
'a child, who is studying in school [at the moment]'

Considering the four imperfective auxiliaries this paper focuses on, there is one striking deviation. While *žat* selects its lexical verb and converb according to the split in the lexicon (see Section 1.3 above), the other three auxiliaries select the converb with respect to the finiteness of the AVC. The auxiliaries *otïr, tur* and *žür* can only combine with CVB.A in a nonfinite position[3].

(9)

				Auxiliary verb	
				Finite usage	Nonfinite usage
Lexical verb	CVB.A	+	otïr, tur, žür	✗	✓
	CVB.B			✓	✓
	CVB.A		žat	✓	✓
	CVB.B			✓	✓

The reason the generalization is worded using *finiteness* and not the type of converb, is that this applies to other nonfinite affixes as well. In such nonfinite positions, the auxiliary is frequently marked with CVB.B, since apart from marking the lexical verb in many AVCs, CVB.B also acts as a coordinator between VPs. This is shown in (10)a, while in (10)b another nonfinite form is shown, that is a nominalized, case marked complement of a VP.

(10) a. …batïrlar-dï es-ke al-a otïr-ïp …
…heroes-ACC mind-DAT take-CVB.A AUX(sit)-CVB.B
'Keeping the heroes in mind, [the soldiers marched forward].'

3 There are counterexamples, but for every thousand occurrences of LexV-CVB.A + AUX-CVB.B, there are only 2-3 occurrences of LexV-CVB.A + AUX-FINITE (Kilgarriff et al. 2004). This argument is meant to be taken as a statistical fact.

b. el-de qal-a tur-uw-ï-na
country-LOC stay-CVB.A AUX(stand)-NMLZ-3SG-DAT

ruqsat ber-di
permission give-PST.3SG
'S/he gave permission to him/her to stay in the country.'

1.5 Inflectional class and aspect

In this section I will be looking at two tenses, the nonpast and the aorist. I will argue that the four imperfective auxiliaries *žat, otïr, tur* and *žür* 'lie, sit, stand, walk', and their lexical verb counterparts constitute an inflectional class since they exhibit idiosyncratic morphological properties. This lines up with their idiosyncratic TAM specification, which is a strong argument for treating them as an inflectional class, and for assuming that the lexemes used in auxiliary and main verb constructions are one and the same.

Firstly, the four imperfective auxiliaries' morphology is unique in the aorist, since the third singular form is equal to the lexeme's stem, which is due to a process of haplology (tur-ur → tur, otïr-ïr → otïr, žür-ür → žür) whereby the aorist exponent's similarity to the coda of the verb stem caused one of the identical syllables to drop (Johanson 2004). From the four imperfective auxiliaries *žat* has gone through a different path, as instead of having lost its coda, it is fossilized in the old aorist form (žat → žatïr; the modern Kazakh, productive aorist is *žatar*). Eventually, *žat*'s inflectional morphology is identical to the other three auxiliaries. One peculiarity of this special inflection is that the third singular of the haplologized aorist coincides with the verb's stem (except *žat*), which in other verbs is reserved for the second singular imperative. The partial paradigms of the aorist forms in the haplologized and in the regular inflectional class are shown in (11).

(11)

	hapl. aorist	*reg. aorist*
stem	otïr 'sit'	bar 'go'
1SG	otïr-mïn	bar-ar-mïn
2SG	otïr-sïŋ	bar-ar-sïŋ
3SG	otïr	bar-ar

Now we turn to the semantic properties of the tense marked verbs. The nonpast tense, marked with the suffix *–A(y)*[4], can convey a number of present and future temporal specifications. The present progressive is usually not among these, as it is expressed in AVCs.

4 Capital letters indicate segments subject to consonant or vowel harmony.

The aorist, marked with the suffix *–(A)r* (see the table above), has a number of meanings as well, such as general truth (as in "ice melts when the weather is warm"), unsure future (maybe something will happen) or near future. The above description holds for all lexical and auxiliary verbs, apart from the four imperfective auxiliaries – both in an AVC and as a main verb in their original meaning. Uniquely, when marked for the nonpast, they specify the habitual aspect (12), and when marked for the aorist, they express the present progressive (13).

(12) a. Toɣžan negizi aldïŋɣï qatar-da otïr-a-dï
Toɣžan usually front row-LOC sit-NPST-3SG (HAB)
'Toɣžan usually sits in the front row.'

b. *Toɣžan negizi aldïŋɣï qatar-da otïr
Toɣžan usually front row-LOC sit.AOR.3SG (*HAB)
intended: 'Toɣžan usually sits in the front row.'

(13) a. Toɣžan qazir orïndïq-ta otïr
Toɣžan now chair-LOC sit.AOR.3SG (PROG)
'Toɣžan is sitting on a chair right now.'

b. *Toɣžan qazir orïndïq-ta otïr-a-dï
Toɣžan now chair-LOC sit-NPST-3SG (*PROG)
intended: 'Toɣžan is sitting on a chair right now.'

This would allow for an analysis that is similar to Daniels and Corbett's (2019), where a particular inflected form of a lexeme of a closed class (in that language the idiosyncrasy affects only one lexeme) shifts in semantics compared to all other lexemes inflected the same way. In Kazakh, four lexemes inflect for a particular tense, and the semantics changes in a systematic way compared to the rest of verbs. Compare the following examples where I assume that all verbs are in the aorist form (regardless of their haplologized or regular inflectional class membership). In sentence a., the verbal lexeme is one of the four verbs from the haplologized inflectional class, while in sentence b. and c. the verbal lexeme is in the regular inflectional class.

(14) a. Toɣžan qazir orïndïq-ta otïr
Toɣžan now chair-LOC sit.AOR.3SG (PROG)
'Toɣžan is sitting on a chair right now.'

(Muhamedowa 2015: 199)

b. erteŋ žaŋbïr žaw-ar
tomorrow rain rain-AOR.3SG (FUT)
'It will rain tomorrow probably.'

c. #qazir žaŋbïr žaw-ar
now rain rain-AOR.3SG (FUT/*PROG)
'It might be raining soon.' (intended: 'It is raining right now.')

This distinction is not only present in the lexical usage of these verbs, but also when they function as auxiliaries in AVCs. In the following examples, in sentences a. the auxiliary appears in the aorist form and conveys the present progressive TAM, while in sentences b. the auxiliary is inflected for the non-past tense, and it conveys the present habitual TAM.

(15) a. qazir oyïn oyna-p žür
now game play-CVB.B AUX(walk). AOR.3SG (PROG)
'The [child] is playing now.'

b. *qazir oyïn oyna-p žür-e-di
now game play-CVB.B AUX(walk)-NPST-3SG (*PROG)
intended: 'The [child] is playing now.'

(16) a. *keyde … de-p žatïr
sometimes … say-CVB.B AUX.(lie).AOR.3SG (*HAB)
intended: 'Sometimes [people] say …'

b. keyde … de-p žat-a-dï
sometimes … say-CVB.B AUX(lie)- NPST-3SG (HAB)
'Sometimes [people] say …'

1.6 Arguments that AVCs are periphrastic

AVCs might be treated as one-word (inflection, synthetic) or many-words (periphrasis, analytic) constructions. In this section I argue that Kazakh AVCs should be considered periphrases.

Firstly, let us look at semantic compositionality. As part of an AVC, the auxiliary's lexical meaning does not typically interact with the overall meaning of the AVC, although the speakers are aware of their being a separate semantic constituent. An informant told me at a session that her mother once criticized her because she used the lexical verb *eat* with the progressive auxiliary *žat* 'lie', since "it is impolite to eat while lying. You should use the auxiliary *otïr* 'sit' instead." The two imperfective auxiliaries are indeed freely interchangeable in this case. However, it is clear that the auxiliary *žat* is the most productive one and it is completely acceptable to combine it with al-

most any lexical verb, even with ones that result in an "impolite" combination. *Žat* indeed combines with lexical verbs whose meaning is not quite compatible with a lying position, including *eating, running* or *standing.* In other words, the semantics of the individual components of an AVC do not add up to the entire semantics (Ackerman and Stump 2004; Spencer 2001; Vincent 2011)

Syntactically, Kazakh AVCs are rigid structures, which could be an argument for an inflectional analysis, however, as reported in (Muhamedowa 2015:129), one adverb can intervene. The bolded adverb in example (17)a generally follows the NP it modifies, but in the case of AVCs, it is positioned in between the lexical verb and the auxiliary, as in (17)b. The opposite of this phenomenon can be an argument for morphologization (Bonami & Samvelian, 2015: 354, also see Müller, 2010: 608–609), thus this is an argument for a syntactic treatment.

(17) a. bir ret *qana* kör-di-m
one time *only* see-PST-1SG
'I saw it only once.'

b. oyïn oyna-p *qana* žür-mey
game play-CVB.B *only* AUX(walk)-NEG.CVB
'…[children] do not only play, [but also paint pictures and walk].'

Furthermore, as far as I can hear, the constituents of an AVC are pronounced as separate prosodic units and short pauses also occur when the speaker is hesitating. Regarding stress, Muhamedowa (2015: 124) notes that certain auxiliaries express different semantic distinctions when the lexical or the auxiliary verb is stressed.

Lastly, for phonology, auxiliaries can obey the 'initial bilabial glide rule'. The phonemes /o/ and /ö/ are preceeded by a bilabial glide in initial position, such that _# /o/, /ö/ → [ʷo], [ʷö]. In non-initial positions the glide does not appear. The imperfective auxiliary *otïr* 'sit' many times obeys this rule, as my field recordings show (e.g. [ʷ*oqïp* ʷ*otïr*] 'S/he is reading'). If morphotactics treated AVCs as a single item, the glide would not be present (and the example above would be [ʷ*oqïp otïr*]).

It is duly noted, however, that one auxiliary (*žat* 'lie') does fuse with the lexical verb (Muhamedowa 2015: 131), but this is only one auxiliary and the construction is considered to be of 'low register', and the fusion is never reflected in writing.

(18) a. ol žumïs iste-p žatïr
3SG work do-CVB.B AUX(lie).AOR.3SG (PROG)
'S/he is working.'

b. ol žumïs iste-vatïr
3SG work do-AUX(lie).AOR.3SG (PROG)
'S/he is working.'

It must also be mentioned that other Turkic languages have gone further the grammaticalilzation path and ended up with suffixes that were once auxiliaries. The present progressive in Turkish, for example, is marked with a suffix that is a cognate to *žür* 'walk', an imperfective auxiliary in Kazakh and many other Turkic languages. In Turkish, however, the converb has eroded into a linking vowel that is subject to vowel harmony (as all converbs are), however, the nucleus in the affix itself does not harmonize. The further grammaticalized Shor, a Siberian Turkic language, has auxiliary-origin suffixes whose nucleus is within the vowel harmony domain as well (Anderson 2004: 92–93).

It is likely that Kazakh auxiliaries could turn into suffixes in the future, but today, prosodic, syntactic and phonological evidence support that Kazakh auxiliaries are far from canonical affixes (Spencer and Luís 2013) and thus the balance turns into the analytic side, even if some traits point toward the synthetic direction.

Lastly, after having agrued that Kazakh AVCs are analytic constructions, it should also be made clear that they are periphrases. Following Ackerman and Stump (2004, as well as Spencer and Popova, 2015; for a canonical analysis, see (Brown et al. 2012)), the following criteria apply:

1) The AVCs have a featurally intersective distribution, since they can freely combine with large part of the verbal lexicon, even considering the regular incompatibilities we know of.

2) The union of the morphosyntactic property sets of the elements building up an AVC is not equal to the morphosyntactic property sets of the entire construction. Consider the bleached semantics of the auxiliary, or the fact the CVB.B can appear in a progressive AVC – note that CVB.B, when not in an AVC, is a marker of coordination and it is affixed to verbs describing an event that is completed (example (18)a).

3) Lastly, the exponents of the morphosyntactic property set in an AVC are distributed. Consider any example where the converb, the auxiliary or the auxiliary's inflection can change the aspectual specification of the AVC.

This section gave a summary of the data that will be analyzed in the next section. We have seen how the auxiliary and the lexical components of an AVC interact, how they can inflect, and what aspects emerge as a result. In the present section I argued for a periphrastic analysis.

2 Modelling in HPSG

2.1 Multiple inheritance with Paṇinian competition

The present analysis assumes the following statements, with respect to the above arguments:

- Kazakh AVCs are periphrases
- An auxiliary verb is the same lexeme as its main verb counterpart, and their differences are best described by derivational rules.
- Aspect is inherently carried by both the AVC, and the tense marker affixed to the AVC (if applicable, consider non-tensed examples)
- The aspect specification expressed by the tense markers should be considered a cross-cutting feature.
- There is overabundance (to the best of my knowledge)

The assumption that Kazakh AVCs are periphrases is implemented by following the feature geometry of periphrases in (Bonami, Borsley, and Tallerman 2016). In their approach, the auxiliary element's lexical identity is identical to the lexical verb's identity, and the auxiliary verb borrows its own phonological form from another lexical item. An alternative to this approach, that is not explicitly tailored for periphrases, would be where the lexical verb is specified in the COMPS list of the auxiliary (see e.g. Müller, 2010: 634).

The following analysis will use a monotonic, multiple inheritance type hierarchy of derivational rules combined with an online type construction approach (cf. Bonami & Crysmann, 2016; Crysmann & Bonami, 2016; or Malouf, 1998 but without the assumption of defaults).

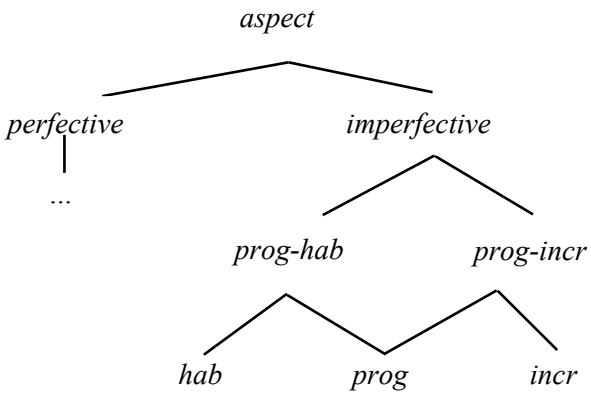
2.1.1 Assumed type hierarchy

I assume that both the auxiliary and the tense marker are specified for aspect. The auxiliary must be specified, since non-finite AVCs are specified for the same aspect values as finite AVCs, but do not bear tense markers; see example (8) above. The tense markers are individually specified for aspect (in the haplologized inflectional class), even when not in an AVC, but when affixed to a main verb, as shown in examples (12) and (13).

The tense marker can technically 'override' the AVC's aspect, as shown in Section 1.5. In order to keep this analysis free of defaults and any kind of overriding, the hierarchy recognizes that the nonpast tense marker can indicate both the *habitual* and the *progressive*, while the aorist tense marker can indicate the *progressive* and the *incremental*. This hierarchy is almost identical to the typology in (Comrie 1976), but this small additional complexity allows us to treat the lowest level of this hierarchy as part of a separate, orthog-

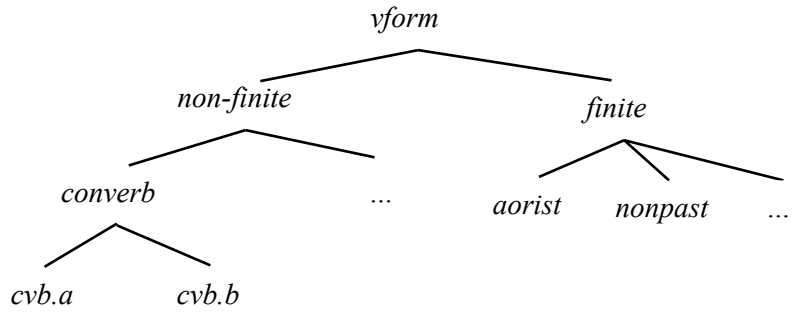
onal set of values that can only be accessed by one dimension, and not the other (more on the Online-type construction analysis in Section 2.1.3).

(19) Hierarchy of aspect values



In order to formalize generalizations on the structural characteristics, I will assume the hierarchy for VFORM values in (20). This step is important to explicitly model the data under question, but the same time it also represents a foresight for future research that will be looking at other auxiliaries that combine with lexical verbs of non-finite forms that are not converbs, or auxiliaries that are marked for tenses other than the aorist or the nonpast.

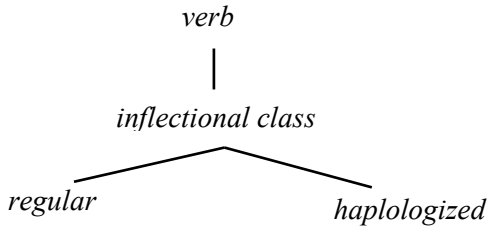
(20) Hierarchy of VFORM



And the last assumption formalizes the acknowledgement that there are at least two inflectional classes of Kazakh verbs, one of which (*haplologized*) characterizes the four imperfective auxiliaries. This formalization is similar to that of Koenig's *subregularities* (1999: 130–133). Koenig assumes a separate branch of the hierarchy that includes the inflectional properties of the exceptional classes. Since at the moment we only need to formalize the exis-

tence of a set of lexemes that constitute an inflectional class, I will not represent the peculiarities of the actual inflection.

(21) Hierarchy of inflectional classes



2.1.2 Analysis

This Section presents an analysis that uses a monotonic (does not require defaults), multiple inheritance type hierarchy. In addition, I follow recent papers (Bonami, Borsley, and Tallerman 2016; Crysmann and Bonami 2016) that argue for the implementation of Pāṇinian competition into HPSG.

At the top of the partial hierarchy in (22) is the type *derivational lexical rules*. The following type is *aux* which represents the common properties of all auxiliary verbs in Kazakh, and gives rise to the periphrastic construction. It is specified that the semantic content value of the auxiliary is identified with that of the lexical verb's (in COMPS), but there is an added ASP(ect) feature as well. The INFL|LID feature, that is the lexical identity of the auxiliary, is underspecified, since it needs to allow the 25 auxiliaries to be identified with their main verb counterpart. The details of this selection need to be examined in future research. Lastly, since all AVCs require the main verb to take some sort of a converb form, this is specified in this description as well.

The subtype *aux-ipfv* is a restriction that is true for the four imperfective auxiliaries detailed in this paper. They are selected on the basis of their inflectional class membership (*hapl*), that contains only these four verbs. The ASP value is further specified to *ipfv*, which is a subtype of *aspect*. The sister of this type is just a reminder that there are perfective AVCs as well.

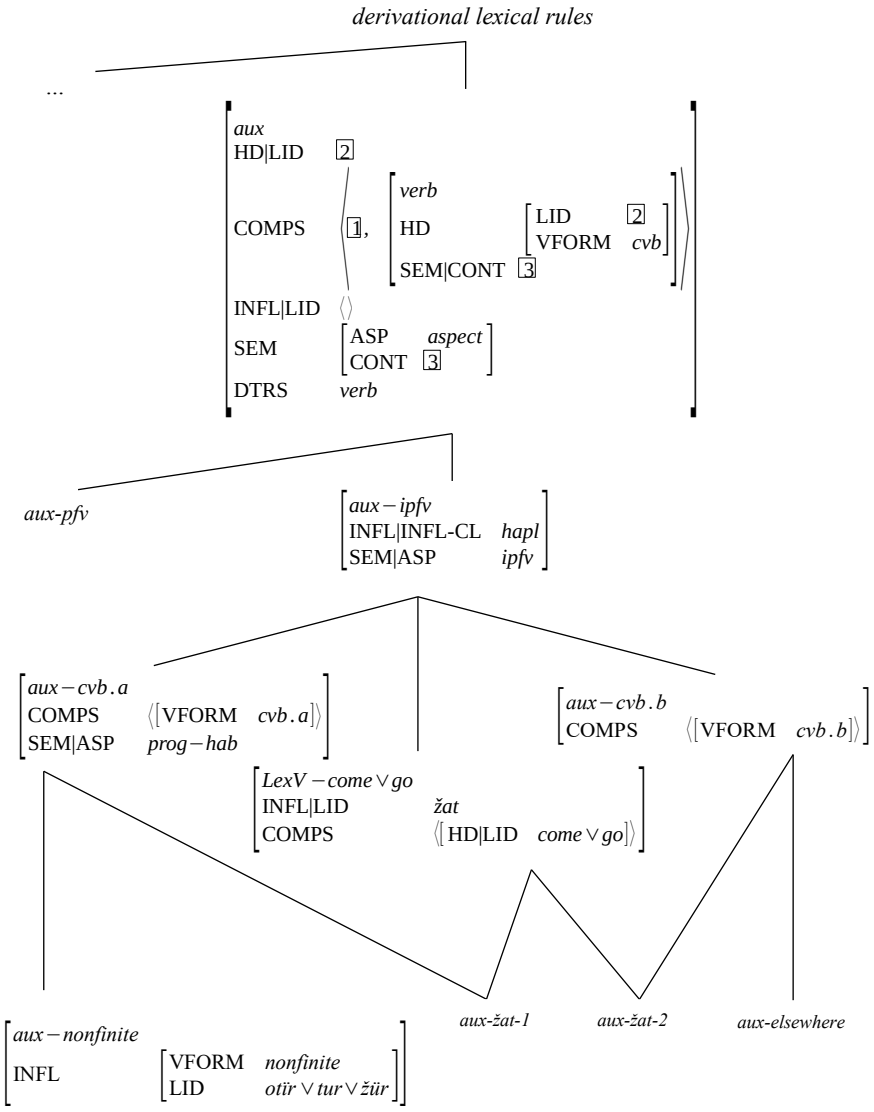
The following seven types describe how the converb forms, the auxiliary and the lexical verb identities are allowed to combine.

Aux-nonfinite describes the AVCs that could only appear in a nonfinite usage (recall Section 1.4). The types *aux-žat-1* and *aux-žat-2* account for the distribution of the auxiliary *žat* and the converb forms, as well as the lexical verbs *come* and *go*. *Aux-žat-1* licenses examples like the one in (1), while *aux-žat-2* licenses the example in (6). The type *aux-elsewhere* is a necessary point in order to implement Pāṇinian competition by licensing less specified constructions that are acceptable (Crysmann and Bonami 2016: 363–64). This type licenses all four auxiliaries to select CVB.B, unless one of the de-

scribed types is more specific. I believe the data I know of fits into this hierarchy.

Notice that the leaf nodes are specified for aspect. This is crucial to reflect the fact that AVCs on their own express aspect on the one hand, and on the other hand at this stage of my knowledge of this language, there are multiple constructions that express the same aspect (recall Section 1.2). At this point, all AVCs are specified for [ASP *imperfective*].

(22) Dimension 1: Auxiliary



2.1.3 The tense dimension - Online-type construction

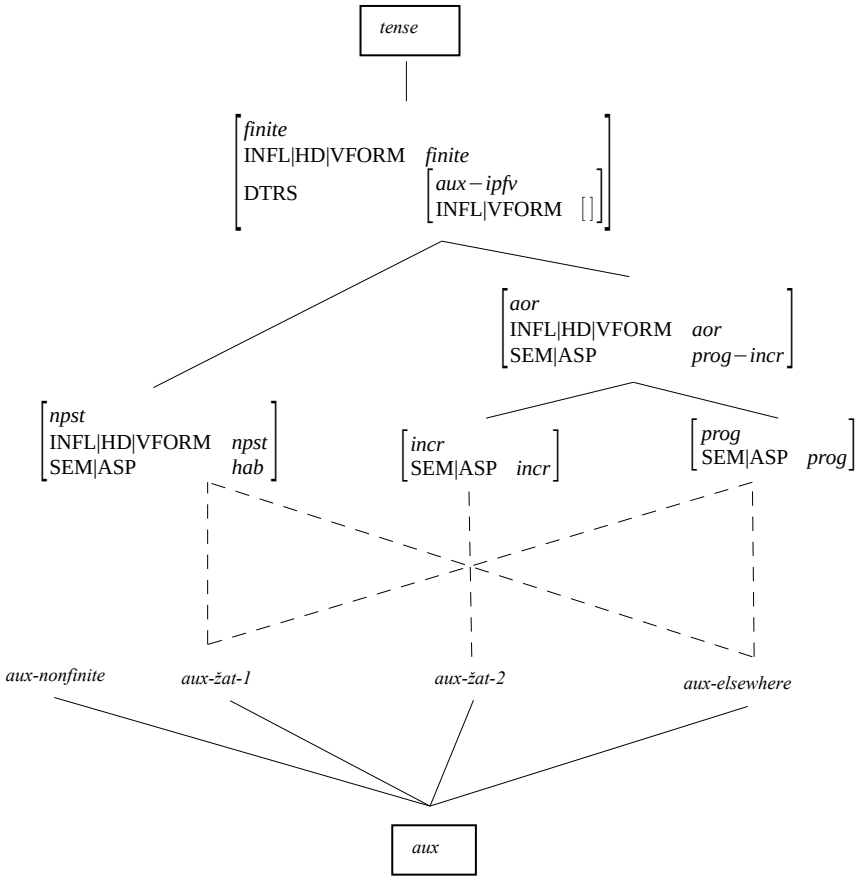
When the auxiliary is affixed by the aorist or the nonpast tense markers, the aspect value is 'overridden'. In the present analysis, this phenomenon will be analyzed as instances of more specific aspect values. This alternation is formalized as an online type construction (Ackerman and Bonami 2017; Bonami and Crysmann 2016; Koenig 1999; Koenig and Jurafsky 1994). That is, leaf nodes of either dimension may be underspecified, and require to unify with the specifications of the other dimension's leaf nodes.

The figure in (23) describes the tense dimension, with the addition of the of the leaf nodes of the auxiliary dimension in order to show the alternating properties (dashed lines). The mother node describes a rule that takes an item of type *aux-ipfv*, with the specification that its VFORM is not specified – this blocks the type *aux-nonfinite* to combine with it. While the *nonpast* tense is only associated with the *habitual* aspect, the *aorist* tense can both bear the *progressive* and the *incremental* aspects. This is duly represented by the intermediate node *aor*.

The leaf nodes in the tense dimension represent the relation between the two tenses, and the three most specific aspect values, shown in (19). The *progressive* and the *habitual* alternate with *aux-žat-1* and *aux-elsewhere*. *Aux-žat-2* can only combine with the *incremental* aspect. Lastly, *aux-nonfinite* cannot combine with any tense-marked type, since by definition, it can only take affixes marking nonfinite clauses.

This analysis might be unusual, considering that the two dimensions interacting involve the same feature, namely, aspect. However, it respects the requirements of online type construction to the extent that the alternating values are never part of both dimensions, they are thus, orthogonal. The tense dimension only specifies the *progressive,* the *incremental* and the *habitual*, while the auxiliary dimension can only access the less specific types of aspect.

(23) Dimension 2: Tense



3 Conclusions

This paper has proposed an analysis of the four imperfective auxiliary verbs in Kazakh. Section 1 presented the data and focused on the different behaviors of the four auxiliaries, a split in the lexicon that required the lexical verbs *come* and *go* to behave idiosyncratically, and showed how aspect emerges from these properties. The section concluded that AVCs should be treated as periphrases.

Section 2 proposed an analysis where aspect is carried both by the AVC and its tense marking separately, but they interact. This interaction is represented in an online-type construction approach, while the interacting nodes are part of monotonic, multiple inheritance type hierarchy. This description implements Pāṇinian competition, and does not reply on defaults or junk fea-

tures (Kathol 1994). It also reflects the overabundance that might be the best term for the optionality we see. Future research will aim to resolve this overabundance and to account for the rest of the AVCs in Kazakh.

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An incremental approach to verb clusters in German

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Abstract

This paper presents an incremental approach to verb clusters in German which radically differs from standard HPSG accounts. While the common assumption is that the verbs in subordinate clauses form clusters and accumulate all their valence requirements on a SUBCAT list, the assumption in this paper is that the arguments in verb final clauses are encapsulated incrementally into syntactic and semantic structures before the verbs are attached. The proposed analysis is in line with psycholinguistic findings. A grammar fragment of German demonstrating an implementation of the analysis is presented.

1 Verb clusters in German HPSG

A widely studied topic in German syntax is that of verbal clusters, as illustrated in (1).

(1) daß ich den Jungen das Buch holen sah
that I the boy the book fetch saw
'that I saw the boy fetch the book'

The clause has an AcI[1] verb *sehen* 'see' which takes an infinitival complement and takes the subject of the infinitival complement as its direct object *den Jungen* 'the boy'. In Müller (2007a) it is given the SUBCAT value shown in Figure 1. The first element on the SUBCAT list is an NP subject (in (1) *ich* 'I'). The last element on the list is an embedded verb (in (1) *holen* 'fetch') which SUBJ and SUBCAT values (1 and 2) also appear on the SUBCAT list of the AcI verb. This ensures that the arguments of the embedded verb (*den Jungen* 'the boy' and *das Buch* 'the book') end up on the subcat frame of the AcI verb.[2]

$$\left[\begin{array}{l} \textit{AcI-verb} \\ \\ \text{CAT}\,|\,\text{SUBCAT}\left\langle \text{NP}\right\rangle \oplus \boxed{1} \oplus \boxed{2} \oplus \left\langle \text{V}\left[\begin{array}{l}\text{SUBJ}\ \boxed{1}\\ \text{SUBCAT}\ \boxed{2}\end{array}\right]\right\rangle \end{array}\right]$$

Figure 1: AcI verb adapted from Müller (2007a, 279)

The schema in Figure 2 shows how complex predicates are combined (Hinrichs and Nakazawa, 1994). In a clause like (1) the AcI verb and the embedded verb are

[†]I would like to thank two anonymous reviewers and the audience at the HPSG 2020 conference in Berlin, Seattle, Buxtehude, wherever, for very useful comments and suggestions. A special thanks goes to Stefan Müller for his constructive feedback. I also would like to thank the research group Language and Society at Western Norway University of Applied Sciences for its valuable support.

[1]Accusative and Infinitive.

[2]Semantic roles and case are also important parts of the account, but that will not be discussed here.

combined. The AcI verb will then be the head daughter. The last element on its SUBCAT list is unified with the SYNSEM of the embedded verb (2). The SUBCAT list of the complex predicate (1) is the subcat list of the head daughter, except from the last element.

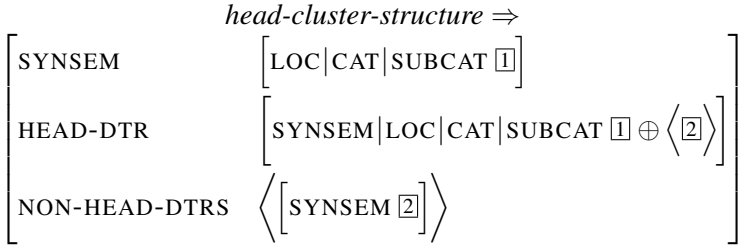

Figure 2: Schema for complex predicates (from Müller (2007a, 240))

The combination of the transitive verb *holen* 'fetch' and the AcI verb *sehen* 'see' in example (1) is shown in Figure 3. The SUBCAT list of the mother is the concatenation of the subject of *sehen* (2) and the SUBCAT list of *holen* (3).

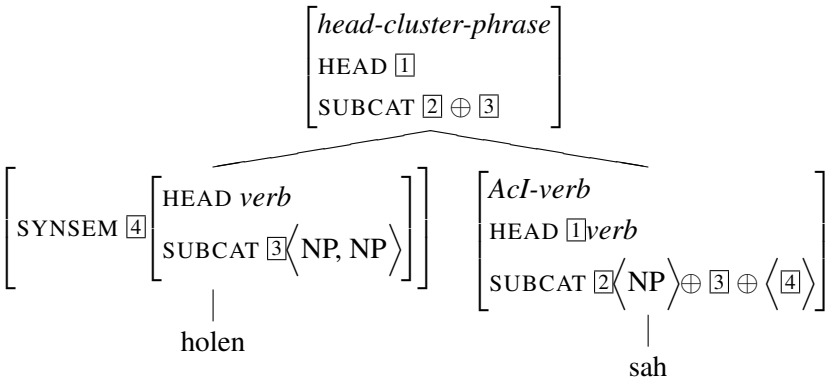

Figure 3: Composition of complex predicate

The arguments are subsequently realized by the Head Argument Schema shown in Figure 4 (Müller, 2007a).

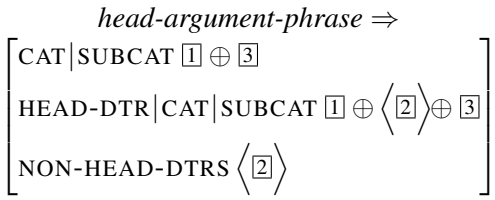

Figure 4: Head Argument Schema (adapted from Müller (2007a, 79))

This rule attaches the arguments one by one in a binary fashion. The fact that the rule splits the SUBCAT list of the head daughter in three, realizes the middle

element (2) as the argument, and then concatenates the initial list (1) and the final list (3) in the SUBCAT of the mother, accounts for the fact that arguments may be permuted. The middle list may contain any of the arguments, since the lengths of list 1 and 3 are underspecified.

The HPSG analysis of verb clusters stems from Hinrichs and Nakazawa (1994). While their focus is on the formation of verb clusters and the position of auxiliary verbs, the part of the analysis where the arguments are realized (the Head Argument Schema) is not formalized. Müller (2007a) gives a precise account of the realization of arguments of verb clusters, as illustrated in Figure 4. The use of the concatenation operator in the Head Argument Schema requires arbitrary relational constraints, which are supported by TRALE (Meurers *et al.*, 2002), and not just unification of typed feature structures, which is the case with DELPH-IN resources (Deep Linguistic Processing with HPSG Initiative) like the LKB system (Copestake, 2002).

I would argue that a unification based approach without relational constraints is preferrable to an approach which requires relational constraints of two reasons. The first reason is parsimony. Even though relational constraints allows a grammar writer to write more compact statements, the underlying formalism is more complex and unrestricted. The second reason is the fact that the problems of an approach become more exposed if they are not masked by relational constraints. An example of the latter is the treatment of argument permutations in connection with verb clusters by the German Grammar (Crysmann, 2003), which is implemented with the LKB system, and therefore does not employ relational constraints. It resolves the challenge by assuming different Head Cluster Rules, one for each possible permutation of the arguments. In this way, the argument realization rule does not have to split the SUBCAT list, it just needs to realize the first element. This, however, leads to a large number of combinations of Head Cluster Rules if the number of embedding verbs is larger than one, and it can be said to be a not very elegant brute force approach.

From a processing perspective, there is a second challenge with Hinrichs and Nakazawa's (1994) approach to verb clusters. Given the fact that restrictions on arguments stem from the verb lexical entries, arguments cannot be linked before the verbs have been parsed. The notion of words being incrementally added to an overall syntactic structure one by one (incremental processing) is well established in the psycholinguistic literature, evidenced by studies showing that sentences in head-final languages do not require higher processing than sentences in head-initial languages (Swets *et al.*, 2008). And studies on German show that there is an unmarked order in which arguments are processed (see Kretzschmar *et al.* (2012) and references therein). If an argument is locally ambiguous with regard to nominative or accusative case and it appears first of the arguments, it will typically be interpreted as the subject. If the final verb reveals that it is not the initial argument that is the subject, we get a garden path effect, and the clause will be reanalyzed. This is illustrated in (2) (Kretzschmar *et al.*, 2012).

(2) a. Dass Erich Nachbarinnen stört, hat jeden
that Erich.amb.sg neighbors.amb.pl disturb.sg, has everyone
verwundert.
surprised
'It surprised everyone that Erich disturbs neighbors.'

b. Dass Erich Nachbarinnen stören, ...
that Erich.amb.sg neighbors.amb.pl disturb.acc.pl
'It surprised everyone that neighbors disturb Erich.'

In both (2a) and (2b), the arguments of the subordinate clause are underspecified with regard to nominative or accusative case. In (2a), the verb agrees with the first argument, while in (2b) it agrees with the second argument. Experiments confirm that the marked order results in clearly visible reanalysis costs on the verb. This performance effect is however not explained by the lexicalist approach to verbal clusters in German.[3]

2 An incremental approach to argument realization

In this section I will show how complex predicates with multiple verb embeddings can be analyzed within the framework of Haugereid (2007, 2009).

2.1 Haugereid (2007)

It is a well-known fact that arguments in the German Mittelfeld can permute very freely, and Müller (2006) uses examples from German subordinate clauses (see (3)) to point out problems with the flat structures that are implied by Construction Grammar (Goldberg, 1995). The examples show how the SUBJect, OBJect and OBLique arguments of a clause may be permuted.

(3) a. daß so grün selbst Jan die Tür nicht streicht
that that green even Jan the door not paints
[OBL SUBJ OBJ V]
'that not even Jan would paint the door that green'

b. daß so grün die Tür selbst Jan nicht streicht
that that green the door even Jan not paints
[OBL OBJ SUBJ V]

[3]The argument I am making here is concerning the processing of an utterance. According to Wasow (2020) HPSG theories are theories of competence, and while they should be possible to incorporate into a theory of performance, they are not themselves theories of performance. As I see it, a lexicalist approach like Hinrichs and Nakazawa (1994) does not show how words are assigned structure and meaning incrementally in a theory of performance. This will have to be accounted for in the theory of performance. On the other hand, the left branching approach I am suggesting in this paper, which like other HPSG theories is a theory of competence, would require far less adaption in order to be incorporated into a theory of performance.

c. daß Jan so grün selbst die Tür nicht streicht
that Jan that green even the door not paints
[SUBJ OBL OBJ V]

d. daß eine solche Tür so grün niemand streicht
that a such door that green nobody paints
[OBJ OBL SUBJ V]
'that nobody paints such a door that green'

In order to account for the clauses in (3) one would need a construction for each possible order of the argument, and if interspersable adjuncts are also to be accounted for, the flat structures becomes unfeasible, given that the number of constructions needed would be infinite.

Haugereid (2007) shows how a constructional approach is still possible if the assumed flat structures are replaced with binary subconstructions. So instead of employing flat structures that realize all the arguments of a clause at once, arguments are assumed to be realized by five types of valence rules; one type of rules for agent or source arguments (CMP1-rules), one type for patient/theme arguments (CMP2-rules), one type for benefactive or recipient arguments (CMP3-rules), one for resultative or end-of-path arguments (CMP4-rules) and one for antecedents (e.g. instrument arguments) (CMP5-rules). These rules may apply before the verb(s) of the clause are attached. In addition to linking the argument to the predicate of the clause, each valence rule contributes an atomic valence type, and during the parse, the valence types are unified with an argument structure type assigned to the verb. When these types are unified, their greatest lower bound is a construction type. If the types do not have a greatest lower bound, the parse fails. This prevents verbs from being assigned arguments that they are not compatible with. It also prevents combinations of arguments that are not licited by the grammar, even though the verb is not yet parsed. This latter fact makes it possible to account for backward gapping in head-final languages like Japanese, where the verb only appears in the final conjunct (Haugereid, 2019).

The rule for attaching a patient/theme argument is shown in Figure 5. It links the complement to the ARG2 of the key relation of the clause KEYREL (1). It also introduces a subconstruction type *arg2+* which will be unified with the other subconstruction types and the argument frame type of the predicate.

$$\left[\begin{array}{l} \textit{cmp2-phrase} \\ \text{ARGS} \left\langle \left[\begin{array}{ll} \text{KEYREL} & \left[\begin{array}{l}\text{PRED } \textit{arg2+} \\ \text{ARG2 } \boxed{1}\end{array}\right] \\ \text{VAL} & \left[\text{CMP2 } \boxed{2}\right] \end{array}\right], \boxed{2}\left[\text{INDEX } \boxed{1}\right] \right\rangle \end{array}\right]$$

Figure 5: Rule for attaching theme/patient (CMP2) arguments

Given the fact that the valence information of a verb is specified by the position

of the argument frame type in the type hierarchy of valence types, and not by means of valence lists, the order of the arguments is not fixed in the lexicon. This opens for permutations of arguments in a way that is not possible with a lexicalist approach, as shown in (4). Here, the arguments are realized in a left-branching manner by the valence rules before the verb is attached. The binary design also allows for interspersable adjuncts.

(4) a. [[[[COMPL CMP4] CMP1] CMP2] V]
b. [[[[COMPL CMP4] CMP2] CMP1] V]
c. [[[[COMPL CMP1] CMP4] CMP2] V]
d. [[[[COMPL CMP2] CMP4] CMP1] V]

2.2 Criticism of Haugereid (2007)

Müller (2007b) points out a problem with the approach taken in Haugereid (2007), namely that there will be a need for a new set of valence rules for each embedding verb (raising verbs and control verbs) in a verbal cluster. The rules assumed in Haugereid (2007) only account for the arguments of the matrix verb. The example in (5) has two embedding verbs (*helfen* 'help' and *läßt* 'let'), and an analysis would require three sets of valence rules, linking at different levels of embedding, as illustrated in Figure 6. This number of embeddings would be multiplied by two since each rule has an extraction variant. Müller (2007b) argues that the number of embeddings in verbal clusters is limited by performance, and that a grammar in principle should allow for an unlimited number of embeddings. This would be unfeasible with the N levels deep linking approach inferred from Haugereid (2007).

(5) weil Hans Cecilia John das Nilpferd füttern helfen läßt.
because Hans Cecilia John the hippo feed help let
'because Hans lets Cecilia help John feed the hippo.'

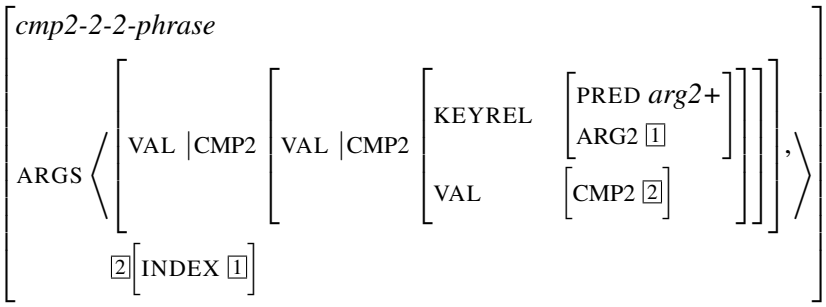

Figure 6: Hypothesized rule for linking theme/patient arguments two levels deep

2.3 Analysis of embedded structures in German subordinate clauses

The problem with the asserted N levels deep linking approach can be solved by means of three unary embedding rules, one for linking the subject of the embedded clause to the subject of the matrix clause (subject raising/control), one for linking the subject of the embedded clause to the indirect object of the matrix clause (object control), and one for linking the subject of the embedded clause to the direct object of the clause (AcI verbs). Figure 7 shows the rule for object control.

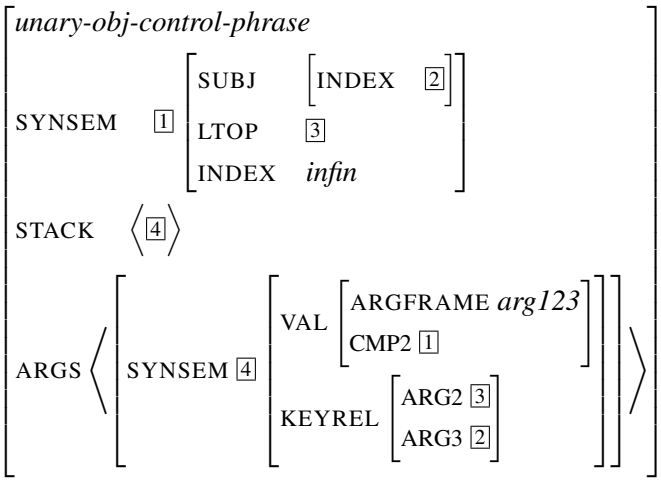

Figure 7: Rule for entering embedded structures with object control in German

The rule takes as input a structure, and outputs a structure embedded in the initial structure. The SYNSEM of the input structure is put on a STACK. The rule constrains the argument frame type of the input structure (the matrix clause) to be of type *arg123*, which means that it should have three arguments (an agent, a patient/theme, and a benefactive). The ARG2 of the input structure is linked to the label of the output (the embedded clause). The ARG3 of the input structure is linked to the subject of the embedded clause.

The rule for entering AcI structures is shown in Figure 8. It is similar to the object control rule, except from the fact that it says that the infinitival clause is the CMP4 and not the CMP2, the ARGFRAME value is *arg124*, and not *arg123*, and the matrix structure ARG2 is linked to the subject of the infinitival clause while in the object control rule the matrix structure ARG3 is linked to the subject of the infinitival rule.

Once the embedded structure has been entered, the valence rules can be employed in a regular fashion. There is principally no limit to how many times the unary embedding rule can be used, and so the linking of arguments embedded two levels deep is no longer a problem.

In addition to the unary embedding rules, the grammar also has a unary popping rule, which pops out of embedded structures (see Figure 9).

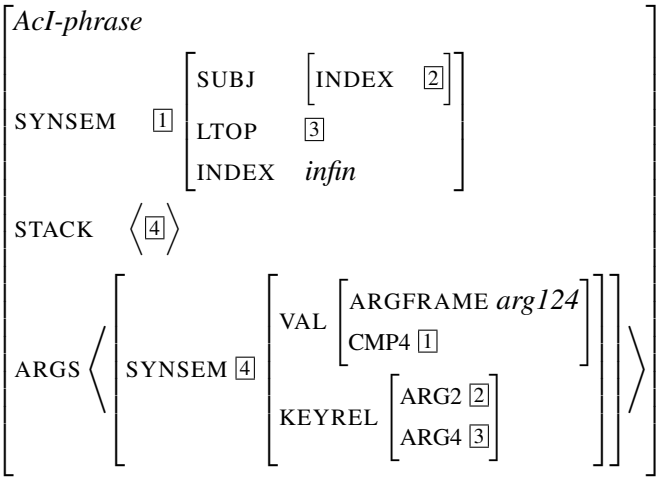

Figure 8: Rule for entering embedded AcI structures in German

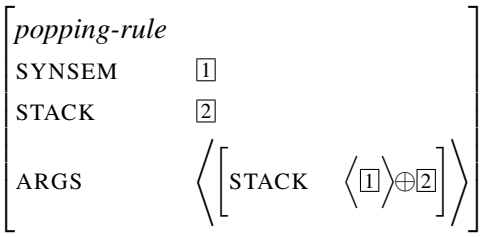

Figure 9: Rule for exiting embedded structures

The embedding and popping rules works in tandem with the valence rules, creating a left branching tree structure. It is important to note that these left branching structures are not constituent trees, but parse trees. The stacking and popping is a way to navigate the constituent tree. So when an embedding rule works, the parser enters one level of embedding. And when the popping rule works, the parser exits that level of embedding. In this way, linking can be done at various levels during parsing.

The assumed constituent tree structure for the sentence in (5) is shown in Figure 10. The structure is fairly flat, and while this would be a challenge in an approach where the parse tree and the constituent tree is the same, it is not a problem in the present approach given the division between parse trees and constituent trees. (This division is explained in more depth in Haugereid and Morey (2012).)

The tree in Figure 11 shows how the embedding rules and popping rules work during parsing of the sentence in (5).[4] The parse starts in the bottom left corner with the complementizer *weil*. First the subject *Hans*, and the indirect object *Cecilia* are attached (and linked). Then the AcI rule works. It enters the SYNSEM of the AVM parsed so far, onto a STACK in the mother. Now, the second indirect

[4]In Figure 11, linking of the arguments is left out for expository reasons.

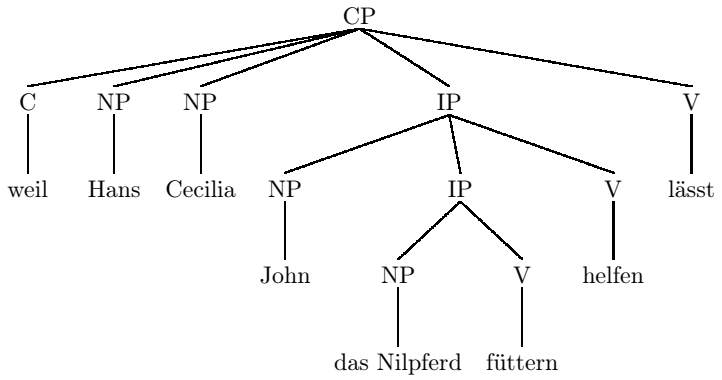

Figure 10: Constituent analysis of German subordinate clause with two embeddings

object *John* is attached (and linked). Note that it is the same type of *cmp3-rule* attaching both *Cecilia* and *John*. No extra valence rule is required, even though the two arguments are at different levels of embedding. The next step is to enter another level of embedding (an object control structure, see Figure 7) before the final argument *das Nilpferd* is attached (and linked). At this point there are two elements on the STACK list, showing the level of embedding. After the arguments are attached, the verbs are attached at the appropriate levels of embedding.[5,6]

The resulting AVM is shown in Figure 12. It shows how the relations of the verbs are linked to their arguments, how the embedded verbs are linked to their matrix verbs (see 2 and 4), and how the indirect objects of the control verbs (ARG3) are linked to the subjects of the embedded verbs (3 and 5)

The tree in Figure 13 illustrates that the approach also accounts for permutations. The unary embedding rule works twice in order to allow the object of *füttern* (*das Nilpferd*) to be linked at the correct level of embedding (2), before the other arguments. Then two popping rules apply in order to let the subject and the indirect object of the matrix clause be linked (*Hans* and *Cecilia*). Then the embedding rule applies again in order to link the object of *helfen* (1). The embedding rule applies over again in order to attach the verb *füttern* at the right level (2). The AVM resulting from the analysis in Figure 13 is the same as the AVM resulting from the analysis in Figure 10.

As shown in Figure 13, the embedding and popping mechanism allows the

[5]The left-branching parse trees are, in addition to the incremental nature of the left-branching structures, motivated by the fact that verbs and complementizers in some languages reflect whether they are on the extraction path. In the approach presented in this paper, verbs and complementizers have local access to the extraction path, so the reflection of the extraction path can easily be accounted for. However, in a regular HPSG grammar, this becomes a challenge, especially with regards to extracted adjuncts (Haugereid, 2009, Chapter 6.9).

[6]The approach has similarities with the parsing approach in Güngördü (1997, Chapter 6).

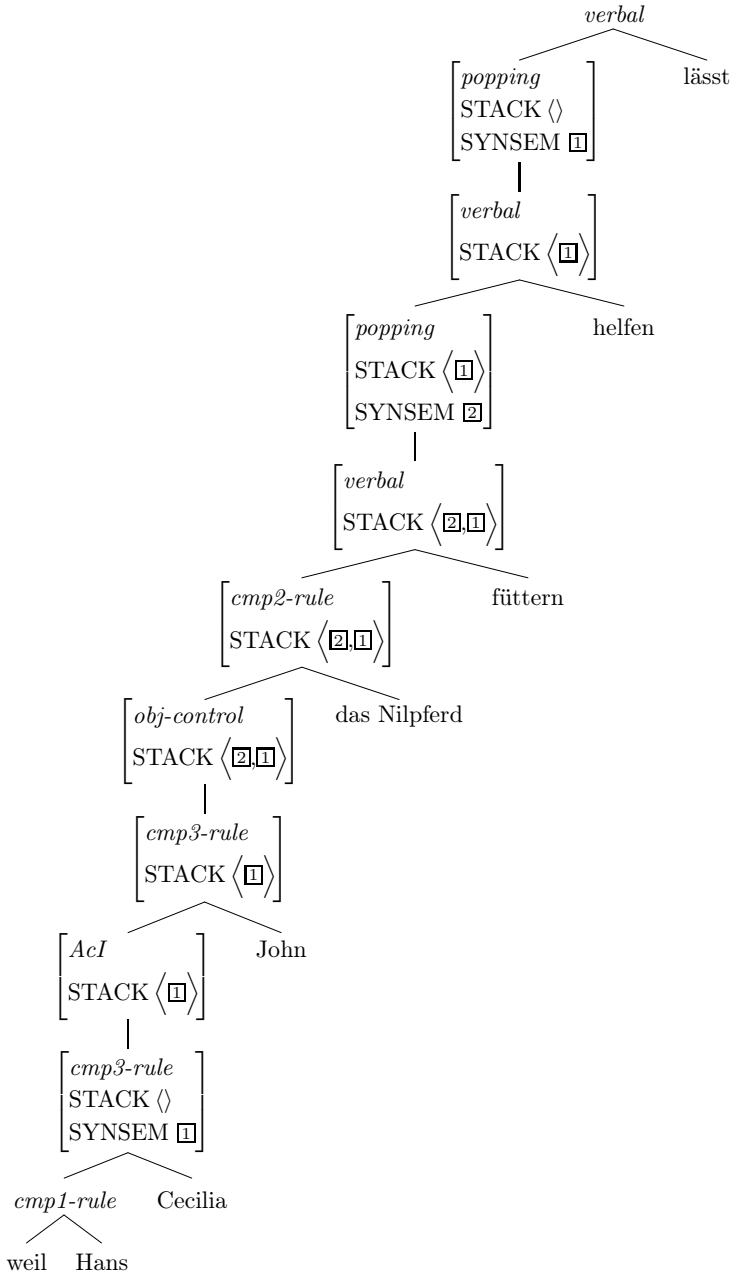

Figure 11: Left-branching analysis of German subordinate clause with two embeddings

parser to enter an embedding, leave it, and then entering it again, adding more specific constraints. The hierarchy of construction types ensures that one is forced down the same embedding if one has exited an embedding and is forced down an embedding again, as illustrated by the tags in Figure 13. So, if the object control

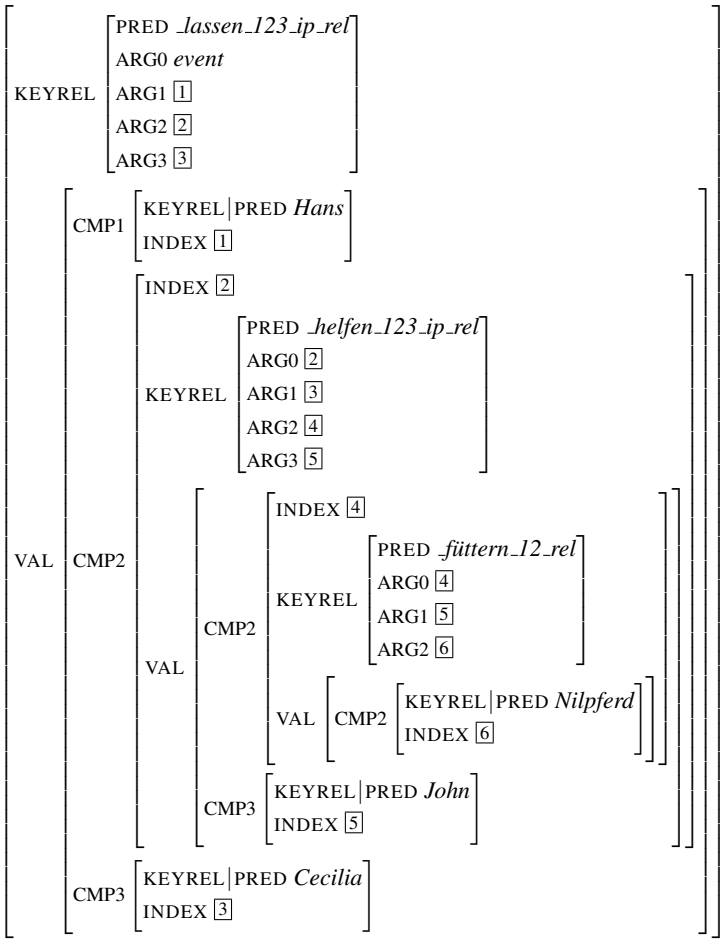

Figure 12: AVM of German clause with two Avl embeddings

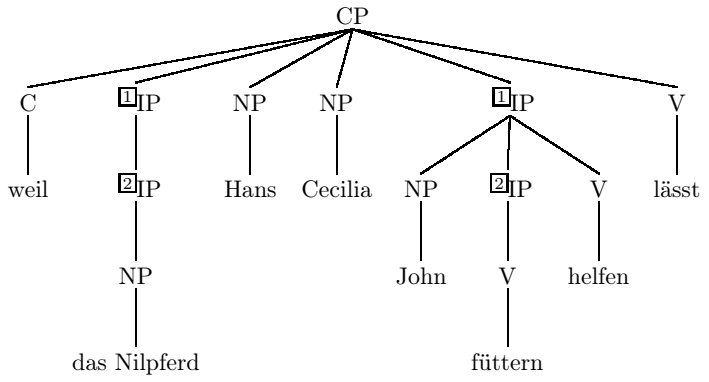

Figure 13: Constituent analysis of German subordinate with two embeddings and permutations

rule in Figure 7 has worked at a certain level earlier in the parse, the same rule will have to work again if there is a need to enter the embedding again. If one tries to employ another embedding rule, like the AcI rule in Figure 8, the ARGFRAME values would not be compatible *arg123* and *arg124*, so the rule would not be applicable.

2.5 Analysis of cross-serial dependencies in Swiss-German

The analysis can also be applied to Swiss-German, which, compared to German, has the verbs in opposite order at the end of the subordinate clause, illustrated in (6) (from Shieber (1985)).

(6) ... mer d'chind em Hans es huus lönd hälfe aastriiche
we the children.ACC Hans.DAT the house.ACC let help paint
'... we let the children help Hans paint the house.'

In the analysis shown in Figure 14, the arguments of the verbs are attached first, and then the verbs are attached. Since the matrix verb comes before the embedded verbs, the parser pops out to the matrix level before it is attached. Then the parser proceeds to attach verbs at increasing levels of depth. This ensures that the case requirements of the verbs at different depths match the case of their arguments, and the predicates of the verbs are unified with the subconstruction types provided by the subconstructions that attached their arguments. If an argument is attached by a rule with a subconstruction type that is not compatible with the predicate of the verb at that level of embedding, the types will not unify, and the analysis fails.

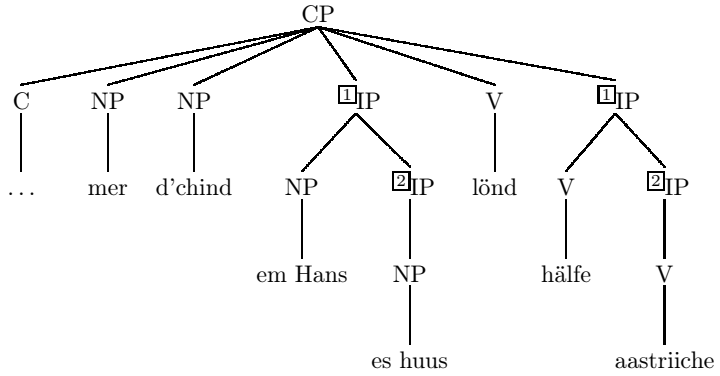

Figure 14: Constituent analysis of Swiss-German subordinate with two embeddings

2.6 Intersective modifier attachment

In addition to permutations of arguments and cross-serial dependencies, the approach also lends itself to an account of intersective modifier attachment at different levels of embedding, before the verbs are attached (see Egg and Lebeth (1995); Crysmann (2004)).

Pütz (1982, 340) shows that the intersective modifier may attach at different levels of embedding in a clause with an embedding verb. In (7) the PP *im Laboratorium* can modify either *blitzen* or *sehen*.

(7) Peter hat es im Laboratorium blitzen sehen.
Peter has it in.the lab flash see
'Peter saw some flashes/lightning in the lab.'

Crysmann (2004, 308) shows that in a subordinate clause, the modifier may permute with the arguments of the verb (see (8)). Still it is just as ambiguous as the sentence in (7).

(8) weil im Labor Peter es blitzen sah
because in.the lab Peter it flash saw
'because Peter saw some flashes/lightning in the lab'

Egg and Lebeth (1995) shows that the sentence in (9) has three readings resulting from different attachments of the modifier *im Märtz*. The modifier can attach to the verb *sollen*, the verb *machen*, as well as the noun *Termin*, even though it is not adjacent to any of them.

(9) Sollen wir im März noch einen Termin ausmachen?
shall we in March an appointment make
'Should we schedule a meeting in March?'

Both Egg and Lebeth (1995) and Crysmann (2004) suggest analyses of the modifiers in (7)–(9) where the semantic attachment is underspecified.

In the present approach it would be possible to link the modifiers directly, during parsing, as shown in Figures 15 and 16.

In Figure 15, the PP is realized under the CP node in the constituent tree, and it therefore modifies the verb *sah*. In Figure 16 on the other hand, the embedding rule is employed before the PP is attached, so that it ends up modifying the verb of the IP, namely *blitzen*. The approach could also account for attachment of adjuncts to nouns, as illustrated in example (9), where one of the readings is that the modifier *im März* modifies the noun *Termin*.[8]

[8]The structure of NPs is not at topic of this paper, and so it is not discussed further here.

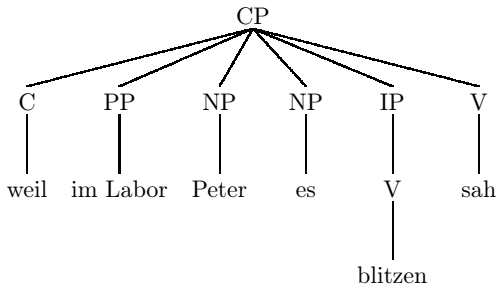

Figure 15: *Im Labor* attaches to *sah*

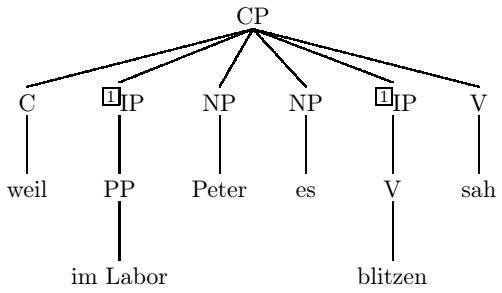

Figure 16: *Im Labor* attaches to *blitzen*

3 Implementation and discussion

The analysis is implemented with the LKB system (Copestake, 2002) in a German demo grammar (Haugereid, 2009, 308-313) based on the Norwegian HPSG grammar Norsyg (Haugereid, 2009). Apart from the lexicon, only slight alterations are made in order to account for the basic clause structures in German.[9] It successfully analyses the examples in (1) and (5) and produces proper semantic representations. The implementation demonstrates that the analysis works, and the grammar analyzes verb-final clauses with multiple embeddings like example (5).

Currently, the implementation only opens for scrambling locally, that is, at the same level of embedding. In order to allow for scrambling between embeddings, allowing for example *das Nilpferd* in (5) to come before the other arguments, as shown in Figure 13, the embedding rules need to be less constrained, that is, they will have to be applicable before all arguments at a level of embedding are realized.[10] This loosening of constraints is not feasible, since the embedding rule then could take itself as input, and the LKB system does not have a way to explore one

[9] In addition to the changes described in Haugereid (2009, 308–310), a unary version is made of the object control rule, and both the object control rule and the AcI rule (which already was unary) were allowed to apply before the verb.

[10] Currently, they are constrained to apply after the arguments at the matrix level are realized.

level of embedding at a time and stop when it arrives (or does not arrive) at an analysis. This would however be an interesting path to pursue, as it would be in line with psycholinguistic findings of garden-path effects, involving backtracking and reanalysis. Whenever the parser has to backtrack from attempting to parse the unmarked order of the arguments of a sentence, the effort on the parser would increase, just like the human processing efforts are increasing when attempting to process a garden path sentence.

The division between a parse tree and a constituent tree demonstrated in this paper allows for linking of arguments during parsing, and it is shown that by retaining a constituent tree, one is able to let the parser enter the same level of embedding more than once, and in this way allow for cross-serial dependencies and modifier attachment at different level of embedding.

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What does being a noun or a verb mean?

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Abstract

The indigenous languages of North America have played a critical role in discussions of the universality of part-of-speech distinctions. In this paper, we show that Oneida does not include a *grammatical* distinction between nouns and verbs. Rather, Oneida inflecting lexical items are subject to two cross-cutting semantic classifications, one that concerns the sort of entities they describe, the other the sort of semantic relation they include in their content. Labels such as *noun* and *verb* can still be used for cross-linguistic comparison, as the semantic partition of lexical items corresponds to canonical nouns and verbs according to morphologists and some typologists. But the meta-grammatical status of these labels is quite distinct from the status of corresponding labels in Indo-European languages like English.

One of the goals of linguistics is to determine how similar or different languages of the world are. Broadly speaking, one can approach questions about universality versus diversity using two different strategies. The first strategy makes use of an *a priori* guideline. One version of this approach, let's call it *Methodological Universalism*, assumes that if one language has a feature, all languages have that feature, at least as the default hypothesis. This is the tack taken by, for example, Cinque & Rizzi (2008). The other strategy takes a more empirical approach to the issue and holds that positing a feature in a language cannot be based on the presence of that feature in other languages. We dub such an approach *Methodological Minimalism*. Features of an unfamiliar language, in this second approach, must be argued on the basis of positive evidence drawn from that language. This tack is typical of typological approaches to language description (see Haspelmath 2007 and the conclusions of Evans & Levinson 2009, among others). It is also the tack assumed in some work within HPSG, at least implicitly (see the CoreGram project and Müller 2015) and this is the approach we take in this paper. The particular issue we focus on is whether there is evidence for the inclusion of part-of-speech information in lexical entries of all languages. Part-of-speech information is, typically, justified by constraints on co-occurrence, either syntactic or morphological. For example, certain verbs must co-occur with PPs. Similarly, nouns may co-occur with different inflectional suffixes than verbs. There have been several attempts over the years to reduce such co-occurrences to semantic properties of the combining expressions (see, e.g., Langacker 1987), but such attempts have not proved convincing to most linguists, partly because the semantic distinctions involved are very subtle and not agreed upon by the majority of semanticists. As a result, most syntacticians would agree with Pollard & Sag (1987) that encoding the part of speech of the head of a verb's complements is necessary (see van Eynde to appear for an overview of treatments of parts of speech in HPSG and Chaves 2013 for a semantic analysis of English parts of speech within Sign-Based Construction Grammar that focuses on coordination and predicative structures).

[†]As with all of our collaborative work, the order of authors is alphabetical. We acknowledge with gratitude the late Mercy Doxtator, the late Norma Kennedy, and Olive Elm, with whom Michelson has discussed some of the issues tackled in this paper.

In previous work (Koenig & Michelson, 2014), we have argued that Oneida (Northern Iroquoian) contrasts with English and most languages in not providing evidence for *syntactic* part-of-speech information. Summarizing our argument, there is no evidence for syntactic selection or syntactic constraints on binding in Oneida; nor is there evidence for argument structure alternations. Consequently, there is no need to include either an ARG-ST or a VALENCE feature. And with the absence of these features the motivation for a HEAD feature disappears. In fact, we argue that the feature SYN is entirely unmotivated in Oneida and, in agreement with Methodological Minimalism, we suggest it is not part of the information included in signs.

The absence of *syntactic* part-of-speech information does not necessarily entail the total absence of part-of-speech information, though. Evans (2000b) shows that the syntax and morphology of a single language can include distinct parts of speech; the absence of syntactic part-of-speech information in Oneida does not mean there is no evidence for morphological parts of speech. Such a possibility is particularly pertinent for Oneida, since it is a polysynthetic language with a very rich inflectional system. In this paper, we argue that the grammar of Oneida does not include *morphological* part-of-speech distinctions either and that such information should be left out of lexical entries. We furthermore argue that Oneida inflectional constraints are sensitive to two orthogonal semantic classifications of lexical entries; simplifying somewhat, one pertains to the sort of individual described by the entry (which we model as distinct sorts of INDEX values), the other the sort of semantic relation used to describe those individuals (which we model as distinct sorts of KEY values; see Koenig & Davis 2006 for the use of the KEY attribute for argument structure and Koenig & Michelson to appear for its use in inflection).

1 Grammatical and meta-grammatical parts of speech

The indigenous languages of North America have played a critical role in discussions of typological questions, particularly questions pertaining to the universality of part-of-speech distinctions. Boas (1911, 441), when discussing Kwakiutl, a Wakashan language, states that "all stems seem to be neutral, neither noun nor verb". More recently, Sasse (1993) expresses doubts that Cayuga (a Northern Iroquoian language related to Oneida) distinguishes nouns and verbs (but see Sasse 2001 for a more nuanced view and Mithun 2000 for the opposite view). More recently, Chafe (2012) argues that Seneca (another Northern Iroquoian related to Oneida) does not include a class of adjectives, contra Baker's (2003) claim that Mohawk, again Northern Iroquoian, includes, like all languages according to Baker, a class of adjectives (see Michelson to appear for an overview of the issues surrounding parts of speech in Iroquoian).

Our claim that the grammar of Oneida has neither syntactic nor morphological parts of speech seems, at first glance, at odds with Mithun (2000), who argues for a noun/verb distinction in Iroquoian. It is not. This is because scholars do not distinguish between two uses of part-of-speech labels, grammatical uses and meta-

grammatical uses. Because scholars can use labels such as *noun* and *verb* in such radically different ways— compare the uses of the distinction between nouns and verbs in work as distinct as Cinque & Rizzi (2008), Croft (2001), and Dixon (2009)— comparison between languages is difficult and confusion likely. Grammatical part-of-speech labels are referenced in constraints that are part of a language's grammar. (1) provides two very informal sketches of constraints that reference nouns and verbs, respectively. The first constraint informally says that if the part of speech (of a lexical item) is *noun*, then certain argument structure properties are true of that lexical item; the second constraint informally says that if the part of speech is *verb*, certain inflectional properties are true of that lexical item. Both kinds of constraints justify distinguishing in the grammar of the language the HEAD values *noun* and *verb*, as the distinct labels help properly restrict their domain of application.

(1) Examples of *grammatical* POS constraints:
$[\ldots\textsc{head}\ \textit{noun}] \Rightarrow [\ldots\textsc{arg-st}\ \ldots]$
$[\ldots\textsc{head}\ \textit{verb}] \Rightarrow [\ldots\textsc{infl}\ \ldots]$

(2) illustrates a meta-grammatical use of part-of-speech labels. The first conjunct says that if a lexical item has a particular semantic content, its HEAD value is *verb*. The second says that a lexical item whose HEAD value is *verb* has such and such inflectional properties. Given the transitivity of the material conditional, the conjunction of constraints in (2) entails the constraint in (3) and the HEAD value of the lexical item can therefore be dispensed with. Nothing is gained by adding a part-of-speech label in the consequent of the first conjunct: it is an extraneous piece of information.

(2) *Meta-grammatical* morphological POS constraints:
$\left([\ldots\textsc{cont}\ \ldots] \Rightarrow [\ldots\textsc{head}\ \textit{verb}]\right) \wedge \left([\ldots\textsc{head}\ \textit{verb}] \Rightarrow [\ldots\textsc{infl}\ \ldots]\right)$

(3) $[\ldots\textsc{cont}\ \ldots] \Rightarrow [\textsc{infl}\ \ldots]$

Using the labels *noun* and *verb* can still be useful even if those labels are not part of any grammatical constraint, as long as it is understood that they are used as meta-grammatical labels employed for cross-linguistic comparison and that one makes clear that the grammatical categories these labels denote might have a different status in different languages. They are semantic categories in a language where they are referenced by constraints of the kind represented in (3); they are formal categories in a language where they are referenced by constraints of the kind represented in (1). To avoid confusion, we will use Quine's quasi-quotation symbols ⌜ and ⌝ (Quine, 1981, 35), e.g. ⌜noun⌝ and ⌜verb⌝, to refer to meta-grammatical labels. Our notion of meta-grammatical labels bears similarity to the notion of comparative concepts advocated by a number of typologists (Dryer 1997, Croft 2001, and Haspelmath 2010). But, our meta-grammatical labels are still labels for a language's categories, which is not true of comparative concepts. For example, Croft's *noun* and *verb* prototypes (Croft, 2001, 88–89) are not categories in any language's grammar (in fact, they are not categories in any clear sense of the term). Since what morphologists and syntacticians are often interested in is a comparison of certain grammatical

categories across languages (see Corbett 2008, 136–137 on how to establish correspondences between categories across grammars of distinct languages), it is useful to have identical meta-grammatical labels that cover these categories whatever their status (semantic or formal).

The main claim of our paper, then, is that putative part-of-speech labels in Oneida function like the *verb* label in (2). The labels can be dispensed with in the grammar of the language and be treated as meta-grammatical labels (i.e. as ⌜verb⌝ and ⌜noun⌝). We furthermore argue that two kinds of semantic properties are relevant for Oneida morphology: properties of indices (what kind of entity is described) and properties of the semantic relation that describes that entity, as shown informally in (4) and (5).

(4) [CONT [IND ...]]⇒ [INFL ...]

(5) [CONT [KEY ...]]⇒ [INFL ...]

2 Nouns and verbs in Iroquoian linguistics

It is traditional in Iroquoian linguistics to distinguish between particles (morphologically inactive lexical items) and inflecting nouns and verbs, which we will refer to, following the previous discussion, as ⌜noun⌝ and ⌜verb⌝. ⌜Nouns⌝ and ⌜verbs⌝ are lexical items that fit the templates in Table 1. The particulars of these two templates are not critical to our discussion (see Koenig & Michelson 2020 for arguments that support the layering of inflection implicit in both templates).

Word		
	Stem	
$Pro_{N/POSS}$	N_{Base}	NOUN-SUFFIX

Word			
		Stem	
(Prepro)	Pro_{V}	V_{Base}	ASPECT

Table 1: The layered inflection of Oneida ⌜nouns⌝ and ⌜verbs⌝

Importantly, for the discussion to follow, ⌜nouns⌝ take noun suffixes and particular sets of pronominal prefixes (labeled N and POSS in Table 1) and ⌜verbs⌝ take aspect suffixes, another set of pronominal prefixes (labeled V in Table 1) and, optionally, prepronominal prefixes (see Diaz et al. 2019 for a thorough description and analysis of Oneida prepronominal prefixes). The text in (6) illustrates these traditional parts of speech. Words in normal font in the partially segmented Oneida text are particles; those in bold are ⌜verbs⌝; those in italics are ⌜nouns⌝; finally, those in bold italics are kinship terms, a category we return to in Section 5.

(6) *né· kati? wí· thikʌ́ wʌ́hnisla·té·* *tshahyahtʌ·tí·*
né· kati? wí· thikʌ́ **w-ʌhnisl-ate-?** **tsh-a-hy-ahtʌti-?**
well then it's that 3Z/N.SG.A-day-exist-STV COIN-FACT-3M.DU.A-leave-PNC
aknulhá· *khále? lake?níha* *né· kwí· thikʌ́*
ak-nulhá· khále? ***lake-?niha*** né· kwí· thikʌ́
3FZ.SG>1SG-mother and 3M.SG>1SG-father so it's that

*yoʔkalásh*ʌ *kwí·* *ʌtsyakwatekhwu·ní·*
yo-aʔkalashʌ kwí· **ʌ-ts-yakw-ate-khw-uni-ʔ**
3Z/N.SG.P-evening[STV] FUT-REP-1EX.PL.A-SRF-food-make-PNC
osahé·taʔ kwí· *waʔknínaʔtsyiha·lʌ́·* *né· kwí·*
o-sahe?t-aʔ kwí· **waʔ-kni-naʔtsy-ihal-ʌʔ** né· kwí·
NPF-bean-NSF FACT-3FZ.DU.A-kettle-hang-PNC so it's
ʌtsyákwa-k-eʔ *n*ʌ *ʌtsyakwatekhu·ní·*
ʌ-ts-yakwa-k-eʔ nʌ **ʌ-ts-yakw-ate-khw-uni-ʔ**
FUT-REP-1EX.PL.A-eat-PNC when FUT-REP-1EX.PL.A-SRF-food-make-PNC
*yoʔkalásh*ʌ
yo-aʔkalashʌ
3Z/N.SG.P-evening[STV]

'Well anyway that day when my mother and my father went away, for our supper, the two of them boiled beans, that's what we would eat when we have our supper.' (Norma Kennedy, Worms in the Soup, recorded 2009)

For reasons of space, most of our discussion of Oneida inflection will focus on pronominal prefixes. We summarize here the distinctions of particular relevance to our discussion. All morphologically active lexical items in Oneida—lexical items that participate in derivational or inflectional morphological processes—i.e. ⌜nouns⌝ and ⌜verbs⌝, have a pronominal prefix. Pronominal prefixes reference up to two animate arguments; a default third singular feminine-zoic prefix is used when there is no animate argument (see Koenig & Michelson 2015b for details about pronominal prefixes in Oneida). There are three main paradigm classes of pronominal prefixes. The first class consist of portmanteau-like Transitive prefixes that reference two animate semantic arguments. The second and third class are Intransitive prefixes that reference a single animate semantic argument (or no argument at all, if the predicate associated with the meaning of a lexical item does not have animate arguments). The second class consists of Agent Intransitive prefixes; the third class consists of Patient Intransitive prefixes. The terms *Agent* and *Patient* are traditionally used as these two sets of prefixes often reference proto-agent and proto-patient arguments, respectively, in the sense of Dowty (1991). But, as Michelson (1991) shows, this is merely a strong tendency and, ultimately, the paradigm class ⌜nouns⌝ or ⌜verbs⌝ belong to cannot be predicted (with one salient exception we return to in Section 4.4).

3 Determining the ontological sorts of traditional nouns and verbs in Oneida

Our claim in this paper is that morphological part-of-speech distinctions in Oneida reduce to two orthogonal semantic classifications of inflecting lexical items. The traditional templates for ⌜noun⌝ or ⌜verb⌝ mostly pick up on the first semantic dimension of classification, namely what sort of entity is being described. To support this hypothesis, we combed through entries in Michelson & Doxtator (2002) to de-

termine the sort of entities they describe. First, we considered the ontological sorts of the entities described by ⌜verb⌝ entries. Given the number of such entries (2,777) and the fact that determining the ontological sorts of what they describe is rather straightforward, we sampled entries from the dictionary. Then, we determined the ontological sorts of *all* underived ⌜noun⌝ entries and all ⌜noun⌝ entries derived from ⌜verb⌝ entries in Michelson & Doxtator (2002)—approximatively 1,000 entries.

All ⌜verb⌝ entries in our sample describe events and states. Some denote what Maienborn (2005) calls *Kimian states*. Although Kimian states are not first order individuals in the universe of discourse for Maienborn, but rather abstract objects in the sense of Asher (1993), they share with eventualities (events or ordinary states) that they have a temporal dimension; or are time and world bound to use Maienborn's terminology. We will refer to the meaning of ⌜verbs⌝ as *time-conditioned descriptions*. Underived ⌜nouns⌝, on the other hand, describe a much wider variety of sorts of entities; critically, none have a temporal dimension. We will refer to the meanings of (underived) ⌜nouns⌝ as being *non-time-conditioned descriptions*. (7) characterizes informally the kinds of denotations of underived ⌜nouns⌝ together with some examples from Michelson & Doxtator (2002). The non-time-conditioned nature of these ⌜nouns⌝ is rather clear, we believe, except for time intervals, and emotions/traits. We reserve discussion of the latter until our description of derived nouns. As for names of time intervals, although they obviously have something to do with time, their denotation does not hold at a particular time nor is it exemplified at a particular time. It is in this sense that they constitute non-time-conditioned descriptions.

(7) ABSTRACT CONCEPTS *-yanlʌhsl-* 'law', *-kal-* 'value, worth'
ANIMALS *-skanutu-* 'deer', *-itsy-* 'fish'
BODY PARTS *-ʌʔnahs-* 'tongue', *-(w)yahutsh-* 'wing'
CLOTHING *-lisl-* 'pantleg, *-aʔkohs-* 'skirt'
COLOURS *-tsiʔnkwal-* 'yellow', *-luhy-* 'blue'
EMOTIONS OR TRAITS *-atlaʔsw-* 'luck', *-elyʌʔt-* 'intention, purpose'
FOOD *-lan-* corn soup, *-ʔwahlu-/-ʔwahl-* 'meat';
HOUSEHOLD ITEMS *-ks-* 'dish, plate, bowl', *-naʔtsy-* 'pail, pot, kettle'
SOCIAL RELATIONS *-hwatsil-* 'family', *-nahkw-* 'marriage'
NATURAL FORMATIONS *-nyatal-* 'lake', *-naw-* 'swamp'
PLANTS *-hnanaʔt-* 'potato', *-hneht-* 'evergreen, pine'
PEOPLE *-wil-* baby, *Kayʌʔkeha·kà·* 'Mohawk'
TIME INTERVALS *-ʌhnishl-* 'day, weather', *-ohsl-* 'year, winter'
LOCATIONS OF A SOCIAL NATURE *-nat-* 'town, village'
PLAY *-kal-* 'story';
SENSES *-ahuhs-* 'sense of hearing', *-asl-/-sl-* 'odor/smell'
TOOLS *-aʔshal-* 'knife, blade', *-nuwal-* 'needle, pin', *-alhyohkw-* 'sinker, ring, hoop'
WEATHER *-nyʌht-* 'snow', *-atshat-* 'fog, steam'

There are several different processes for deriving ⌜nouns⌝ from ⌜verbs⌝ in Oneida, as discussed in detail in Koenig & Michelson (2020). The two most relevant processes for our purposes are exemplified in (8) and (9).

(8) *yotshe?tʌ́·tuhe?*
yo-tshe?t-ʌ?tu-he?
3z/N.SG.P-jar-suspend-HAB
'pear'

(9) *owistóhsli?*
o-wisto-hsl-i?
3z/N.SG.P-be.cold-NMZR-NSF
'butter'

Most derived ⌜nouns⌝ follow the pattern illustrated in (8): the word is inflected entirely like a ⌜verb⌝, as shown by the fact that *yotshe?tʌ́·tuhe?* fits the template for ⌜verbs⌝ in Table 1, and only then the derivation of the ⌜noun⌝ takes place. But, despite the fact that *yotshe?tʌ́·tuhe?* inflects as is expected of a base that means 'suspend, be suspended', i.e. as is expected of a base that describes a state, its denotation is unexpectedly a fruit, i.e. the meaning of *yotshe?tʌ́·tuhe?* is a non-time-conditioned description. There is thus a mismatch between the sort of entities described by these derived ⌜nouns⌝ and the kind of inflectional prefixes and suffixes they have. Since in many cases there is also a mismatch between the compositional meaning of the word and its lexicalized non-time-conditioned meaning, we analyze these derived ⌜nouns⌝ as the output of a lexical rule (or construction) that maps an inflected ⌜verb⌝ to a morphologically inactive word and effects the requisite semantic shift. Since the bases of the derived ⌜nouns⌝ are inflected verbs whose meanings are of the expected sort and the derived ⌜nouns⌝ are not inflecting lexical items, these derived ⌜nouns⌝ are irrelevant to our claim about the correspondence between morphologically active ⌜nouns⌝ and ⌜verbs⌝ and ontological sorts.

Some derived ⌜nouns⌝ follow the pattern illustrated in (9). In these cases, derivation precedes inflection and there is a match between the ⌜nominal⌝ inflection and the sort of the derived ⌜nouns⌝: *owistóhsli?* is inflected as one would expect of a base that describes a non-time-conditioned entity. The denotation of all these derived ⌜nouns⌝ fit the categories listed in (7). Most of the Oneida nouns that denote emotions or traits are derived ⌜nouns⌝ including the entries in (10). We now turn to those difficult cases; what we say also applies to the corresponding non-derived ⌜nouns⌝s. To maintain that nouns denote non-time-conditioned descriptions in the face of such entries, we need to assume that these derived nouns describe a different sort of entity than their stative verb sources. Thus, we need to follow scholars who have argued that the denotation of nominalized predicates is different from that of the corresponding verbal predicates (Cocchiarella, 1978; Chierchia & Turner, 1988). More specifically, we assume with Francez & Koontz-Garboden (2015) that (derived or underived) ⌜nouns⌝ that denote emotions and traits denote an ordered set of degrees of the emotion or trait. In other words, $[\![happiness_N]\!]$ (i.e. the denotation of the nominalized base *-atsheyalʌhsl-*) is the set of all (ordered) degrees of happiness.

(10) a. *atshanunyáhsla?*
atshanuny-a-hsl-a?

3z/N.SG.A:get.happy-JN-NMZR-NSF
'happiness'

b. *atsheyalʌ́hsla?*
atsheyalʌ-hsl-a?
3z/N.SG.A:be.shy-NMZR-NSF
'shyness'

Given these assumptions, underived and derived ⌜nouns⌝ and ⌜verbs⌝ in Oneida can be said to constitute a strictly canonical association between inflectional class and ontological sorts: ⌜nouns⌝ encode non-time-conditioned descriptions and ⌜verbs⌝ time-conditioned descriptions. More generally, Oneida ⌜nouns⌝ and ⌜verbs⌝ constitute a strictly canonical association between (meta-)grammatical parts of speech and ontological sorts of the kind discussed in Spencer (2005) and Corbett (2012). Now, attempts to reduce part-of-speech labels to semantic distinctions are not new. But, whatever the merits of such analyses, they either rely on subtle and idiosyncratic semantic distinctions (Langacker, 1987) or it is unclear how they capture the similarity in semantic sort of derived event nominals and verbs (Chaves, 2013). What is remarkable about Oneida ⌜noun⌝ and ⌜verb⌝ categories is that they are canonical in a straightforward way and along traditional or relatively standard semantic lines. Interestingly, in our analysis the ontological correlate of ⌜verbs⌝ is more coherent than that of ⌜nouns⌝: ⌜verbs⌝ share a positive property, their denotation has a temporal dimension, whereas ⌜nouns⌝ are defined merely by the absence of that property, an observation that goes back to Aristotle's *On interpretation* (16^a3). We conjecture that this asymmetry is not specific to Oneida and that ⌜verbs⌝, across languages, are more ontologically coherent than ⌜nouns⌝. Be that as it may, the ontological canonicity of ⌜nouns⌝ and ⌜verbs⌝ entries in traditional Iroquoian linguistics means that these labels are, when applied to Oneida, meta-grammatical labels of classes of inflecting lexical entries that denote distinct sorts of entities.

4 Semantically restricted inflectional constraints

Having established the ontological sorts that are the correlates of the classification of lexical entries into the traditional Iroquoianist ⌜verb⌝ and ⌜noun⌝ categories, we turn to inflectional constraints that target semantically defined classes of entries and our HPSG treatment of those inflectional constraints. We begin with the structure of inflecting lexical entries in Oneida and the different kinds of inflectional constraints that are part of the morphology of Oneida.

4.1 Inflectional constraints in Oneida

(11) provides the basic structure of morphologically active or inflecting lexical items in Oneida.

(11)
$$\begin{bmatrix}
\textsc{phon} & \textit{list}(\textit{phoneme}) & \\
\textsc{cont} & \begin{bmatrix} \textsc{index} & \begin{bmatrix} \textsc{var} & \textit{var} \\ \textsc{phi} & \textit{index} \end{bmatrix} \\ \textsc{relations} & \textit{list}(\textit{rel}) \\ \textsc{key} & \textit{rel} \end{bmatrix} & \\
\textsc{infl} & \begin{bmatrix} \textsc{infl-feat} & \begin{bmatrix} \textsc{pro} & \begin{bmatrix} \textsc{affix-type} & \textit{A/P} \\ \textsc{agr} & \textit{list}(\textit{n-tc-index}) \end{bmatrix} \\ \textsc{npro} & \textit{npro-feat} \end{bmatrix} \\ \textsc{realization} & \begin{bmatrix} \textsc{mph} & \textit{set}(\textit{m-form}) \\ \textsc{ms} & \{\textit{pro}, \textit{stem}\} \cup \textit{set} \\ \textsc{rr} & \textit{realizational-rules} \end{bmatrix} \end{bmatrix} &
\end{bmatrix}$$

Note that there is no SYN attribute, but that the inflectional information (the value of the attribute INFL) is rich. Inflectional information is divided into inflectional feature information (the value of INFL-FEAT) and realizational informationn (the value of REALIZATION). There are two sets of informational features, pronominal feature information (the value of PRO), which is information relevant to both ⌜nouns⌝ and ⌜verbs⌝, and non-pronominal information, which is the part of inflection where ⌜nouns⌝ and ⌜verbs⌝ differ (⌜nouns⌝ take ⌜nouns⌝ suffixes and ⌜verbs⌝ take aspect suffixes and, optionally, prepronominal suffixes). The AFFIX-TYPE attribute specifies whether a lexical item selects the Agent or Patient paradigm when it takes Intransitive prefixes (this selection is relevant even for semantically polyadic lexical items, since a polyadic lexical item with only one animate semantic argument takes Intransitive prefixes, see Koenig & Michelson 2015a and Koenig & Michelson 2015b for details). AGR lists the indices of (up to two) animate semantic arguments that are referenced by pronominal prefixes. We follow Crysmann & Bonami (2016) in the structure of realizational information; we will introduce features of REALIZATION as they become relevant for particular inflectional constraints. On the semantic content side, we distinguish an (extended) INDEX (Richter & Sailer, 2004, 134) and the semantic relations (RELS) contributed by a lexical item (there can be several, because, of, for example, possessed nouns and noun incorporation). The KEY relation is the member of RELS of relevance for pronominal prefix inflection (see Koenig & Davis 2006 for the notion of KEY and Koenig & Michelson to appear for its relevance to Oneida inflection). We model the difference between non-time-conditioned and time-conditioned descriptions we discussed in Section 3 by positing two subsorts of *extended-index*, *non-time-conditioned-index* and *time-conditioned-index* (abbreviated in AVMs as *non-tc-index* and *tc-index*, respectively). Lexical items whose index is of sort *non-time-conditioned-index* correspond to the class of lexical items referred to by the meta-grammatical label ⌜noun⌝ and those whose index is of sort *time-conditioned-index* correspond to the class of lexical items referred to by the meta-grammatical label ⌜verb⌝.

Before discussing inflectional constraints that target lexical items with a particular sort of INDEX or a particular sort of KEY, or both, we list the different kinds of inflectional constraints that must be distinguished in an inflectional system of Oneida's complexity. First, there are constraints that relate arguments of the KEY relation to AGR indices. One can think of these constraints as the equivalent of linking for head-

marking languages. Second, there are constraints on values of AFFIX-TYPE, i.e. constraints that ensure that lexical items are assigned to the correct Intransitive paradigm class (Agent vs. Patient). Third, there are constraints relating particular morphs (a member of the set of MPH (morphs)) to the PHON of the word; these constraints are the HPSG equivalent of morphophonological rules. Fourth, there are constraints relating PRO inflectional features to subsorts of the member of the MS set labeled *pro*. The morphosyntactic feature *pro* only includes the minimal lexical information that is "visible" to exponence rules. INDEX, KEY, and AFFIX-TYPE information, as we will see, condition the paradigm class of *pro*, but are not features that the exponence rules can "see" (see Corbett 2008, 134 on the notion of conditions on features): exponence rules for pronominal prefixes are only sensitive to the ϕ-features of animate arguments and paradigm class. Finally, the value of RR lists the realizational or exponence rules that license a particular word form, i.e. the rules that effect the many-to-many association between inflectional features and morphs (Crysmann & Bonami, 2016).

4.2 Examples of inflectional constraints sensitive to sorts of indices

In this section, we illustrate with two distinct kinds of inflectional constraints the claim that some inflectional constraints are sensitive to ontological sorts. The first set of constraints pertains to the value of the NPRO inflectional feature: lexical items that describe non-time-conditioned entities select different sorts of values for NPRO than lexical items that describe time-conditioned entities. Constraints (12) and (13) match the proper set of lexical items to the appropriate subsort of NPRO value. The type declarations in (14) and (15) (we use the symbol ≔ for type declarations) specify which non-pronominal inflectional features are appropriate for entries that describe time-conditioned and non-time-conditioned entities. Taken together, constraints (12)-(15) ensure that non-time-conditioned entries carry a noun-suffix feature and that time-conditioned entries carry prepronominal prefix features, aspect features, and are assigned to the class of active vs. stative entries, depending on whether they can occur in all three aspects or only the stative aspect (whether they are *v.a.* or *v.s.* entries in Michelson & Doxtator 2002).

(12) $\left[\textsc{content}\ \left[\textsc{index}\ \textit{tc-index}\right]\right] \Rightarrow \left[\textsc{infl}|\textsc{infl-feat}|\textsc{npro}\ \textit{tc-npro}\right]$

(13) $\left[\textsc{content}\ \left[\textsc{index}\ \textit{non-tc-index}\right]\right] \Rightarrow \left[\textsc{infl}|\textsc{infl-feat}|\textsc{npro}\ \textit{non-tc-npro}\right]$

(14) $\textit{tc-npro} \coloneqq \begin{bmatrix} \textsc{prepro} & \textit{prepro-feat} \\ \textsc{asp} & \textit{aspect} \\ \textsc{active} & \textit{boolean} \end{bmatrix}$

(15) $\textit{non-tc-npro} \coloneqq \left[\textsc{noun-suffix}\ \textit{nsuff}\right]$

The second example of an inflectional constraint restricted to lexical items that carry a particular sort of index is exemplified in the following excerpt from Michelson et al. (2016) (pronominal prefixes are in bold font). The prefix for the word 'blanket' *okʌ́haʔ* is *o-*; that for the word 'it is warm' *yoʔtalíhʌ* is *yo-*. The prefix for the ⌜noun⌝ 'blanket' lacks the word-initial glide that the prefix for the ⌜verb⌝ for being warm includes. This is a general pattern: all Patient prefixes (including Possessive Patient

prefixes) for ⌜nouns⌝ lack the word-initial glide of the corresponding ⌜verb⌝ prefix and some of the Agent and Transitive ⌜noun⌝ prefixes also lack the word-initial glide of the corresponding ⌜verb⌝ prefix.

(16) *né· s né· thikʌ́ kítkit ostó·sliʔ ya·wét né·*
né· s né· thikʌ́ kítkit **o**-stoʔsl-iʔ ya·wét né·
it's that that chicken 3z/N.SG.P-feather-NSF like it's
yakotunyá·tu okʌ́haʔ. Ó·ts,
yako-at-uny-a-ʔt-u **o**-kʌh-aʔ ó·ts
3FI.P-SRF-make-JN-CAUS-STV 3z/N.SG.P-blanket-NSF Gee
yoʔtalíhʌ s kwí· né· thi·kʌ́.
yo-aʔtalihʌ s kwí· né· thikʌ́
3z/N.SG.P-be.warm[STV] it's that
'she made kind of like a blanket out of chicken feathers. Gee it was warm.'
(P. Cornelius, 307)

Since the lack of glides only applies generally to Patient prefixes, we provide in (17) the inflectional constraint for Patient prefixes for ⌜nouns⌝. (17) says that the phonology of ⌜nouns⌝ that take Patient prefix morphs that start with a glide does not include the glide. (The statement of the constraint assumes the templatic approach to prefixal inflection discussed in Diaz et al. 2019 according to which pronominal prefixes occur in position 7 in the template and stems in position 8.)

(17)
$$\left[\begin{array}{l}\textsc{cont}\ \left[\textsc{index}\ \textit{non-tc-index}\right] \\ \textsc{infl}\ \left[\begin{array}{ll}\textsc{infl-feat} & \left[\textsc{pro}\ \left[\textsc{affix-type}\ P\right]\right] \\ \textsc{realization} & \left[\textsc{mph}\ \left\{\left[\begin{array}{ll}\textsc{ph} & \langle \textit{glide} \rangle \oplus \boxed{1} \\ \textsc{pc} & 7\end{array}\right], \left[\textsc{pc}\ 8\right]\right\} \cup \textit{eset}\right]\end{array}\right]\end{array}\right]$$
$$\Rightarrow \left[\textsc{phon}\ \boxed{1} \oplus \textit{list}\right]$$

Note that this constraint (and related constraints for Agent and Transitive pronominal prefixes) relates the exponent of the relevant prefixes to the overall phonology of the word, i.e. we treat the absence of glide as a morphophonological fact. We have two reasons for this analytical choice. First, the constraint applies across cells in a paradigm and across paradigms. It is not confined to certain exponents or paradigms and does not therefore constitute an alternative realizational rule. Second, the constraint is not entirely regular (as we alluded to, it does not apply to all cells that would otherwise start in a glide within the Agent or Transitive paradigms) and cannot thus be treated as a strictly phonological rule (leaving aside the fact that it only applies to lexical items that describe non-time-conditioned entities, an unlikely restriction for a phonological rule).

4.3 An example of inflectional constraints restricted to certain semantic relations

Michelson (1991) and Koenig & Michelson (2015a) argue that the assignment of lexical entries to the Agent or Patient Intransitive paradigm class cannot in general be

predicted from their meaning. But, as Michelson et al. (2016) discuss, there is a semantically defined class of entries where Agent or Patient paradigm class assignment is predictable: entries that include a possession relation in their semantic content. In this case, Agent/Patient class membership is predictable from the (in)alienability of the relation: the entry is assigned to the Agent class if the possession relation is inalienable, the Patient class if the relation is alienable, as shown in (18) and (19) for possessed ⌜nouns⌝ and (20) and (21) for ⌜verbs⌝ that incorporate possessed ⌜nouns⌝, respectively (see Koenig & Michelson to appear for details). The fact that these constraints apply to a word that describe one's nose (18) or to a word that describes a state of one's eyes being big (20) shows that these constraints apply irrespective of the lexical entry's INDEX sort, as long as the entry's semantic content includes a possession relation.

(18) *laónhwale?*
lao-nhwal-e?
3M.SG.POSS-fur-NSF
'his fur'

(19) *la?nyú·ke*
la-?nyu-?ke
3M.SG.A-nose-LOC
'his nose'

(20) *Kʌh né· na?teyeká·lahse?.*
kʌh né· n-a?te-**ye**-kahl-a-?se?
this, yea assertion PART-DL-**3FI.A**-eye-size.of-STV.PL
'Her eyes were THIS big.' (Verland Cornelius, *Ghosts, flirts and scary beings*, recorded 2007)

(21) *yah te?wé·ne? tsi? nihotinúhsahse? tsi? nú·*
yah te?we·ne? tsi? ni-**hoti**-nuhs-a-?se? tsi? nú·
it's incredible how PART-3**M.DP.P**-house-size.of-STV.PL where
*ni**hati**nákle? kʌ́·*
ni-**hati**-nakle-? kʌ́·,
PART-3M.PL.A-reside-STV y'know
'it's incredible how big their houses were where they lived,' (Mercy Doxtator, *Why dogs don't talk*, recorded 1998)

(22) and (23) model these two predictable assignments of paradigm class.

(22) [CONTENT [KEY *alien-poss-rel*]] ⇒ [...PRO [AFFIX-TYPE *P*]]

(23) [CONTENT [KEY *inalien-poss-rel*]] ⇒ [...PRO [AFFIX-TYPE *A*]]

4.4 Examples of a sort and semantic relation restricted inflectional property

Finally, we discuss inflectional constraints that target lexical items on the basis both of the sort of entity they describe and the kind of semantic relations included in their semantic content. The basic descriptive fact of the first case of this kind is that pronominal prefixes on alienably possessed nouns are a subtype of Patient prefixes, as exemplified in Table 2. Let's compare the column P(V) that lists a subset of pronominal prefixes for ⌜verbs⌝ that belong to the Patient paradigm class and the column P(poss) that lists a subset of pronominal prefixes for possessed ⌜nouns⌝.

	C-stems		
	A	P(V)	P(poss)
…	…	…	…
3M.SG	la-	lo-	lao-
3M.DU	ni-	loti-	laoti-
3M.PL	lati-	loti-	laoti-
3FZ.SG	ka-	yo-	**ao-**
3FZ.DU	kni-	yoti-	**aoti-**
…	…	…	…

Table 2: A subset of Agent, Patient and Possessive Patient prefixes for Consonant stems

As is easily seen, the P(poss) exponents for third person masculine indices are simply the P(V) exponents with an *a* before the *o* (only P(V) exponents that have an *o* after the initial consonant/glide differ from P(poss) exponents). The same pattern is true of third feminine-zoic exponents aside from the additional difference that, as expected of lexical items that belong to the Patient paradigm and describe non-time-conditioned entities, the initial glide is missing as per constraint (17).

We model Possessive Patient prefixes as forming a distinct paradigm from ordinary Patient prefixes. Figure 1 provides part of the hierarchy of pronominal morphosyntactic features (the *pro* member of MS).

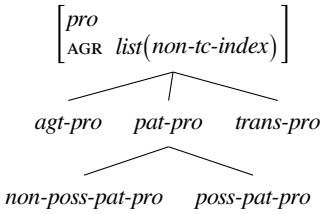

Figure 1: A part of the hierarchy of the *pro* morphosyntactic feature

Each subsort of *pro* indexes a set of exponents that belong to a different paradigm. Agent prefixes are those morphs that expound an *agt-pro* and Patient prefixes are those morphs that expound a *pat-pro*. Both of these subsorts inherit the AGR attribute. Thus, two different prefixes can expound the same list of indices. (24) and (25)

are two realizational rules that expound an ordinary Patient and Possessive Patient third singular feminine-zoic index, respectively. The different subsorts of *pro*, the morphosyntactic feature that is being realized, are sufficient to ensure the presence of different exponents, *yo-* or *yao-*. Note that the exponent for the third singular feminine-zoic index is *yao-*, although words that make use of this rule will actually always start with *ao*, as per the morphophonological constraint in (17).

(24)
$$\begin{bmatrix} \text{MUD} & \left\{ \begin{bmatrix} \textit{non-poss-pat-pro} \\ \text{AGR} & \left\langle \begin{bmatrix} \text{PHI} & \begin{bmatrix} \text{PERS} & \textit{3} \\ \text{GEND} & \textit{fem-zoic} \\ \text{NUMBER} & \textit{sg} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \right\} \\ \text{MPH} & \left\{ \begin{bmatrix} \text{PH} & \langle \text{yo} \rangle \\ \text{PC} & 7 \end{bmatrix} \right\} \end{bmatrix}$$

(25)
$$\begin{bmatrix} \text{MUD} & \left\{ \begin{bmatrix} \textit{poss-pat-pro} \\ \text{AGR} & \left\langle \begin{bmatrix} \text{PHI} & \begin{bmatrix} \text{PERS} & \textit{3} \\ \text{GEND} & \textit{fem-zoic} \\ \text{NUMBER} & \textit{sg} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \right\} \\ \text{MPH} & \left\{ \begin{bmatrix} \text{PH} & \langle \text{yao} \rangle \\ \text{PC} & 7 \end{bmatrix} \right\} \end{bmatrix}$$

For rules such as (24) and (25) to hold of the right set of lexical items, we need to ensure that only lexical items that bear a morphosyntactic pronominal prefix feature that is of sort *non-poss-pat-pro* or *poss-pat-pro* instantiate these realizational rules. This is what constraints (26) and (27) do. Constraint (26) ensures that lexical items that belong to the Patient paradigm bear a morphosyntactic feature that is expounded with a Patient prefix. Constraint (27) ensures that alienably possessed ⌜nouns⌝ bear a morphosyntactic feature that is expounded with a Possessive Patient prefix.

(26)
$$\begin{bmatrix} \text{INFL|INFL-FEAT|PRO} & \begin{bmatrix} \text{AFFIX-TYPE} & \textit{P} \\ \text{AGR} & \langle \textit{non-tc-index} \rangle \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{INFL|REALIZATION|MS} & \{\textit{pat-pro}\} \cup \textit{set} \end{bmatrix}$$

(27)
$$\begin{bmatrix} \text{SEM} & \begin{bmatrix} \text{INDEX} & \textit{non-tc-index} \\ \text{KEY} & \textit{alien-poss-rel} \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{INFL|}\ldots\text{|MS} & \{\textit{poss-pat-pro}\} \cup \textit{set} \end{bmatrix}$$

Incorporated possessed nouns provide another example of the orthogonality of the two semantic classifications to which Oneida inflectional constraints are sensitive, INDEX values and KEY relations. As examples (20) and (21) above show, possessed nouns can be incorporated into stative verbs (see Koenig & Michelson to appear for discussion). The semantic content of the resulting ⌜verb⌝ includes three semantic relations. Consider the verb form *nihotinúhsahse?* 'their houses were big': it includes the state description glossed as 'big', the denotation of the incorporated noun (*-nuhs-* 'house'), and the relation of possession. As Koenig & Michelson (to appear) show, it is the possessor argument of the possession relation that is referenced by the pronominal prefix (a fact that Koenig & Michelson call *Possession Dominance*): it is the possession relation that is the KEY relation, i.e. the relation that matters for linking purposes. *Possession Dominance*, which is sensitive to the semantic content of the lexical item,

is provided in (28). (Keep in mind that RELS lists all the relations included in a lexical entry's semantic content; in the context of noun incorporation, there will be two such relations, three when a possessive noun is incorporated.)

(28) $[\text{CONTENT } [\text{RELS } \boxed{2}]] \wedge \text{member}(\boxed{1}\textit{poss-rel}, \boxed{2}) \Rightarrow [\text{CONTENT } [\text{KEY } \boxed{1}]]$

Now, because the possession relation, as per (28), is the entry's KEY, assignment of the lexical entry to the Agent/Patient paradigm classes is governed by the possession relation's (in)alienability, as per (22) and (23). In other words, the same constraints apply to possessed ⌜nouns⌝ that are not incorporated and those that are incorporated when it comes to which semantic argument is marked (the possessor) and the entry's paradigm class assignment. But, when a possessed ⌜noun⌝ is incorporated, the sort of the INDEX of the ⌜verb⌝ does not change: the resulting stem still describes a state (of being big in (21)). In other words, the word's INDEX is still of sort *time-conditioned-index*. As a result, NPRO inflection is determined by the *time-conditioned-index* of the verb: the result of the combination of the two bases includes aspect suffixes and, optionally, prepronominal prefixes (e.g., the partitive *ni-* in (21)) and, were there no prepronominal prefix, the relevant prefixes would include the pronominal prefix's exponent's initial glide. Possessed noun incorporation illustrates the complex interplay of INDEX and KEY properties in the inflectional morphology of Oneida.

5 Against a mixed category analysis of kinship terms

The preceding section detailed some Oneida inflectional constraints. Some constraints target lexical items on the basis of the kind of entities they describe, some target lexical items on the basis of the kind of semantic relations that are part of the entry's semantic content (the relation of (in-)alienable possession in the case of paradigm class assignment) and some target lexical items on the basis of both the kind of entities being described as well as the semantic relations that are part of their semantic content (non-time-conditioned indices and relation of possession in the case of Possessive Patient prefixes). In this section, we show that our claim that Oneida inflectional constraints are sensitive to two orthogonal semantic classifications allows for a reanalysis of the properties of kinship terms discussed in Koenig & Michelson (2010). We mentioned kinship terms in the context of excerpt (6). In that excerpt, *aknulhá·* 'my mother' was an example of kinship term. As Koenig & Michelson (2010) discuss, kinship terms in Oneida have some inflectional properties of ⌜nouns⌝ (kinship terms do not have aspect suffixes, some pronominal prefixes are glideless) and some inflectional properties of ⌜verbs⌝ (reflexive prefixes are possible, (most) kinship terms have transitive prefixes).

Koenig & Michelson (2010) analyze kinship terms as a mixed category à la Malouf (2000): Oneida inflecting lexical items are divided into two sorts of parts of speech, *nominal* and *verbal*, with *noun* and *kinship* being of sort *nominal* and *verb* and *kinship* being of sort *verbal*. Kinship terms thus share some properties with both nouns and verbs in their analysis, hence their dual status. But Koenig & Michelson

must stipulate which nominal and which verbal properties kinship terms have: since these properties are stipulated of the sorts *nominal* and *verbal*, any other partition of these properties is in principle possible. But, of course, it is not. *Nominal* lexical items cannot have aspect suffixes, because their index is of the wrong sort: if a lexical item does not describe a time-conditioned entity, aspect is not a possible semantic property and aspect suffixes are inappropriate. Our new approach to parts of speech *explains* the behavior of kinship terms: kinship terms have all the properties that befits the fact that they describe non-time-conditioned entities and the fact that the semantic relation that is part of their semantic content is a dyadic relation. In other words, kinship terms describe non-time-conditioned entities (one member of the kin relation), so they have the inflectional properties appropriate for entries with an index of sort *non-time-conditioned-index* and their KEY relation is a kinship relation, so they have the inflectional properties of polyadic relations.

6 Does Oneida have a morphological noun/verb distinction?

In this paper, we examined the question that is the title of this section. What we have suggested is that this is the wrong question to ask, because what is meant by the labels *noun* and *verb* is ambiguous. This ambiguity explains why we can agree with the evidence and its interpretation laid out in Mithun (2000) and still maintain that there is no morphological distinction between nouns and verbs in Oneida (just as we argued that there is no syntactic distinction between nouns and verbs in Oneida in Koenig & Michelson 2014). *The grammar* of Oneida does not include a noun vs. verb distinction because its inflectional system is only sensitive to classifications of lexical items along two orthogonal *semantic* dimensions, the sorts of INDEX and KEY relation their semantic content includes. But the absence of any grammatical constraint that references the part-of-speech labels *noun* and *verb* does not mean the labels have no linguistic use when it comes to comparing Oneida to other languages. Oneida inflectional constraints partition lexical items along a dimension typical of canonical nouns and verbs of the kind discussed in Spencer (2005) and Corbett (2012). Oneida can, thus, be profitably compared to other languages in terms of a *meta-grammatical* distinction between ⌜nouns⌝ and ⌜verbs⌝, bypassing the issue of the status of those categories within the grammar of Oneida. Such a comparison shows that Oneida inflection targets lexical categories that are canonical ⌜nouns⌝ and ⌜verbs⌝ and that they are canonical because inflectional potential follows ontological sort. The derivation of ⌜noun⌝ bases from ⌜verb⌝ bases changes the ontological sort of the bases and the inflectional potential of the derived bases is correspondingly altered. The derivation of ⌜noun⌝ words from ⌜verb⌝ words, on the other hand, derives morphologically inactive words from fully inflected ⌜verbs⌝ (whose inflection reflects their ontological sorts) and the issue of inflectional potential is moot. Discussions about universals of parts of speech or limits of variation often miss the possible distinct status of categories used in language descriptions (but, see the contrast between descriptive and

analytic uses of the term *syllable* in Hyman 2011, 58), a distinction of some importance to discussions of universality or linguistic diversity. After all, discussions of the purported universality of the distinction between nouns and verbs or of how children learn to assign lexical items to these universal syntactic categories (Pinker, 1984, 40) are moot if the status of the partition is not kept constant.

Let us end this paper with a discussion of what the status of morphological part-of-speech information in Oneida tells us about what makes the language rather unique. On the one hand, Oneida morphological parts of speech conform to some semantic canon linguists rarely expect to be instantiated in languages of the world. On the other hand, the inflectional reflexes of this canonicity are uniquely complex because of the amount and different kinds of information speakers must attend to to properly inflect ⌜nouns⌝ and ⌜verbs⌝. Now, it is not unusual for the morphological referencing or syntactic realization of semantic arguments to be sensitive to the distinction between monadic and polyadic predicates, the grammar of possession to be different from the grammar of other semantic relation, or for kinship terms to behave differently from other kinds of relations (see Evans 2000a). In other words, it is quite frequent for the grammar of a language to distinguish different kinds of semantic relations when it comes to referencing semantic arguments morphologically or realizing semantic arguments syntactically. Nor is it unusual for the morphology of a language to be sensitive to ontological sorts. After all, the very notion of canonical (Spencer, 2005) or prototypical (Croft, 2001) parts of speech depends on distinguishing among ontological sorts. But what is unusual is for both dimensions of classification to simultaneously condition the same inflectional slot, namely pronominal prefixes. This is what is most remarkable about Oneida's morphological parts of speech: the proper referencing of semantic arguments via pronominal prefixes requires juggling at the same time ontological sorts and properties of the KEY semantic relation. This need to attend to two orthogonal semantic classification only compounds the formal complexity of pronominal prefixes exponence rules discussed in Koenig & Michelson (2015b) and makes Oneida's inflectional morphology rather unique. To borrow the bricolage metaphor discussed in Koenig & Michelson (to appear), the tools required to properly inflect Oneida words are nothing special, but the fact that these tools must be used concomitantly is.

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Recursive adjectival modification in CLLRS

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Abstract

This paper sketches an analysis in Lexical Resource Semantics of adverbial and adjectival modification in nominal projections which is extensible to modification of other syntactic categories. It combines insights into the syntax-semantics interface of recursive modification in HPSG with underspecified semantics and type-logical meaning representations in the tradition of Montague grammar. The analysis is phrased in such a way that it receives a direct implementation in the Constraint Language of Lexical Resource Semantics as part of the TRALE system.

1 Introduction

This paper has two main goals: (1) it presents a Montagovian semantics of recursive adjectival modification in English in LRS (Lexical Resource Semantics, Richter & Sailer (2004)) hand in hand with its implementation in CLLRS (Constraint Language of Lexical Resource Semantics, Penn & Richter (2005)), and (2) it points out that the seemingly straightforward constraint-based rendering of the semantic composition system crucially goes beyond what traditional hole semantic analyses with dominance constraints can do. The important innovation is the underspecification of the semantic functor, i.e. the predicate of a logical expression is underspecified, whereas the holes of dominance constraints into which the labels of other formulæ can be plugged are in the argument positions of functors. While LRS was always able to cover such cases, the syntax and semantics of CLLRS had to be generalized to capture them. A precursor of the present type-logical theory of recursive modification was proposed in a more traditional HPSG feature geometry by Kasper (1997).

2 Data and intended semantics

Adjectival modification has not received much attention so far in LRS or in CLLRS, with the exception of the challenging lexical item *different* in Lahm (2018) and Richter (2016). The present focus is on more ordinary adjectives and their adverbial modifiers. In Montague grammars with semantic representations in Intensional Logic and a composition system based on intensional functional application such as the fragment of English in (Gamut, 1991, p. 198), adjectives are semantically treated as functions from properties to sets of entities. In the spirit of lifting types to the most complex case necessary, this permits an account of the fact that a *former senator* is not a senator, and an *alleged senator* may not be a senator. As usual in LRS, our

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representations are stated in Two-sorted Type Theory, Ty2 (Gallin, 1975). We follow the decision in the English fragment for an automatic reasoning architecture by Hahn & Richter (2015) and add a world index to the representation of adjectives. The type of non-logical constants for adjectives then is $\langle s\langle\langle s\langle et\rangle\rangle\langle et\rangle\rangle\rangle$, with $\langle s\langle et\rangle\rangle$ being the type of nominal constants. Adverbial modifiers of adjectives such as *potentially* in *potentially controversial plan* map an adjective meaning into an adjective meaning, which makes them of type $\langle\langle s\langle\langle s\langle et\rangle\rangle\langle et\rangle\rangle\rangle\langle s\langle\langle s\langle et\rangle\rangle\langle et\rangle\rangle\rangle\rangle$. As we are not concerned with quantification in nominal phrases, we will assume syncategorematic quantifiers as translations of quantificational determiners as in the older LRS literature rather than categorematic (possibly polyadic) quantifiers for simplicity.

In the following examples, we show a few representative noun phrases with adjectival modification and their translation (omitting the translation of the determiner, which would be translated as an existential quantifier binding the variable x in each example). World variables are notated as w_n and are of type s; x, y, z are variables of type e.

(1) a. (a) controversial plan
$controversial(w, (\lambda w_2 \lambda y.(plan(w_2, y))), x)$

b. (a) potentially controversial plan
$(potential(controversial))\,(w, (\lambda w_2 \lambda y.(plan(w_2, y))), x)$

c. (an) invisible pink unicorn
$invis(w, (\lambda w_2 \lambda y.(pink(w_2, (\lambda w_3 \lambda z.(unicorn(w_3, z))), y))), x)$

d. (a) clearly potentially genuine unicorn
$(clear(potential(genuine)))\,(w, (\lambda w_2 \lambda y.(unicorn(w_2, y))), x)$

The meaning of an adjective has three arguments of type s, $\langle s\langle et\rangle\rangle$, and e, respectively. Semantically, the two lambda abstractions in (1a) are unnecessary, but they will be technically useful for defining the semantic composition principles in (CL)LRS representations, which is why they are depicted here as well. The same holds for all corresponding lambda abstractions in (1b)–(1d).

Classes of adjectives are traditionally distinguished by the inference patterns they license (Partee, 1995; Kamp & Partee, 1995). We assume that they are given by appropriate meaning postulates (shown here according to (Hahn & Richter, 2015, p. 558)):

(2) a. For every intersective adjective meaning α (*blond, female, Chinese*):
$\exists P^1_{\langle s\langle et\rangle\rangle} \forall w_s \forall P^2_{\langle s\langle et\rangle\rangle} \forall x_e (\alpha(w, P^2, x) \leftrightarrow (P^1(w, x) \wedge P^2(w, x)))$

b. For every subsective, non-intersective adjective meaning α (*tall, genuine, pink*): $\forall P_{\langle s\langle et\rangle\rangle} \forall x_e \forall w_s (\alpha(w, P, x) \rightarrow P(w, x))$

c. For every privative adjective meaning α (*fake, former*):
$\forall P_{\langle s\langle et\rangle\rangle}\forall x_e\forall w_s(\alpha(w,P,x) \rightarrow \neg P(w,x))$

In an HPSG grammar, these could either be stated as part of the representations of words in an appropriate store for meaning postulates (licensed by principles generalizing over the appropriate word classes so that individual lexical entries do not have to mention them separately) or triggered at utterance level by the presence of the respective lexical items in the utterance.

3 (CL)LRS Analysis

To keep the presentation compact, we do not separate LRS and CLLRS descriptions but render the underlying LRS specification in a syntax that loosely follows the CLLRS code of the corresponding grammar implementation. The external content is indicated by `^`, the internal content is shown between curly braces ({,}), the main content is underlined, and square brackets ([,]) indicate the subterm relation. Capital letters are metavariables.

(3) pink $\rightsquigarrow$ `^(([{`*pink*`}])(W, λWλX.[ 1 (W,X)], X))`
(where 1 is shared with the MOD|LOC|CONTENT|MAIN value of *pink*)

(4) potentially $\rightsquigarrow$ `^(([{`*potential*`}])([ 2 ]))`
(where 2 is shared with the MOD|LOC|CONTENT|MAIN value of *potentially*)

We need a new clause of the LRS Semantics Principle which formulates the semantic combinatoric restrictions for combinations of adjectives (HEAD value *adjective*) with nominal projections and of adverbial modifiers (HEAD value *adj_ adv*) with adjectival projections.

(5) Semantics Principle, new clause for (adverbial) adjectival modification:
In a *head-adjunct* phrase with an adjective or and adverbial modifier of adjectives as non-head daughter ([HEAD *adj_ adv* $\vee$ *adjective*]), the internal content of the head daughter is a subterm of an argument of the internal content of the non-head daughter.

Moreover, an assumption of the LRS Projection Principle must be modified, according to which the internal content is always inherited from the head daughter of a phrase: In accordance with the insight that in adjectival modification (and related structures) syntactic head and semantic head are not the same, in these phrases the internal content is inherited by the phrase from the external content of the non-head daughter. The first two clauses of the principle in (6) are unchanged, whereas the third clause distinguishes INCONT inheritance in non-head-adjunct structures from the new case of head-adjunct structures:

(6) LRS Projection Principle
In each *phrase*,
   a. the EXCONT values of the head and the mother are identical,
   b. the PARTS value contains all and only the elements of the PARTS values of the daughters,
   c. (i) if it's not a head-adjunct phrase,
      the INCONT values of the head and the mother a re identical,
      (ii) if it is a head-adjunct phrase,
      the EXCONT value of the non-head daughter and the INCONT value of the mother are identical.

Given the lexical specifications in (3) and (4), the new clause of the Semantics Principle and the modified LRS Projection Principle for internal content inheritance, we can now investigate how the semantic representations in (1a)–(1d) are licensed.

(7) unicorn $\rightsquigarrow$ `^[{`*unicorn*`(W, X)}]`

With the (simplified) lexical semantic specification of a noun like *unicorn* in (7), we obtain (8) for *pink unicorn*:

(8) pink unicorn $\rightsquigarrow$ `^[({`*pink* `(W, λWλX.[`*unicorn*`(W,X)], X)})]`

The internal content of *pink unicorn* (8) is inherited from the external content of *pink* (3) (Projection Principle), the variables `X` in (3), (7) and (8) are all identical (a consequence of the lexical specification of *pink*), the predicate *unicorn* in (8) is in the scope of the two lambda abstractions due to the lexical requirement of *pink* and in accordance with the modifier clause of the Semantics Principle in (5): Since the first argument of *pink* is a world variable of type s and the last argument is a variable of type e, only the second argument can accommodate the internal content of *unicorn*. Moreover, the representation in (8) corresponds to (1a). In particular if *pink unicorn* is combined with the indefinite determiner translated as existential quantifier, we obtain $\hat{}\exists x(\{pink\ (\mathtt{W},\ \lambda\mathtt{W}\lambda x.unicorn(\mathtt{W}, x),\ x)\}\colon [x])$ as representation for the full NP, since `X` in (8) is identified with the object level variable x contributed by the determiner (by lexical requirement of *unicorn* according to standard LRS analysis); and x must also occur in the scope of the quantifier ($[x]$ after ':', separating restrictor from scope).

Now consider another adjective, *invisible*:

(9) invisible $\rightsquigarrow$ `^(([{`*invisible*`}])(W, λWλX.[ 3 (W,X)], X))`
(where 3 is shared with the MOD|LOC|CONTENT|MAIN value of *invisible*)

(9) is combined as non-head daughter with *pink unicorn* in (8) to form *invisible pink unicorn*. In this case, 3 is identified with the MAIN value of

the head daughter, which is the MAIN value of *unicorn*. But in addition, according to the new clause of the SEMANTICS PRINCIPLE, (5), the internal content of the head daughter (*pink unicorn*) must be a subterm of an argument of the internal content of *invisible*. This is only possible in the scope of the two lambda abstractions of its second argument. But that means that the expression shown in the constraints in (8) must be in the scope of the two lambda expressions contributed by *invisible*, leading to what is shown in (1c). In fact, it turns out the variables x, y and z of (1c) are all the same variable x according to the (CL)LRS constraints of the grammar, but they are either bound by different lambda abstractions (z, y) or unbound in the term (the last occurrence of x in (1c)).

Let's assume alternatively that we combine *potentially* (4) with *pink* (3). In the resulting phrase, *potentially* is the non-head daughter and *pink* is the head daughter. According to the clause of the SEMANTICS PRINCIPLE above, the internal content of *pink*, which is the non-logical constant *pink*, is (a subterm of) the argument of the functor *potential*. Note that the typing of the two non-logical constants fits this requirement when *pink* is the argument of *potential*. According to the LRS PROJECTION PRINCIPLE, the external content of *potentially* becomes the internal content of *potentially pink*. Overall, this leads to the following constraint for *potentially pink*:

(10) potentially pink $\rightsquigarrow$
`^(([{`*potential*`(`*pink*`)}])(W, λWλX.[ 1 (W,X)], X))`

The adjectival phrase *potentially pink* with the semantic representation in (10) can be combined with a noun like *unicorn* in the same way in which *pink* alone can be combined with *unicorn*. Alternatively, *potentially pink* can be combined with another adverbial modifier before it finds its nominal head (see (1d)).

A crucial feature of the analysis above is the underspecification of the functor of adjectival modification: The main relation of adjectives is potentially a subterm of the overall functor (see (3)), thus making it possible that something else takes their main relation as argument first to build a complex functor which then applies to the arguments of the adjective. This potential for combining with a modifier is preserved after a first modifier combines with an adjective, as shown in (10).

Underspecification of functors, naturally formulated in LRS, turns out to be challenging for implementation. In the tradition of term representations for expressions of first order logic, the original representation of functors in CLLRS tied predicates to their arguments, and they could not be separated. Similarly, formulations of underspecified representations in the tradition of hole semantics with dominance constraints (Bos, 1995) leave holes in argument positions which can be plugged by labels of subformulæ, but there are no holes in the position of syntactic functors. CLLRS was re-implemented

with a new data structure for term representations and a new specification syntax for stating arguments of fully specified or underspecified functors.

4 Conclusion

The analysis presented above has been implemented as a component of a larger fragment of English with CLLRS semantics in TRALE. The CLLRS implementation is entirely parallel to the LRS specification. The syntax-semantics interface follows the main ideas put forth by Kasper (1997) in his seminal paper on the semantics of recursive modification in HPSG. One major difference is the semantic representation language where the present proposal chooses a classical higher-order logic. Another difference is the narrower empirical focus on modifiers in the nominal domain of the present paper. With a type-logical representation language, we expect the main ideas to be applicable in the verbal domain as well, but important details depend on the choice a particular verb semantics that require much broader considerations. The parallels to Kasper (1997) are far-reaching: There is a clear distinction between the inherent content of lexical items from the semantic combinatorics, the inherent lexical content is separated from its use in different constructions. At the same time, the combinatorial behavior of signs is projected from the lexical head of constructions, while a uniform semantic principle is responsible for regulating the essential restrictions on head-modifier constructions. Both approaches cover different kinds of modifiers (operators, intersective), captured in the present analysis by meaning postulates for classes of adjectives.

Predicative adjectival constructions were not covered in the analysis above, but they can be added by assuming a lexical rule which relates attributive forms to predicative forms, including a slightly modified lexical semantic specification. For the adjective *pink*, the semantic specification would look as shown in (11-a), where *entity* is a property of any entity in the model, and standard semantic composition principles of LRS are sufficient to then derive an adequate semantic representation for (11-b).

(11) a. pink $\rightsquigarrow$ `^(([{`*pink*`}])(W,` *entity*`, X))`
b. Few unicorns are (entirely) pink.

Adverbial modifiers apply to predicative adjectival constructions as they do in the attributive case. However, further assumptions are needed to add adverbial modifiers of adverbials to the picture, as in *a very occasionally invisible unicorn*. If *very* first modifies *occasionally* before *very occasionally* modifies *invisible*, the non-logical constant of *very* must be of a different type from the type of the constant of *occasionally*. It might be useful to consider type polymorphism for adverbials by underspecification as a possible solution. Just as an extension of the present analysis of modification to the

verbal domain, this is left to future consideration.

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A Smurf-based Approach to Placeholder Expressions

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Abstract

The *Smurf* comics series is, among others, famous for the so-called *smurf language*, in which words or parts of words can be replaced by *smurf*. We will argue that this *smurfing* has the properties of placeholding. Based on data from German translations of Smurf comics, we will provide a formalization of smurfing in German which can be generalized to a theory of placeholder expressions.

1 Introduction

Placeholder expressions are item such as those in (1).

(1) whatsit, whatchamacallit, thingamajig, what's-his/her-name, what-d'you-call-her/him, you-know-who, so-and-so

Cheung (2015) assignes them the following properties: First, they substitute a *target*. Second, the target can be a word, a phrase, but also a syllable. Third, there must be some pragmatic reasons for why the speaker utters the placeholder instead of the target.

In this paper, we will connect placeholder expressions and the *Smurf language*. The Smurfs are comics and cartoon figures which were invented by the Belgian cartoonist Peyo (Pierre Culliford) and which have been published since 1958. While originally in French, the Smurf comics have been translated into more than 25 languages. The "language" of the Smurfs, or rather their way of speaking is characterized by the use of the expression *smurf*, or its equivalent in the language of the publication, to replace words or parts of words. This is shown in (2) with the same example, taken from the English and German translations of the French original in (2c).

(2) *The Hungry Smurfs*. p. 7

a. What a disaster! It makes you want to smurf (= tear) your hair out! (en)

b. Welch eine Kataschlumpfe (= Katastrophe 'catastrophe')! Es ist zum Schlümpfe (= Haare 'hair') ausraufen! (de)

c. Quel désastre! C'est à s'arracher les schtroupfs (= cheveux 'hairs')! (fr)

The connection between the Smurf language and placeholder expressions that we want to explore in this paper can be traced back to the creation myth of the Smurf language. It has been repeatedly reported that the origin of the Smurf language goes back to the following conversation between Peyo and André Franquin, quoted from (Dayez, 2013, 9), our underlining and translation.

[†]We thank the reviewers and the audience for their comments, in particular Ash Asudeh, Berthold Crysmann, Marianne Desmets, and Adam Przepiórkowski. All errors are ours.

Peyo: André, passe-moi la... allez, le... le schtroumpf, là, près de toi!
'André, pass me the... smurf there, next to you!'
André: Tiens, voilà ton schtroumpf! 'Here comes your smurf'
Peyo: Merci de me l'avoir schtroumpfé, ...
'Thanks for smurfing it to me.'
quand je n'en aurai plus besoin, je te le reschtroumpferai.
'when I don't need it anymore, I'll smurf it back to you.'

In its first occurrence, the nonce word *schtroumpf* is used as an ad hoc placeholder as Peyo could not think of the word for salt. Franquin picks this word up and the two continue using it in an ever more playful way.

We will argue that smurfing has properties that make it a placeholder phenomenon: *smurf* replaces another expression and has special pragmatics. At the same time, *smurf* differs from other placeholders in that it is not used for filling a cognitive or lexical gap. Nonetheless, we claim that the analysis of smurfing will be a step towards an analysis of placeholder expressions in general.

We present two previous approaches to placeholder expressions in Section 2. In Section 3, we discuss the properties of German smurfing. An HPSG modelling of smurfing as a placeholder phenomenon is given in Section 4. We summarize our main results and point to future directions of research in Section 5.

2 Previous approaches to placeholder expressions

In this section, we will review the approaches to placeholder expressions in Enfield (2003) and Cheung (2015). Enfield (2003) argues that a placeholder makes a rather general truth-conditional semantic contribution, but its range of meaning can be constrained, and there are additional conditions on whether the speaker and/or the addressee can recover the target expression. We illustrate this with Enfield's analysis of the English placeholder *you-know-WHAT* in (3).

(3) *you-know-WHAT* (Enfield, 2003, 107)
   a. Something
   b. I don't want to say the word for this thing now
   c. I don't say it now because I know I don't have to
   d. By saying *you-know-WHAT* I think you'll know what I'm thinking of.

The variation in the range of meaning can be seen by constrasting *you-know-WHAT* with *you-know-WHO*, where only the latter is restricted to persons. Variation with respect to the accessibility of the replaced expression can be seen by contrasting *you-know-WHAT* with *WHAT-d'you-call-it*, which points to a (temporary) unavailability of the expression to the speaker.

The speaker-addressee related aspects of the characterization of placeholder expressions in Enfield (2003) have the properties of what is discussed under

the label of *use-conditional meaning* in Gutzmann (2013) and Gutzmann & McCready (2016), among others. Whereas we can ask whether the truth-conditional meaning of a sentence is true or false, the appropriate question for an expression with use-conditional meaning is whether it is used felicitously (Gutzmann & McCready, 2016). One type of expressions with use-conditional meaning are *slurs*, such as the word *kraut*. The word (truth-conditionally) refers to Germans, it is used felicitously if the speaker has a negative attitude of the speaker towards Germans in general. Use-conditional meaning has the projective properties of conventional implicature (Karttunen & Peters, 1979; Potts, 2005) and usually comes with speaker-addressee attitudes.

While we agree with most of Enfield's characterization of placeholder expressions, we do not think that they necessarily come with a vague, general truth-conditional semantics. We can show this with cases of replacement of parts of idioms by placeholder expressions. As we will concentrate on German data in the main part of this paper, we will use German examples here, too.

The idiom in (4) contains the word *Barthel*, a so-called *phraseologically bound word* or *cranberry word*. Such words are usually not found outside a particular expression (Aronoff, 1976; Dobrovol'skij, 1989; Richter & Sailer, 2003).[1] As the word *Barthel* is restricted to this expression, we cannot indicate a translation for it. Example (4) shows that the bound word cannot be replaced within the idiom with a general term such as *jemand* 'someone' or *etwas* 'something'.

(4) zeigen, wo Barthel/ #jemand/ #etwas den Most holt
show where ??/ someone/ something the cider gets
'show s.o. what's going on'

Contrary to this, idiom parts can be replaced with placeholder expressions. This is shown for the word *Barthel* in (5), which is replaced by the German placeholder expression *Dingsbums* 'thingamajig' (glossed as PHE for *placeholder expression*). This contrast between general terms and placeholder expressions is not compatible with Enfield's analysis of the truth-conditional meaning of placeholders.

(5) [sie] waren so motiviert, uns zu zeigen, wo Dingsbums
they were so motivated to.us to show where PHE
(= Barthel) den Most holt, daß...
?? the cider gets that
'they were to motivated to show us what's going on that ...'[2]

Cheung (2015) is not very detailed with respect to what we consider the use-conditional meaning of placeholder expressions, but provides a different

[1] See https://www.english-linguistics.de/codii/ for English and German bound words.
[2] https://tinyurl.com/y5f72cdz, accessed 14.10.2020.

approach to their referential meaning. He considers placeholders *metalinguistic demonstratives*. This means that they denote the expression that they replace. If *what's-her-name* is used instead of the name *Robin*, for example, the placeholder refers to the word *Robin*, i.e. $[\![$*what's-her-name*$]\!] =$ *Robin*. Whenever a placeholder is used, there is also an operator **SHIFT** in the structure. This operator, then, maps the expression denoted by the placeholder to its denotation, i.e. [[**SHIFT**(*Robin*)]] = [[*Robin*]] = **robin**.

This approach presents an elegant answer to the question of how a placeholder and its target are connected semantically. However, it is not clear if it captures all aspects of this connection. We will address this point in more detail in our discussion of the smurfing data.

There is, however, one problem. Cheung (2015, 276) shows with examples such as (6) that placeholding can also affect phonological units. In this example, the target of the placeholder is the second syllable of the Chinese form of the French name *Hollande*.

(6) Ao-shenme-de (= Ao-lang-de) shi xianren Faguo zongtong.
Ho-PHE-de (Hollande) be current France president
'Ao-something-de (= Hollande) is the current President of France.'

The problem of the analysis is that Cheung (2015, 302) assumes that the placeholder, together with the **SHIFT** operator, forms a syntactic constituent that is inserted between the two intact syllables. While it is conceivable that the placeholder denotes the syllabel *lang*, it is not clear what kind of semantic object **SHIFT**(*lang*) would denote.

Our brief discussion of two formal approaches to placeholding shows (i) that placeholders come with use-conditional semantic aspects, (ii) that they can substitute concrete lexical items, and (iii) that they can even substitute meaningless parts of lexical items. We will show in the next section that smurfing has the same properties.

3 Properties of smurfing

In this section, we will turn to smurfing. We mainly use the data collected in Dörner (2012), which consist of the 536 instances of smurfing found in 6 German Smurf stories. This will be expanded by browsing through early English, French, and German Smurf comics (1958–1988). In addition, we will use data and observations from the literature on smurfing (Bollig, 2016; Bourcier & Martin, 1996; Chatzopoulos, 2008). Chatzopoulos (2008) will be an important source as she provides the first formal analysis of smurfing.

Chatzopoulos (2008) distinguishes a literal and a "semantically unspecified" use of the morpheme *smurf* – or its equivalent in other languages. In its literal use, as in (7a), *smurf* refers to Smurfs or anything Smurf-related. This use is

also found in the speech balloons attributed to non-Smurfs, such as Gargamel. The second use, illustrated in (7b), constitutes the special use that Chatzopoulos refers to as *smurfing*.

(7) a. Gargamel: Smurf-prints! (= footprints left by Smurfs) (Chatzopoulos, 2008)
b. Are you making smurf (= fun) of me? (*The Fake Smurf*, 4)

In this section, we will look at two general properties of smurfing: its pragmatics and recoverability. Then, we will argue that there are two types of smurfing: phonological and morphological smurfing.

3.1 Pragmatics of smurfing

According to Chatzopoulos (2008), smurfing is a strong marker of Smurf identity. This is confirmed in an exemplary look at the German translations of two Smurf stories – *Der fliegende Schlumpf* (English title: *A Smurf in the Air*), and *Die Schlümpfe und die Zauberflöte* (English title: *The Smurfs and the Magic Flute*). In the first story, there are only Smurfs, i.e., all conversations are among Smurfs. We find smurfing in 33% of the panels in which there is a speech balloon. In contrast to this, the second story contains both Smurfs and non-Smurfs. In it, there is smurfing in 68% of the speech balloons showing Smurfs talking to each other. Smurfs use smurfing when talking to a non-Smurf in 23% of the panels. Non-Smurfs never use smurfing when talking to each other. There is no (successful) use of smurfing by a non-Smurf towards a Smurf.[3]

This indicates that non-Smurfs do not smurf. Furthermore, the smurfing rate is higher when Smurfs are depicted in contact with non-Smurfs than when they are among themselves. As smurfing is also used towards non-Smurfs – though to a lesser extent – it marks the Smurf identity of the speaker. This shows that smurfing is used to contrast Smurfs and non-Smurfs also linguistically. In other words, Smurfs are depicted in the comics as a special sociolinguistic group.

We will include this pragmatic property of smurfing in its use-conditional meaning, abbreviated as **Smurf-UC**.

(8) Identity use-conditional meaning of smurfing (**Smurf-UC**):
By smurfing, a speaker is marked as Smurf and signals their Smurf-ness.

Such a kind of use-conditional meaning is not uncommon. It is, in fact, at the heart of classical variationist research in sociolinguistics – though rephrased in terms of formal pragmatics.

[3] In this particular story, one non-Smurf tries to use smurfing to communicate with a Smurf, but never does so successfully.

3.2 Recoverability of smurfing

A central point in the research on smurfing is the question of the recoverability of the target. Chatzopoulos (2008) proposes an Optimality Theoretical approach to smurfing. She postulates a constraint SMURF: "Smurf all lexical morphemes." This constraint is outranked by a recoverability constraint which restricts smurfing to contexts in which the target can be recovered. She lists a number of factors that enable recoverability. One of them is phonological similarity, as in her example in (9).

(9) smurfday (= birthday) (Chatzopoulos, 2008)

Smurfing of parts of multiword expressions enhances recoverability as well. Chatzopoulos (2008) explicitly mentions "proverbs, idioms and phrases with some degree of fossilization." We saw an example of this in (2) above, where part of the idiom *tear one's hair out* is smurfed. The third factor named in Chatzopoulos (2008) is a pragmatically rich context. Such a context is often provided by the pictures or the general situation.

Bollig (2016, 55) challenges this common opinion that smurfing is always recoverable providing the example (10) from the story *Schtroumpf vert et vert schtroumpf* (English title: *Smurf vs. Smurf*).

(10) A: Qu'est-ce qui est schtroumpf, qui a un schtroumpf vert et qui schtroumpfe quand on le schtroumpfe?
'What is smurf, has a green smurf and smurfs when you smurf it?'
B: Je ne sais pas ... un schtroumpf?
'I don't know ... a smurf?'
A: Mais non, voyons! DEUX schtroumpfs!
'But no, look! TWO smurfs!'
(*Schtroumpf vert et vert schtroumpf*, p. 2; our translation)

While it is clear that the reader cannot recover the smurfing, the two Smurfs in conversation are depicted as being able to do so. Consequently, the speaker is depicted as assuming recoverability for the addressee. This is the same condition we find for the English placeholder *you-know-WHAT*, see (3d) above. We can formulate it as a second use-condition on smurfing in (11).

(11) Recoverability use-conditional meaning of smurfing (**Recov-UC**):
By smurfing the speaker thinks the addressee knows what target the speaker is thinking of.

After these two subsections on the pragmatics of smurfing, we will take a closer look at its grammatical properties in the following two sections.

3.3 Phonological smurfing

According to Chatzopoulos (2008), English *-smurf-* can replace one syllable, but keeps the overall metrical properties of the smurfed word. We find smurfing of individual (underlying) syllables in German as well, see (12). In the first line, we state the underlying syllable structure of the word containing the smurfing, together with its non-smurfed target. In the second line, we show the syllabification of the result.

(12) a. Ka.ta.schlumpf.e (= Ka.ta.stroph.e 'catastrophe')
→ Ka.ta.schlum.pfe

b. schlumpf.est.ier.en (= pro.test.ier.en 'protest')
→ schlum.pfes.tie.ren

Note, however, that the first segment of the syllable *test* is deleted in (12b). This might be due to some simplification of the syllable structure, even though *schlumpf.tes-tie-ren* is in line with the phonotactic constraints of German. In any case, this example indicates that the phonological replacement mechanism does not seem to be fully deterministic.

We saw with the Chinese example from Cheung (2015) in (6) that such a syllable replacement is possible with genuine placeholders as well. Example (13) shows the replacement of a syllable by a placeholder in German.

(13) soll an irgendeinen support eine analy...dingens datei
must.1.SG to some support an analy-PHE file
(= Analyse-datei) senden.
analysis-file send
'I must send an analysis file to some support.'[4]

As this type of smurfing is phonologically conditioned, we refer to it as *phonological (p-)smurfing*.

3.4 Morphological smurfing

In this subsection, we will show that, at least for German, a phonological account of smurfing is not sufficient. Instead, there is a second type of smurfing, which we will call *morphological (m-)smurfing*.

In (14a) the form *ver-schlumpf-t* occurs as the smurfed version of the word *verstanden* 'understood'. If we had a pure phonological smurfing, we would expect to find *verschlumpfen*, see (14b) instead. This shows that the smurfed verb *ver-schlumpf-en* has a different inflectional paradigm than the target *ver-steh-en* 'understand'.[5]

[4] https://tinyurl.com/y3kghypm, accessed 05.10.2020.

[5] We use the following abbreviations in the glosses of German examples: DER derivational affix, F feminine, GE prefix for past participle formation, INF infinitive, M masculine, N neuter, PTCP past participle, PL plural, PRS present tense, PST past tense, SG singular.

(14) a. Hast du ver-schlumpf-t (= ver-stand-en)?
have you DER-smurf-PTCP (= DER-stand-PTCP 'understood')
'Do you understand?'
b. *Hast du ver-schlumpf-en (= ver-stand-en)?

We also find cases in which there occurs a derivational affix that is not present in the target.

(15) Eine schlumpf-ig-e (= gut-e) Idee!
a smurf-DER-F.SG good-F.SG idea
'a good idea'

In (15), the target adjective consists just of a simple morpheme as the stem to which an inflectional suffix attaches. The smurfed version, however, consists of the root *schlumpf*, the derivational affix *-ig* (which marks denominal adjectives), and the inflectional marking. A purely phonological smurfing process would have let to the simpler form *schlumpf-e*.

These two examples suggest that the target of m-smurfing is a morphological unit rather than a syllable. This can be further substantiated by looking at the possible size of the target. In (14a) above, the target was a root morpheme, *steh* 'stand'. We also find cases in which the target is a combination of a root and a derivational affixes, such as (16).

(16) Um das Nützliche mit dem Angenehmen zu schlumpf-en
to the useful with the pleasant to smurf-INF
(= ver-bind-en), ...
(= DER-bind-INF 'connect')
'to mix business with pleasure, ...'

Finally, even entire compounds can be smurfed. The German expression of congratulation contains the compound *Glück-wunsch* 'luck-wish'. In our data, we find two possible smurfed forms of this word. In one, only the last component of the compound is replaced with *schlumpf*. In the other, the entire compound is realized as *Schlumpf*.

(17) Herzlichen Glück-schlumpf/ Schlumpf (= Glück-wunsch)!
hearly luck-smurf/ smurf! (= luck-wish)
'Congratulations!'

This shows that, in fact, the target of smurfing can be any morphological unit that contains at least one root and excludes inflection.

Interestingly, we find the same for general placeholder expressions in German as well. In (18), there are two occurrences of the placeholder *Dings*. The first one replaces the compound *Glück-wunsch* 'luck-wish', the second the compound *Geburts-tag* 'birth-day'.

(18) Herzlichen Dings (= Glück-wunsch) zum Dings (= Geburts-tag)!
heartly PHE (= luck-wish) to.the PHE (= birth-day)
'Congratulations to your birthday!'[6]

We have seen in (14a) that m-smurfing of verbs does not conserve the inflectional class of the target. The same is true for nouns. The masculine and neuter noun form *Schlumpf* 'smurf' forms its plural with an umlaut, *Schlümpf-e* 'smurf-PL'. This umlaut also occurs if the target does not have an umlaut. This is the case in example (2b) above. The neuter noun *Haar* 'hair' has an umlaut-less plural *Haar-e*. Nonetheless, its smurfed form, *Schlümpf-e*, shows the umlaut.

On the other hand, there is no umlaut or additional plural affix its feminine form, *Schlumpfe*, even if the target has an umlaut or an additional affix. This is shown in (19). The feminine word *Hand* 'hand' forms its plural with umlaut and *-e*, *Händ-e*. Nonetheless, the smurfed form remains *Schlumpfe*.

(19) ... bin ich dabei, mir die Schlumpf-e (= Händ-e) zu waschen
am I busy me the smurf-DER (= hand-PL) to wash
'I am busy washing my hands'

While a smurfed word does not inherit the inflectional properties and the internal morphological structure of the target, it inherits a number of morpho-syntactic properties, such as gender (for nouns) and auxiliary selection (for verbs), as well as argument selection in general.

We saw instances of gender inheritance in the examples above, such as (19) (feminine noun) and (17) (masculine noun). Auxiliary selection is illustrated in (20). The smurfed verb combines with the perfect auxiliary *haben* 'have' in (20a) and with the auxiliary *sein* 'be' in (20b), just as its target.

(20) a. Du hast schon ge-schlumpf-t (= ge-wähl-t)!
you have already GE-smurf-PTCP (= voted)
'You have already voted!'

b. Hast du aber Glück gehabt, dass ich gerade vorbei-ge-schlumpf-t
have you but luck had that I just along-GE-smurf-PTCP
(= vorbei-ge-komm-en) bin!
(= come along) am
'How lucky you are that I have just come along!'

In all examples, the argument structure of the smurfed expression is the same as that of the target. We add example (21), where the smurfed verb occurs with a reflexive pronoun *sich* 'himself'. The target of the smurfed verb is inherently reflexive. This shows that the argument structure does not follow from the target's semantics but is inherited from the target. Consequently, a

[6] https://tinyurl.com/y5unq8yb, accessed 30.09.2020.

m-smurfing	p-smurfing
depends on morphological structure	depends on syllable structure
target is (simple or complex) morphological unit	target is single underlying syllable
can combine with derivational affixes not in the target [*schlumpf-ig*]-*e* (= *gut-e*)	no internal complexity
form is determined by paradigm *schlumpf/schlümpf*	form is constant

Table 1: Differences between m- and p-smurfing

purely denotational relation between the placeholder and its target as in Cheung (2015) seems potentially problematic.

(21) Schnell, Gargamel be-schlumpf-t (= be-weg-t) sich etwas!
fast, Gargamel DER-smurf-3.SG.PRS (= moves) himself a bit
'Hurry up, Gargamel is moving a bit!'

The differences between m-smurfing and p-smurfing are summarized in Table 1. We showed that the distinction between phonological and morphological replacement can be found in general placeholding as well.

The data in this section illustrate the following properties of smurfing: There is a single inflectional word *Schlumpf* 'smurf' with umlaut, which has a literal and a placeholder use. The placeholder use comes with use conditions of Smurfness of the speaker and recoverablility of the target for the hearer. There are two types of smurfing: one that targets a phonological unit (p-smurfing), and one that targets a morphological unit (m-smurfing). We observed that these properties are also found in placeholder expressions. We take this as support for treating smurfing as an instance of placholding.

4 HPSG modelling

In the present section, we will develop our formal analysis of smurfing as part of an HPSG analysis of placeholding in general. We will use the morphological component of Bonami & Boyé (2006), extended with the modelling of compounding from Desmets & Villoing (2009). The inheritance of properties of the target to the overall smurfed expression will be expressed as *transparent heads*, which is a standard technique of HPSG, employed in Pollard & Sag (1994) and more explicitly in Levine (2010). We will assume that there are two lexemes *Schlumpf* – a literal and a non-literal lexeme. The two lexemes share the same

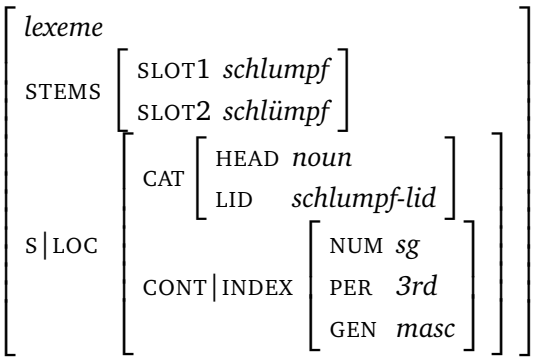

Figure 1: Lexical entry of the lexeme *Schlumpf* 'smurf'

inflectional paradigm. Smurfing is modelled as by allowing the use of the non-literal lexeme inside existing placeholder constructions of German.

4.1 Lexemes

Our formal modelling follows the empirical observations from Section 3 very closely. In this subsection, we will specify two related lexemes for the word *Schlumpf*, one for the literal and one for the non-literal use. We follow Sag (2012) and others in using a feature LEXICAL-IDENTIFIER (LID). The value of this feature is shared between a phrase and its head daughter. Nonetheless, contrary to other HPSG publications, we do not treat LID as a head feature but assume that it is defined on *category* objects.[7]

To account for the two uses of *Schlumpf* we assume that its LID value is of sort *schlumpf-lid*. This sort has two subsorts, *schlumpf-lit* and *schlumpf-phe*, for the literal and the non-literal use respectively.

Bonami & Boyé (2006) introduce a feature STEMS on lexemes, whose value for provides the stem allophones needed for inflection. Combining the features STEM and LID, we can specify the lexical entry for *Schlumpf* as in Figure 1.

This combines with constraints on the two different uses given in (22). The constraint in (22a) specifies that the literal use of *Schlumpf* refers to a Smurf. The non-literal, placeholder, use of *Schlumpf* does not have a semantics of its own, but contributes the two use conditions discussed in Sections 3.1 and 3.2: Smurf-ness of the speaker (**Smurf-UC**) and recoverability of the target for the addressee (**Recov-UC**). These two use conditions are included in the BACKGROUND feature, which is the place for projective semantic contributions in HPSG (Pollard & Sag, 1994; Green, 1994).

[7]This makes it possible to share head features among signs that do not belong to the same lexeme – see Figure 5 below and Soehn (2006) and Richter & Sailer (2009).

(22) a. Constraint on the literal use of *Schlumpf*:

$$\left[\,\text{S}|\text{L}|\text{CAT}|\text{LID}\ \textit{schlumpf-lit}\,\right] \Rightarrow \left[\begin{array}{l}\text{S}|\text{L}|\text{CONT}\ \left[\begin{array}{l}\text{INDEX}\ \boxed{1}\\ \text{RESTR}\ \left\{\left[\begin{array}{l}\textit{smurf-rel}\\ \text{INST}\ \boxed{1}\end{array}\right]\right\}\end{array}\right]\end{array}\right]$$

b. Constraint on the non-literal use of *Schlumpf*:

$$\left[\,\text{S}|\text{L}|\text{CAT}|\text{LID}\ \textit{schlumpf-phe}\,\right] \Rightarrow \left[\,\text{S}|\text{L}|\text{CTXT}|\text{BACKGROUND}\ \left\{\textbf{SMURF-UC}, \textbf{RECOV}\right\}\,\right]$$

The sort *schlumpf-phe* is the LID value of the placeholder use of the word *Schlumpf*. We assume that this sort is not only a subsort of *schlumpf-lid*, but also of a sort *placeholder-lid* (*phe-lid*). The same is true for other lexemes that have both a placeholder and a non-placeholder use, such as *Ding* 'thing'. If a word has only a placeholder use, such as German *Ding(en)s* or *Dingsbums* (both 'thingamajig'), the sort of its LID value is a subsort of *phe-lid* exclusively. We saw in our brief summary of Enfield (2003) that placeholder expressions in general come with a use-conditional meaning. They can, but need not, impose further restrictions on their syntax or semantics. In the case of *Schlumpf*, there is no semantic restriction, but it is specified as a masculine noun with a particular inflectional paradigm.

4.2 Placeholder constructions

In this subsection, we will present a general formalization of placeholding (in German). We assume that smurfing is regular placeholding, where the chosen placeholder is *Schlumpf*. We argued above that we need to distinguish two types of smurfing – and placeholding in general: phonological and morphological smurfing/placeholding. In all cases of smurfing/placeholding, the only semantic and pragmatic constraints contributed by placeholder are its use-conditional meaning. The semantics of the resulting expression as well as many of its morpho-syntactic properties are inherited from the target. To model this, we will assume that placeholding is a combination of two lexemes: a placeholder and its target. This combination is a generalization of compounding.[8] We think that phonological placeholding is an instance of *blending* (Fradin, 2015), whereas morphological placeholding is some other type of *subtractive lexeme combination* for which we have not found a fully parallel process outside placeholding yet.

As there is no explicit generalization of compounding in HPSG, we will take the architecture of Desmets & Villoing (2009) as starting point for our analysis.

[8]We are grateful to Berthold Crysmann and Marianne Desmets (p.c.) for stressing that placeholding is not an ordinary form of compounding.

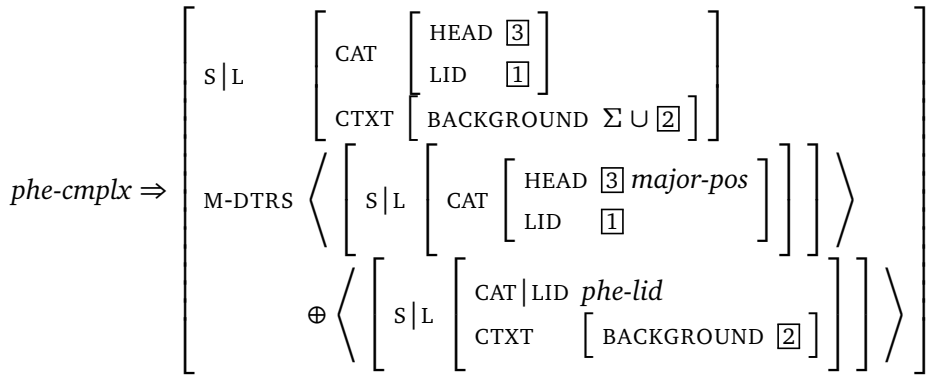

Figure 2: Constraint on the sort *phe-cmplx*

In this approach, lexemes can be simple or complex. Compounds are cases of complex lexemes. The components of a compound are its *morphological daughters*, for which Desmets & Villoing introduce a list-valued feature M-DAUGHTERS. Using this feature architecture, we assume that there is a sort *phe-complex* (*phe-cmplx*), which has two morphological daughters: the placeholder and the target.

In Figure 2, we provide the general constraint on all placeholder complexes: There are two morphological daughters. One is a placeholder, i.e., its LID value is of sort *phe-lid*. The other one is the target. The target must be of a major part of speech. The overall expression inherits from the target (at least) its LID value (1) and its HEAD value (3). The use-conditional meaning of the placeholder is integrated into the use conditions of the complex – specified as the BACKGROUND set 2.

This constraint on placeholding complexes captures a number of observations we have made in earlier sections. First, the target must be of a major part of speech and cannot be a functional morpheme. Second, placeholding is a process on lexemes, which means that inflection will be added to the placeholding complex. Third, the LID value of the complex is identical with that of the target.

This last property allows for the placeholding of parts of idioms and other fixed expressions, as observed in (4) and found massively in smurfing. Theories of idioms in HPSG have made heavy use of some way of lexeme-specific selection to guarantee that the idiom-specific words combine. Kay et al. (2015) show how this approach can be used even for syntactically fixed and semantically non-decomposable idioms such as *kick the bucket* 'die'. As a placeholding complex shares the LID value with the target, placeholding of idiom parts is immediately accounted for.

We can now turn to phonological placeholding, which we consider a type of blending. Fradin (2015) provides an overview of blending. In the classical cases, it is a very flexible type of combining lexemes in which truncated forms of the components are combined, as in English *brunch* (*br(eakfast) + (l)unch*)

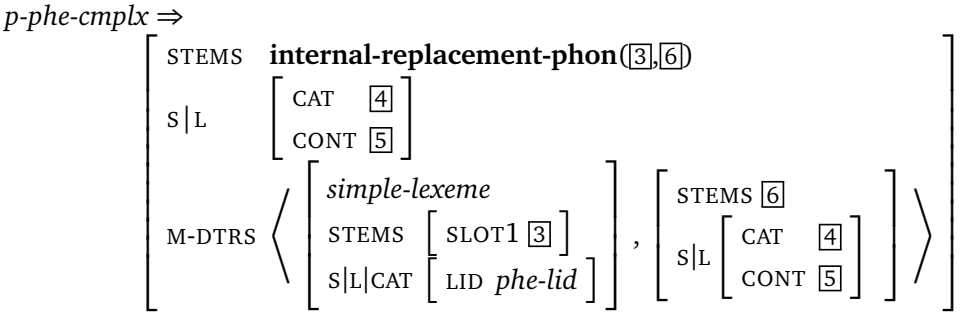

Figure 3: Constraint on p-placeholding

or German *Kripo* (*Kri(minal)* + *Po(lizei)* 'Criminal Investigation Department'). There are also blends in which one component is inserted into the other internally. Fradin (2015, 391) provides the French example *mét<amour>phose*, in which the word *amour* 'love' replaces (parts of) the second and the third syllable of *métamorphose* 'metamorphosis'. This is immediately reminiscent of the cases of p-smurfing discussed in Section 3.3, such as *Kata<schlumpf>e* (= Katastrophe 'catastrophe'), to use Fradin's notation.

We use the sort *p-phe-cmplx* to model p-placeholding. This sort is a subsort of *phe-cmplx* and, thus, inherits all properties from Figure 2. The sort *p-phe-cmplx* should ultimately also be treated as a subsort of the sort used for constraining (internal) blending. We treat the first component as the placeholder, the second component as the target. This is motivated by the fact that the second component determines most properties of complex words in German. The placeholder must be morphologically simple, whereas the target can be complex.

In this complex, the resulting word inherits its category and semantic properties from the target – given here as the CAT and CONT values (4 and 5). This is more information than the minimal information inherited from the target specified in Figure 2. The constraint on the supertype *phe-cmplx* ensures that the use-conditional meaning of the placeholder daughter projects to the overall complex. The special phonological effect of internal blending is encoded in the function **internal-replacement-phon**. This function takes as its arguments, the relevant stem form of the placeholder and the STEM value of the target. The output is a replacement of part of the target's phonology by the placeholder's phonology. Fradin (2015) names general principles governing the way in which the phonology of blends is determined.

In Figure 4, we illustrate how the constraints in Figures 2 and 3 are at work to derive the word *Katschlumpfe* as a p-placeholder combination of *Schlumpf* and *Katastrophe*. The highest local tree is the projection from an (unflected) lexeme to its inflected word form. We simplify the feature geometry in the tree.

Next, we can look at m-placeholding, which we will model using a sort *morphological-phe-complex* (*m-phe-cmplx*). The constraint on this type is given in Figure 5. We saw in Section 3.4 that the inflectional properties of the com-

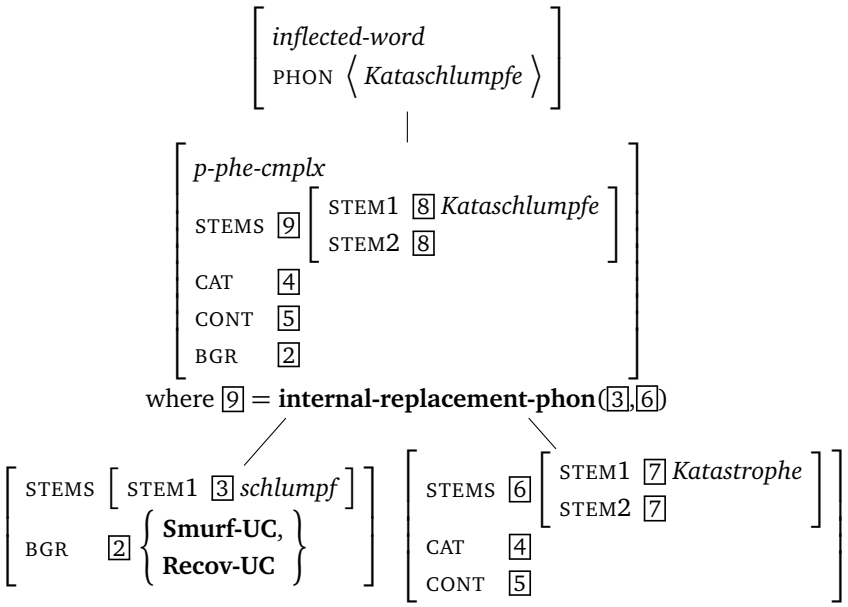

Figure 4: Derivation of the word *Kataschlumpfe*

bination are determined by the placeholder, not the target. For this reason, we assume that the placeholder is the second component in m-placeholding. At the same time, the complex shares its HEAD, VAL, and CONT values with the target. This is modelled through the technique of *transparent heads*, i.e., the morphological head is specified as inheriting these properties from the non-head. In Figure 6, we provide the derivation of the complex placeholder *schlumpf-ig-e*.

The constraint on the sort *m-phe-cmplx* not only allows for potentially complex targets, but the placeholder may be complex as well. This captures the fact that we find deriviational affixes on the placeholder that are absent from the target, such as *schlumpf-ig-e* 'smurf-DER-F.SG' for *gut-e* 'good-F.SG' in (15). We assume that the derivational affixes used with the basic placeholder expression only cause a conversion, i.e., a change of part of speech or of grammatical gender, but they do not change the LID value.

In our analysis, the placeholder and the target agree in part of speech, valence, and content. This explains the use of derivational affixes on the placeholder: if the target is an adjective, such as *gut* 'good', it cannot directly combine with the nominal placeholder *Schlumpf*. Consequently, the placeholder first needs to combine with a derivational affixes like *-ig*. Similarly, the placeholder can impose constraints on the kinds of targets it combines with. We saw this with *you-know-WHAT* in (3a). This placeholder constraints its target to objects and is not compatible with persons.

We should briefly turn to the question whether we can relate m-placeholding to a more general morphological process. There is a similarity to the replacement of lexemes by others in taboos or euphemisms (Allan & Burridge, 1991).

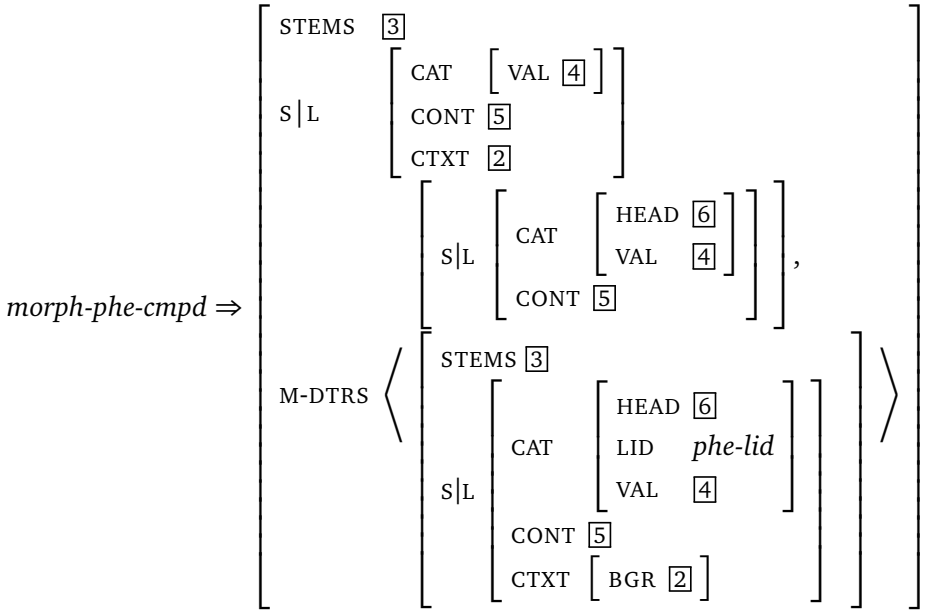

Figure 5: Constraint on m-placeholding

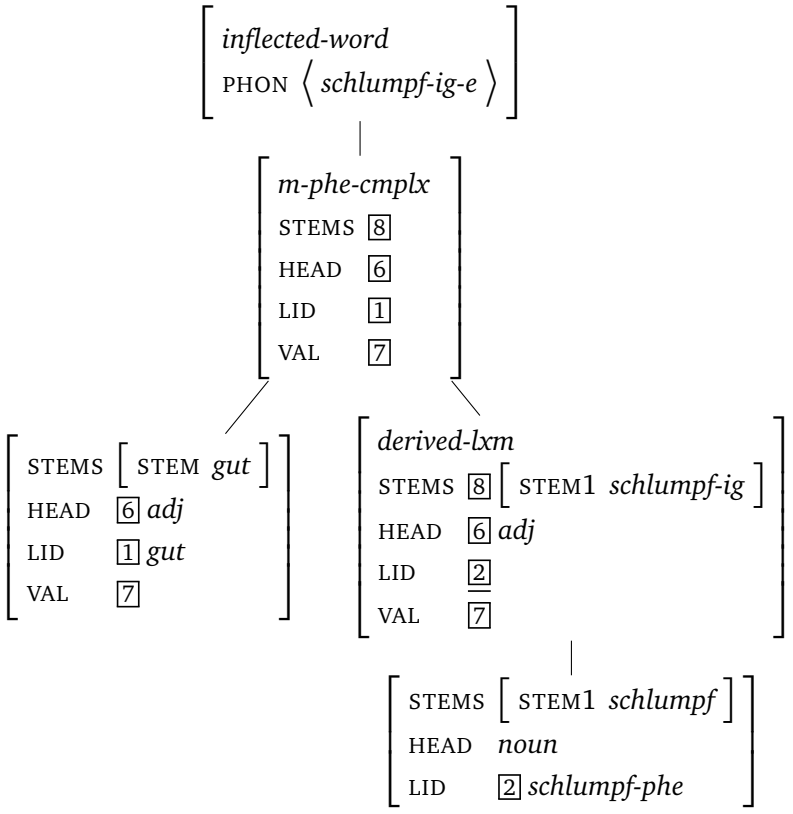

Figure 6: Derivation of the word *schlumpf-ig-e*

In German, the word *Scheiße* 'shit' is marked as vulgar. Replacing it with the phonologically similar word *Scheibe* 'disc' attenuates this marking. Allan & Burridge (1991, 15) refer to this type of lexeme replacement as *remodelling*. However, Allan & Burridge (1991) do not give examples in which such remodellings combine productively with derivational affixes.

Our analysis shows a certain parallel to the one in Cheung (2015): we assume a placeholder lexeme which does not have a lexically specified semantics. Cheung's operator **SHIFT** corresponds to our placeholder complex. Cheung (2015) needs to exclude free uses of the placeholder, i.e. uses of the placeholder not in the scope of **SHIFT**. Similarly, we need to exclude occurrences of placeholder lexemes outside placeholder complexes. This can be done with the constraint in (23). It determines that words cannot have an LID value of sort *phe-lid*. This constraint is modelled in analogy to the ban on the occurrence of non-canonical *synsem* objects in syntax.

(23) $word \Rightarrow \neg \left[\text{S}|\text{L}|\text{CAT}|\text{LID} \;\; phe\text{-}lid \right]$

All placeholder combinations inherit their LID value from the target – see Figure 2. Consequently, the constraint in (23) exclude the occurrence of targetless placeholders in sentences.[9]

A second distributional question that we would like to address is whether there may be recursive placeholding. At first sight, it seems reasonable to exclude spurious ambiguity. In the given modelling, it is possible to combine the noun *Wunsch* 'wish' with *schlumpf* in an m-placeholder complex. The result has a non-placeholder LID value. Consequently, it could combine recursively with yet another placeholder, even *Schlumpf*. To exclude this, we can require that a placeholder needs to make a recognizable contribution in a placeholder complex. As the main function of placeholders is use conditional, we can require that the use-conditional meaning of a placeholder, as collected in its BACKGROUND value, must not be included in the BACKGROUND value of the target.

This correctly excludes a redundant application of the same placeholder within one word. At the same time, it allows, in principle, the stacking of different placeholders.[10] It is conceivable that a placeholder word could be smurfed – though our database does not include such an example. This is illustrated in the constructed example in (24).

(24) Hast du den Dings-schlumpf gesehen?
have you the $\overline{\text{PHE-smurf}}$ seen?
'Did you see the WHAT-d'you-smurf-it?' (constructed)

The target of the smurfing is *Dingsbums*, which, itself is a placeholder expression. It could, for example, stand for the monster bird *Krakakass* (*Howli-*

[9]Depending on the available types of derivation and compounding, other morphological processes may also be restricted to non-placeholder lexemes.

[10]We are grateful to Ash Asudeh (p.c.) for bringing up this point.

bird in English). Consequently, it seems to be well motivated to require a non-redundant use-conditional contribution of placeholders.

5 Conclusion

In this paper, we provided a detailed look at smurfing in German Smurf comics. We classified smurfing as an instance of placeholding and developed a formal analysis. To our knowledge, such a placeholder analysis has not been proposed previously. This treatment can give an answer to the justified question of why smurfing should be of interest for formal linguistics, given that smurfing is an artistic invention. If our approach is on the right track, smurfing relies on the placeholding possibilities of a particular language. The only "invention" is in the choice of the placeholder lexeme and its use conditions. The smurfing complexes themselves fully rely on existing placeholder formation rules of the language. Support for this assumption comes from cross-linguistic differences in smurfing, as observed, for example, for English and Modern Greek in Chatzopoulos (2008). Smurfing can provide us with a rich database for placeholding as it is much more frequent than natural occurrences of placeholding.

Our approach combines the insights of previous work on placeholding and smurfing. The integration into a sign-based framework like HPSG makes it possible to combine semantic, pragmatic, and syntactic aspects. It is eventually this formal perspective that helped us identify two types of smurfing and placeholding. This separation helps solve problems of Chatzopoulos (2008), who only looked at phonological smurfing, and Cheung (2015), whose theory is suited for morphological placeholding, but less so for phonological placeholding.

There are at least two possible future directions to explore. First, we should explore smurfing and placeholding in other languages to test the hypothesis that smurfing builds on existing placeholding processes. Related to this, it is possible that there are other types of placeholding than phonological and morphological placeholding, which we identified for German.

Second, we can go beyond placeholding. We pointed out that phonological placeholding can be considered an instance of blending. Fradin (2015) describes blending as a systematic but extra-grammatical process. We reinterpreted this in treating blending as a grammatical process, which is, however, less constrained than compounding and has a potentially non-deterministic phonology. Similarly, we would like to explore the parallelism of morphological placeholding and other processes, such as remodelling in euphemisms.

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Multiple Question Fronting without Relational Constraints: An Analysis of Russian as a Basis for Cross-Linguistic Modeling

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Abstract

We present an analysis of multiple question fronting in a restricted variant of the HPSG formalism (DELPH-IN) where unification is the only natively defined operation. Analysing multiple fronting in this formalism is challenging, because it requires carefully handling list appends, something that HPSG analyses of question fronting heavily rely on. Our analysis uses the append list type to address this challenge. We focus the testing of our analysis on Russian, although we also integrate it into the Grammar Matrix customization system where it serves as a basis for cross-linguistic modeling. In this context, we discuss the relationship of our analysis to lexical threading and conclude that, while lexical threading has its advantages, modeling multiple extraction cross-linguistically is easier without the lexical threading assumption.

1 Introduction

We present an analysis of multiple constituent question fronting in HPSG. We take prototypical constituent (aka *wh-*) questions to be a conventional and direct way of asking for information (Idiatov, 2007, p.6):

(1) Who arrived? [eng]

(2) Who saw what? [eng]

(3) Who do you think arrived? [eng]

(4) Kto chto
who.NOM what.ACC
videl?
see.PST.3SG
'Who saw what?' [rus][1]

Constituent questions are a case of *long distance dependency* constructions (LDD) meaning that the question phrase can appear outside of the boundary of the clause to which it belongs (3).

Languages differ with respect to how many question phrases can front. Famously in Slavic languages, all question phrases may be fronted (4). Our goal is to systematically account for the data, presented in §2, where question words, one or more, may appear at the left edge of the clause. We do so by developing a Russian grammar fragment and integrating it into a cross-linguistic grammar engineering framework, the Grammar Matrix (Bender et al., 2002, 2010).

Our work is couched within the DELPH-IN joint reference formalism (JRF; Copestake, 2002a, p.227), a restrictive variant of HPSG developed to balance expressivity with computational efficiency. It does not allow *relational constraints* which stipulate the value of one feature to be some function of the value of one or more others (other than strict identity). Examples of relational constraints in other variants of HPSG include e.g. shuffle operators (Reape, 1994, p.271). The formalism furthermore requires that the number and order of daughters of each phrase

[1]Unless stated otherwise, the examples are constructed by the first author whose native language is Russian. The second author, a native speaker of English, vetted the English examples.

structure rule be fixed in the definition of the rule, precluding systems that separate immediate dominance from linear precedence (e.g. Engelkamp et al., 1992; Kathol, 1995). Thus, our analysis builds on Pollard & Sag 1994 and Ginzburg & Sag 2000 and exists in parallel with linearization-based accounts of multiple fronting such as Penn 1998.

The analysis is part of a larger project (Zamaraeva, forth) the goal of which is to add cross-linguistic support for constituent questions to the Grammar Matrix system (Bender et al., 2002, 2010). The system includes a questionnaire that elicits typological and lexical information about a language from a linguist-user and a back-end logic that customizes the Matrix core grammar types according to the elicited specifications. In addition to facilitating the development of grammars for practical applications, the system also can be used in linguistic hypothesis testing (Bierwisch 1963, p.163, Müller 1999, p.439, Bender et al. 2008; Fokkens 2014; Müller 2015). The resulting grammar fragments are suitable for both parsing and generation and map between surface strings and Minimal Recursion Semantics (MRS; Copestake et al., 2005) representations paired with HPSG feature structures. Integrating an analysis of question fronting into the system extends (i) the platform itself, so that other phenomena (such as relative clauses) can be modeled on top of and in interaction with our analysis; and (ii) the range of hypotheses which can be rigorously tested with the system, such as various combinations of single/multiple and optional/obligatory fronting. We present an analysis of multiple question fronting which represents a hypothesis that data such as Russian can be accounted for with multiple application of the *filler-gap* rule, without natively defined relational constraints.

One analysis that the Grammar Matrix has historically relied upon is *lexical threading*, a concept adapted from Bouma et al. 2001. Lexical threading posits that the length of and the order of elements on the SLASH list (a representation of the gaps in the sentence) is determined at the level of the lexical entry. This allows for an elegant analysis of the English *easy*-adjectives, in particular (Flickinger, 2000). However, we find that overall it complicates the analysis of multiple extraction in languages with flexible word order, particularly in interaction with other phenomena such as coordination. In this paper, we offer two alternatives for an analysis of multiple question fronting: with and without lexical threading. Current work has led to abandoning lexical threading assumptions in the Matrix in favor of a more readily cross-linguistic analysis without it.

The details on the DELPH-IN framework which will be helpful to understand our analysis constitute §3. In particular, we dedicate ample space to the *append-list* type, since, at the time of writing, the existing exposition of append lists is dense. Related work is summarized in §4. Two alternative analyses to account for the data in §2 are presented in §5. We explain how we tested the analyses in §6 and conclude with some thoughts on future work in §7.

2 Data: Multiple question fronting in Russian

Russian exhibits multiple question fronting (5), including in LDD constructions (6), although LDD *wh*-questions may be infrequent.[2] Multiple adjunct fronting appears either impossible (7) or rare, (8) being the only example we have found so far in the Russian National Corpus. Finally, fronting appears optional (9) and adjuncts can appear in any position with respect to the arguments (5), (10)–(11).

(5) *Kogda kto kogo* videl?
when who.NOM who.ACC see.PST
'When did which person saw which other person?' [rus]

(6) *Kogda kto kogo* ty tochno znaesh (chto) videl?
when who.NOM who.ACC 2SG for.sure know (that) see.PST
'When do you know for sure who saw whom?' ('What are the sets of times and persons such that one person saw another at a certain time, such that you know this set of facts for sure?') [rus]

(7) ??*Kogda gde* my kupili eti knigi?
when where 1PL.NOM buy.PAST.1PL this.PL.ACC book.PL.ACC
Intended: 'When [and] where did we buy these books?'

(8) DP. ru vypustilo infografiku obo vseh kvartirah
DP. ru publish.PAST infographic.ACC of all.PREP apartment.PREP
Dostoevskogo (*gde kogda* zhil, *gde chto* napisal)
Dostoyevsky.GEN (where when live.PAST, where what write.PAST)
'DP.ru published an infographic about all Dostoevsky's apartments (where he lived when, where he wrote what) [rus] (Oborin, 1987, RNC)

(9) Ty *gde* rabotaesh?
2SG where work.2SG
'Where do you work?' [rus][3]

(10) *Kto kogo kogda* videl?
who.NOM who.ACC when see.PST
'Who saw whom when?' [rus]

(11) *Kto kogda kogo* videl?
who.NOM when who.ACC see.PST
'Who saw whom when?' [rus]

[2]Some literature contends that they are not possible (Stepanov & Stateva, 2006) but the first author has observed herself producing such constructions, and we have found examples on the web, such as below:

(i) I kto ty dumaesh budet tretjim?
And who.NOM 2SG.NOM think.2SG.PRES be.3SG.FUT third.INSTR
'And who do you think will be the third [in the group]?' [rus] (Galikhin, 2017, loc.246)

[3]This very common Russian sentence was pointed out to the first author by John F. Bailyn in personal communication.

3 Background

This section briefly reviews the general approach to LDD in HPSG (§3.1); explains the specifics of the version of HPSG which we use here, paying special attention to *list* types which are used for non-local features (§3.2); and concludes with some characteristics of the Grammar Matrix system which are relevant to the presentation of our work (§3.3).

3.1 Non-local features and question fronting in HPSG

In GPSG (Gazdar, 1981) and subsequently HPSG (Pollard & Sag, 1994; Ginzburg & Sag, 2000), the analysis of long distance dependencies (LDD) relies on set-valued non-local features SLASH, QUE, and REL. The SLASH feature is used to account for constituents which do not appear in their usual place, and distinct features REL and QUE serve the separate analyses of relative clauses and constituent questions, respectively. For a fronted constituent question, the headed filler-gap rule licenses a phrase with two daughters, a head daughter with a nonempty SLASH value, and a "filler" daughter that has a nonempty QUE value and matches an element of that SLASH value in its LOCAL feature values. The nonempty SLASH value is ultimately licensed by an extraction rule.

Bouma et al. (2001) suggested an influential idea of SLASH amalgamation at the level of the lexical entry, a mechanism which here we call *lexical threading*. A lexical entry combines the NON-LOCAL features of its arguments; thus, a verb's SLASH is the union of the verb's subject's and complements' SLASH sets.[4] At the lexical level, the arguments' SLASH sets are underspecified, but they are specified once the arguments have been realized (either as a constituent or as a gap). The SLASH set is propagated via the head, without the need to stipulate any additional constraints at the level of phrase structure rules. What this means in context of extraction is that the extraction rules do not combine or extend SLASH sets but merely specify that a particular set is nonempty (for example, as discussed in §5.1, the subject extraction rule (26) constrains the SUBJ's SLASH list to be nonempty, by using the *gap* type (25)).

3.2 DELPH-IN Joint Reference Formalism

DELPH-IN (DEep Linguistic Processing with HPSG INitiative)[5] is an international consortium of researchers who are interested in engineering grammars using HPSG. Furthermore, the DELPH-IN Joint Reference Formalism (JRF; Copestake, 2002a, p.227) is a version of HPSG restricted to rely on only unification as a native operation, without relational constraints such as list reordering or counting. The

[4] Bouma et al. (2001) actually use a single DEPS feature instead of SUBJ and COMPS, and furthermore DEPS includes adjuncts, but the decision to use DEPS is separate from the decision to use lexical threading, and we will not discuss DEPS further here.

[5] http://www.delph-in.net

design of the DELPH-IN JRF aims to balance linguistic considerations with engineering ones. On the one hand, it should be possible to implement broad-coverage precision grammars, and on the other hand, it should be possible to effectively use such a grammar in practical applications. (For further discussion, see: Bender & Emerson, 2020, §3.2.)

For the purposes of the non-local features SLASH, QUE, and REL, the most important characteristic of the DELPH-IN JRF is the need to use lists instead of sets. While set-valued features are often used in HPSG, unification of sets is not guaranteed to produce a unique result (Pollard & Moshier, 1990; Moshier & Pollard, 1994). So that unification always produces a unique result, the DELPH-IN JRF does not allow set-valued features, which means that features like SLASH must be list-valued rather than set-valued. A list fixes the order of its elements, and combining two lists (*appending* them) must similarly fix the order.

3.2.1 Lists

Lists can be implemented in the DELPH-IN JRF as follows. The type *list* has two subtypes *nonempty-list* and *empty-list*. The *nonempty-list* type has two features, as shown in (12), where FIRST holds the first element of the list (which can be of any type, hence the most general type *top*), and REST holds the rest of the list. This allows a list to be specified recursively, following the REST feature multiple (0 or more) times. A fully specified list consists of *nonempty-list* multiple times, eventually terminating in an *empty-list*, illustrated in (13) for the list $\langle a,b \rangle$.

(12)
$$\begin{bmatrix} \textit{nonempty-list} \\ \text{FIRST} \quad \textit{top} \\ \text{REST} \quad \textit{list} \end{bmatrix}$$

(13)
$$\begin{bmatrix} \textit{nonempty-list} & \\ \text{FIRST} & a \\ \text{REST} & \begin{bmatrix} \textit{nonempty-list} & \\ \text{FIRST} & b \\ \text{REST} & \textit{empty-list} \end{bmatrix} \end{bmatrix}$$

3.2.2 Difference lists

As mentioned above, the only native operation in the DELPH-IN JRF is unification. However, in order to manipulate the SLASH feature, we would like to be able to append lists. Because a fully specified list terminates with an *empty-list*, the list cannot be extended further. One solution, which DELPH-IN grammars and the Grammar Matrix in particular have relied on so far, is to use *difference lists* (for an exposition, see: Copestake, 2002b, §4.3).[6][7] The basic idea is that, rather than working with fully specified lists, we can work with underspecified lists which are

[6] The concept of difference lists dates back to the early history logic programming (Geske & Goltz, 2007)

[7] Another solution is to use so-called *junk slots* (Aït-Kaci, 1984) (for a summary, see: Götz & Meurers, 1996). However, junk slots require disjunctive type definitions and fully sort-resolved feature structures, which are not part of the DELPH-IN JRF.

easier to append — in particular, lists which end with an underspecified *list*, rather than a *nonempty-list*. We will refer to such a list as a *open* list, in contrast to a fully specified *closed* list.

The *diff-list* type wraps an open list to make list appends convenient. It has two features, as shown in (14), where the value of LIST is intended to be an open list, and the value of LAST is intended to be the open end of that list. The definition in (14) doesn't enforce the fact that LAST should point to the end of the list in LIST, but for a difference list to be useful, this needs to be true. An example is given in (15), for a difference list $\langle !\, a,b\, ! \rangle$. Note that $\boxed{1}$ is of type *list*.

(14)
$$\begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \textit{list} \\ \text{LAST} & \textit{list} \end{bmatrix}$$

(15)
$$\begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \begin{bmatrix} \textit{nonempty-list} & \\ \text{FIRST} & a \\ \text{REST} & \begin{bmatrix} \textit{nonempty-list} & \\ \text{FIRST} & b \\ \text{REST} & \boxed{1}\textit{list} \end{bmatrix} \end{bmatrix} \\ \text{LAST} & \boxed{1} \end{bmatrix}$$

By keeping track of the notional end of the list, using the LAST feature, it is possible to append lists, as shown in (16), where the first *diff-list* is the append of the following two.

(16)
$$\begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \boxed{1} \\ \text{LAST} & \boxed{3} \end{bmatrix} \quad \begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \boxed{1} \\ \text{LAST} & \boxed{2} \end{bmatrix} \quad \begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \boxed{2} \\ \text{LAST} & \boxed{3} \end{bmatrix}$$

Difference lists make it possible to append lists, but there is an important downside, because the notional list is not the same as the value of the LIST feature. Notionally, the contents of a difference list start at LIST, and end at LAST (15). However, once a difference list has been appended to, the value of LAST is the next list, and so the LIST actually contains not only the notional list, but also all lists appended to it.

Because of this, there is an important but awkward division of labour between a difference list and the value of its LIST. The elements of the notional list are to be found in the value of LIST, but the length of the notional list is implicitly defined by the value of LAST. Because the length is only implicitly defined, it is not directly accessible, which means it is even difficult to check if the notional list is empty or nonempty. For this reason, Flickinger (2000) constrained SLASH lists to be of length of at most 1 (which is sufficient for almost all of English), and this constraint was inherited by the Grammar Matrix. However, to accommodate multiple question fronting, this constraint needs to be taken out. While it is possible to analyse multiple long-distance dependencies using difference lists

(Crysmann, 2015), working with difference lists is error-prone, and so we present an alternative that makes it easier to implement a grammar and maintain it.

3.2.3 Append lists

Emerson (2017, 2019) proposed *append lists*[8] as an alternative to difference lists, where there is no discrepancy between the notional list and the value of LIST. This makes working with append lists relatively straightforward.[9]

The *append-list* type wraps a list, using the LIST feature. This can be treated exactly as a normal list, and in particular it can be a closed list (unlike the *diff-list* type, where the list must be open to allow appends). The *append-list* type also has an APPEND feature, as shown in (17), which can be used to specify that this append list is the result of appending some other append lists.

(17)
$$\begin{bmatrix} \textit{append-list} & \\ \text{LIST} & \boxed{0}\textit{list} \\ \text{APPEND} & \begin{bmatrix} \textit{list-of-append-lists} & \\ \text{APPEND-RESULT} & \boxed{0} \end{bmatrix} \end{bmatrix}$$

Append lists are easy to use when writing a grammar, with an example shown in (18), where the first append list is the result of appending the second and third append lists. The first append list's LIST value is $\langle a,b,c \rangle$, with these elements being token-identical to the elements in the second and third lists. In comparison to (16), a grammarian does not need to worry about linking up the end of one list with the start of the next.

(18)
$$\begin{bmatrix} \textit{append-list} & \\ \text{APPEND} & \left\langle \boxed{1}, \boxed{2} \right\rangle \end{bmatrix} \quad \boxed{1}\begin{bmatrix} \textit{append-list} & \\ \text{LIST} & \left\langle a, b \right\rangle \end{bmatrix} \quad \boxed{2}\begin{bmatrix} \textit{append-list} & \\ \text{LIST} & \left\langle c \right\rangle \end{bmatrix}$$

The following two sections can be safely skipped by a reader uninterested in the technical details of how append lists are implemented.

3.2.3.1 The *list-of-append-lists* type

Closed lists cannot be directly appended, so the *list-of-append-lists* type first creates an open list from each closed list, and then appends the open lists in the same way as with difference lists. Just as the *list* type has two subtypes, we have the subtypes *nonempty-list-of-append-lists* and *empty-list-of-append-lists*, with constraints as defined in (19)–(20). Each list in a *list-of-append-lists* is unified with the type *list-with-diff-list*, which creates an open list (a *diff-list*) containing the

[8] Aguila-Multner & Crysmann (2018) refer to append lists as Emerson-style lists.

[9] In fact, append lists are a special case of a general procedure for expressing any (potentially Turing-complete) relational constraint as a type in the DELPH-IN JRF (Emerson, 2019).

same elements. The LAST of each diff-list is identified with the result of appending the remaining lists (compare (19) against the re-entrancy [2] in (16)). This continues recursively until the end of the list (*empty-list-of-append-lists*), where the result is simply an empty list.

(19)
$$\begin{bmatrix} \textit{nonempty-list-of-append-lists} & \\ \text{FIRST}|\text{LIST} & \begin{bmatrix} \textit{list-with-diff-list} & \\ \text{DIFF-LIST} & \begin{bmatrix} \textit{diff-list} & \\ \text{LIST} & \boxed{1} \\ \text{LAST} & \boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{REST} & \begin{bmatrix} \textit{list-of-append-lists} & \\ \text{APPEND-RESULT} & \boxed{2} \end{bmatrix} \\ \text{APPEND-RESULT} & \boxed{1} \end{bmatrix}$$

(20)
$$\begin{bmatrix} \textit{empty-list-of-append-lists} & \\ \text{APPEND-RESULT} & \textit{empty-list} \end{bmatrix}$$

3.2.3.2 The *list-with-diff-list* type

Finally, the *list-with-diff-list* type is a subtype of *list*, which creates a *diff-list* containing the same elements. The re-entrancy [1] ensures the new list contains the same elements, [2] ensures the new list is linked up correctly, [3] propagates the new open end of the list, and [4] creates the new open end of the list. This is shown graphically in Figure 1.

(21)
$$\begin{bmatrix} \textit{nonempty-list-with-diff-list} & \\ \text{FIRST} & \boxed{1} \\ \text{REST} & \begin{bmatrix} \textit{list-with-diff-list} & \\ \text{DIFF-LIST} & \begin{bmatrix} \text{LIST} & \boxed{2} \\ \text{LAST} & \boxed{3} \end{bmatrix} \end{bmatrix} \\ \text{DIFF-LIST} & \begin{bmatrix} \text{LIST} & \begin{bmatrix} \text{FIRST} & \boxed{1} \\ \text{REST} & \boxed{2} \end{bmatrix} \\ \text{LAST} & \boxed{3} \end{bmatrix} \end{bmatrix}$$

(22)
$$\begin{bmatrix} \textit{empty-list-with-diff-list} & \\ \text{DIFF-LIST} & \begin{bmatrix} \text{LIST} & \boxed{4} \\ \text{LAST} & \boxed{4} \end{bmatrix} \end{bmatrix}$$

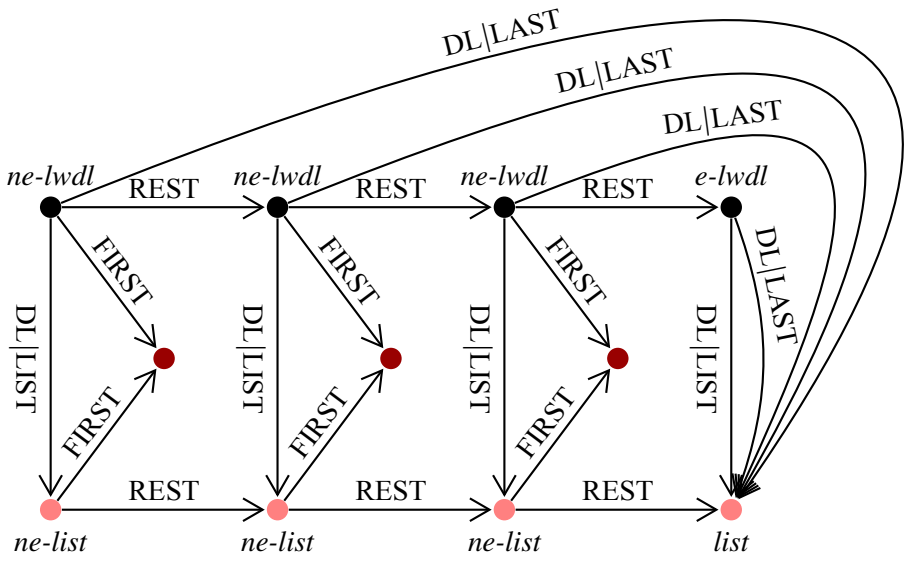


Figure 1: Example of creating an open list from a closed list. The closed list is at the top (black nodes), the open list is at the bottom (pink nodes), and the elements of the list are in the middle (red nodes). In type names, *e* and *ne* stand for *empty* and *nonempty*, and *lwdl* stands for *list-with-diff-list*; DL stands for DIFF-LIST.

3.3 Grammar Matrix

The Grammar Matrix (Bender et al., 2002, 2010) is a DELPH-IN-based grammar customization system. This means that the user fills out a web-based questionnaire with typological, lexical, and morphological information, and, based on the particular combination of such choices, the system applies a programmed customization logic to the right set of 'core' types[10] and outputs an implemented grammar fragment. Loaded into a parser such as the LKB system (Copestake, 2002b) or ACE (Crysmann & Packard, 2012), the grammars automatically map sentences to syntactic HPSG and semantic MRS structures.

The analysis presented here is part of the constituent questions library for the Grammar Matrix (Zamaraeva, forth). As such, we build on the existing analyses — on the lexical and phrasal types implemented in the Grammar Matrix, including those for word order, modification, argument extraction and filler-gap construction, reimplementing them with append lists instead of difference lists. As detailed in §5, most of the novelty we present here is in the space of adjunct extraction, along with the lexical threading-free version of the whole system which relies on append lists instead of difference lists.

Lexical threading was implemented in the Grammar Matrix like in the ERG

[10]Not to be confused with "core vs. periphery" as in Chomsky 1995. The Matrix core types were originally distilled from the English Resource Grammar (Flickinger, 2000), as part of Bender et al. 2002.

(Flickinger, 2000). Most lexical entries inherit from an appropriate supertype, depending on the length of the ARG-ST. For example, the Russian verb *videl* from (4) would be a subtype of *basic-two-arg-lex-item* lexical threading supertype (23).

(23)
$$\begin{bmatrix} \textit{basic-two-arg-lex-item} & & & & & & \\ \text{ARG-ST} & \left\langle \begin{bmatrix} \text{NON-LOCAL} & \begin{bmatrix} \text{SLASH} & \boxed{1} \\ \text{REL} & \boxed{2} \\ \text{QUE} & \boxed{3} \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{NON-LOCAL} & \begin{bmatrix} \text{SLASH} & \boxed{4} \\ \text{REL} & \boxed{5} \\ \text{QUE} & \boxed{6} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SYNSEM|NON-LOCAL} & \begin{bmatrix} \text{SLASH|APPEND} & \langle \boxed{1}, \boxed{4} \rangle \\ \text{REL|APPEND} & \langle \boxed{2}, \boxed{5} \rangle \\ \text{QUE|APPEND} & \langle \boxed{3}, \boxed{6} \rangle \end{bmatrix} \end{bmatrix}$$

The Grammar Matrix has a *regression testing* system associated with it so that any change to the core type hierarchy or to the customization logic is ensured to not have broken any of the previous analyses (Bender et al., 2007). Pairings of language specifications and test suites are stored along with the *gold* semantic representations in the MRS formalism. Each specification–test suite pair represents some language, real or artificial. At the time of writing this paper, there are 499 languages in the regression testing system, 56 of them natural languages. The size of the test suite ranges from 1 to 6165 sentences, the average being 34. The Matrix provided us with testing grounds for our analysis, as explained in §6.

To summarize, our analysis (§5) is situated within a framework which both dictates a number of design decisions (e.g. treating non-local features as lists) and provides us with means for testing our analysis of question fronting cross-linguistically and in interaction with other phenomena.

4 Related Work

As explained above, our analysis exists in parallel to analyses of Slavic languages which use non-DELPH-IN variants of HPSG, like Penn 1998, Przepiórkowski 1998, and Chaves & Paperno 2007, and so cannot be informed by them directly (e.g. we do not have at our disposal a natively defined *shuffle*-operator). In terms of data, we agree with Przepiórkowski (1998), *inter alia*, that any apparent restrictions on the order of extraction should probably not be explained solely on syntactic grounds (and as such we leave them out of scope in §2).

Several grammars of Slavic languages written in the DELPH-IN JRF exist (Avgustinova & Zhang, 2009; Osenova, 2010; Fokkens & Avgustinova, 2013) but none of them cover multiple questions. Osenova 2010 does include an account of single questions as well as relative clauses. Being a Matrix-based grammar, Osenova 2010 also ends up relaxing the non-local constraints inherited from the ERG so as to allow *wh*-words in non-fronted positions, as do we in §5.

Sag et al. (2003, p.452) describe multiple extraction as part of an analysis of English topicalization. To our knowledge, multiple extraction as suggested by Sag et al. (2003) was implemented in the DELPH-IN JRF once before, by

Crysmann (2015) for resumptive pronouns in Hausa. We implement Sag et al.'s (2003) analysis for interrogatives and make it available for automated Grammar Matrix-based implementation after testing it for cross-linguistic applicability.

Append lists are a relatively new concept, and our work is one of the first examples of how they can be used in DELPH-IN grammars. They were first used by Aguila-Multner & Crysmann (2018) for gender resolution in French.

5 Analysis

We would ultimately like to analyse the data in §2 including the flexible order of extracted elements (5), (10)–(11) using recursive application of one filler-gap rule. Append lists, as presented in §3.2.3, allow us to manipulate the SLASH, QUE, and REL features for this purpose.

We offer two alternative analyses, one with the lexical threading assumption and one without. Each option has its advantages and disadvantages, and while for the purposes of the Grammar Matrix we favor the second option, the first option could also serve as a basis for future work.

Lexical threading makes possible an elegant analysis of *easy*-adjectives (Sag et al. 2003, p.439, Flickinger 2000), which would otherwise require additional phrasal rules; the analysis of morphological marking of questions is also easier.[11] However, the combination of *append-list* and lexical threading makes the analysis of VP coordination more problematic.[12]

On the other hand, without lexical threading, we give a simple account of multiple extraction of arguments and adjuncts in the context of flexible word order and have no issues with coordination while also gaining in parsing speed, as multiple adjunct extraction rules are costly for the parser performance.[13]

Under both analyses, at the level of the filler-gap phrase, what is required is simply restating as (24) the version suggested by Sag et al. 2003, (p.448), except in terms of append lists (so, the value of SLASH has a feature LIST).

[11] Assuming lexical threading, one can simply state that a lexical rule applies to e.g. a QUE-nonempty verb, to distinguish lexical rules which participate in an interrogative paradigm. This is not possible without lexical threading because one needs to explicitly state non-local constraints on the verb's various arguments. See also: Zamaraeva (forth).

[12] With lexical threading, both the "input" and "output" of the append operation are accessible in the feature structure, e.g. by looking at a VP's SLASH and SUBJ|...SLASH. However, if adjuncts are not included in lexical threading, then there can be any number of append operations between the SLASH and SUBJ|...SLASH. Even if two coordinated VPs have compatible values for SLASH|LIST and SUBJ|...SLASH|LIST, they may have incompatible values for SLASH and SUBJ|...SLASH, which means that more care is required in writing coordination rules. This illustrates that, unlike with "true" relational constraints, unifying a feature structure with one of the types introduced in §3.2.3 permanently modifies that structure.

[13] On the Russian test described in §6 and with the LKB parser run on a MacBook Pro 2015 laptop with 16GB memory and 3.1GHz Intel Core i7 processor, Analysis 1 speed is 1.47 seconds per sentence on average; Analysis 2 speed is 0.39 seconds.

(24)
$$\begin{bmatrix} \textit{filler-gap-phrase} & \\ \text{SLASH} & \boxed{1} \\ \text{ARGS} & \left\langle \boxed{2}, \begin{bmatrix} \text{SLASH}|\text{LIST} & \begin{bmatrix} \text{FIRST} & \boxed{2} \\ \text{REST} & \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

The two analyses diverge at the level of extraction rules.

5.1 Analysis 1: With lexical threading

At the level of the argument extraction rules, assuming we use lexical threading, we can use the existing Grammar Matrix phrasal types carried over from the English Resource Grammar (Flickinger, 2000; Bender et al., 2002), except we use *append-lists* instead of *diff-lists* and we remove all constraints on the length of the NON-LOCAL lists. Note how (26)–(27) indeed do not even mention the NON-LOCAL features because the SLASH value will be handled by the lexical threading mechanism (23) and the type *gap* (25).

(25)
$$\begin{bmatrix} \textit{gap} & \\ \text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \boxed{1} \\ \text{NON-LOCAL}|\text{SLASH}|\text{LIST} & \left\langle \boxed{1} \right\rangle \end{bmatrix} \end{bmatrix}$$

(26)
$$\begin{bmatrix} \textit{extracted-subj-phrase} & \\ \text{SYNSEM} & \left[\text{LOCAL}|\text{CAT}|\text{VAL}|\text{SUBJ} \quad \langle\rangle \right] \\ \text{HEAD-DTR}|\text{SYNSEM} & \left[\text{LOCAL}|\text{CAT}|\text{VAL}|\text{SUBJ} \quad \left\langle \textit{gap} \right\rangle \right] \end{bmatrix}$$

(27)
$$\begin{bmatrix} \textit{extracted-comp-phrase} & \\ \text{SYNSEM} & \left[\text{LOCAL}|\text{CAT}|\text{VAL}|\text{COMPS} \quad \boxed{1} \right] \\ \text{HEAD-DTR}|\text{SYNSEM} & \left[\text{LOCAL}|\text{CAT}|\text{VAL}|\text{COMPS} \quad \begin{bmatrix} \text{FIRST} & \textit{gap} \\ \text{REST} & \boxed{1} \end{bmatrix} \right] \end{bmatrix}$$

The main novelty we present here pertains to adjunct extraction in the space of multiple question fronting. We introduce a small hierarchy as shown in Fig. 2 of adjunct extraction rules which allows extracting exactly one adjunct either before or after the arguments, to account for (5) and (10).

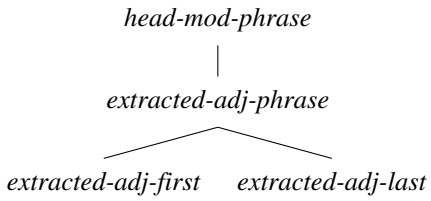


Figure 2: The adjunct extraction rules hierarchy

(28)
$$\begin{bmatrix} \textit{extracted-adj-last} \\ \text{SS} \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT}\vert\text{HEAD} & \boxed{1} \\ \text{CONT}\vert\text{HOOK} & \boxed{2} \end{bmatrix} \\ \text{NLOC}\vert\text{SLASH}\vert\text{APP} & \left\langle \boxed{3}, \begin{bmatrix} \text{LIST} & \left\langle \begin{bmatrix} \text{CAT}\vert\text{HEAD}\vert\text{MOD} & \left\langle \begin{bmatrix} \text{LOC} & \begin{bmatrix} \textit{intersective-mod} \\ \text{CAT}\vert\text{HEAD} \quad \boxed{1} \\ \text{CONT}\vert\text{HOOK} \quad \boxed{2} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix} \right\rangle \\ \text{MODIFIED} & \textit{hasmod} \end{bmatrix} \\ \text{HDR}\vert\text{SS} \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT}\vert\text{HEAD} & \boxed{1} \\ \text{CONT}\vert\text{HOOK} & \boxed{2} \end{bmatrix} \\ \text{NLOC}\vert\text{SLASH} & \boxed{3} \\ \text{MODIFIED} & \textit{notmod} \end{bmatrix} \end{bmatrix}$$

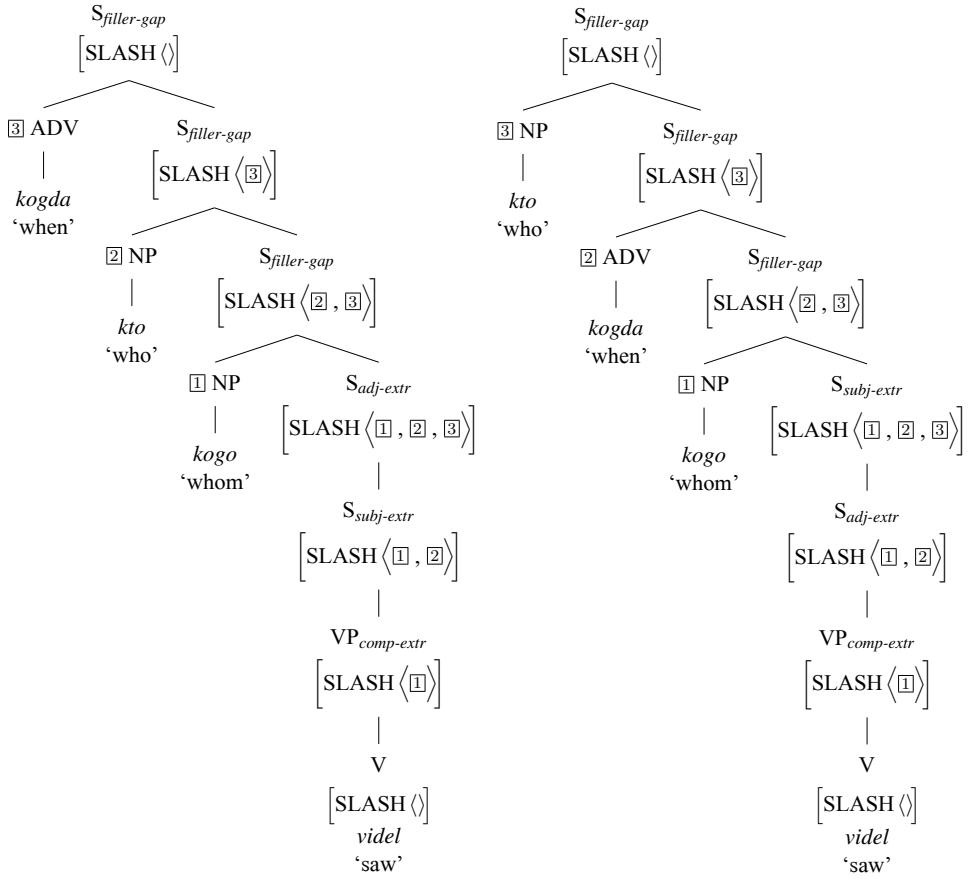
Example (28)[14] shows the rule that is used to extract an adjunct after any arguments (accounting for (5)). Following Flickinger (2000), we block multiple adjunct extraction (7) by the MODIFIED feature and a hierarchy of mutually exclusive types (e.g. *hasmod* vs. *notmod*) appropriate for it.[15] Because SLASH is of type *append-list*, there are no issues with placing the extracted adjunct at the specified position on the mother's SLASH. This works under the lexical threading analysis where the order of the arguments put on the SLASH list is determined at the level of the lexical entry, even before any arguments were actually extracted, but any extracted adjuncts have to be inserted at some specific position (see §3.1).

5.2 Analysis 2: No lexical threading

Without lexical threading, additional phrase structure rules may be required for the English *easy*-adjectives, and modeling interrogative morphology is less straightforward. However, the analysis of extraction becomes simpler, as we may use (28) as the sole adjunct extraction rule. In fact, all extraction rules: subject, complement, and adjunct, append the *gap* element to the existing SLASH list of the head daughter. Without lexical threading, the SLASH list can actually be constructed

[14] Abbreviations: SS: SYNSEM, LOC: LOCAL; NLOC: NON-LOCAL; APP: APPEND; HDR: HEAD-DTR

[15] Removing the MODIFIED constraint would allow both (7) and (8), and then the limit on how many adjuncts can be extracted would have to be put either formally or through constraints on the parsing algorithm (the latter could in principle be seen as a way of modeling processing constraints).



(a) The extracted adjunct is in front of the extracted arguments, as in example (5).

(b) The extracted adjunct is between the extracted arguments, as in example (11).

Figure 3: Analysis 2, for extracted adjuncts and arguments in Russian.

based on the order of the application of extraction rules. In particular, compare Fig. 3a to Fig. 3b, for sentences (5) and (11). It is remarkably easy under Analysis 2 to have an extracted adjunct intervene between the two extracted arguments. With lexical threading, we would need to complicate Analysis 1 to license (11) with additional extraction rules to insert an element into the middle of the list.

Under Analysis 2, we can no longer reuse the Grammar Matrix core as it was originally designed (but we expect the revisions to facilitate future Matrix development). We replace lexical supertypes like (23) by (29):

(29)
$$\begin{bmatrix} \textit{non-local-none-lex-item} & \\ \text{SYNSEM}|\text{NON-LOCAL} & \begin{bmatrix} \text{SLASH}|\text{LIST} & \langle\rangle \\ \text{REL}|\text{LIST} & \langle\rangle \\ \text{QUE}|\text{LIST} & \langle\rangle \end{bmatrix} \end{bmatrix}$$

The supertype (29) states that all NON-LOCAL features are empty and is used for most lexical entries. The phrasal types such as head-subject and head-complement no longer rely on lexical threading and need to explicitly append the NON-LOCAL features of the daughters. We posit the supertypes (30)–(31) and have most phrasal rules inherit from one of them. Of course, extraction rules and the filler-gap rule do not inherit from these types; instead they either append an item to the existing SLASH list (28), (32)–(33) or subtract an item from it (24).

(30)
$$\begin{bmatrix} \textit{binary-non-local-phrase} & \\ \text{ARGS} & \left\langle \begin{bmatrix} \text{SS}|\text{NLOC} & \begin{bmatrix} \text{SLASH} & \boxed{1} \\ \text{REL} & \boxed{2} \\ \text{QUE} & \boxed{3} \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{SS}|\text{NLOC} & \begin{bmatrix} \text{SLASH} & \boxed{4} \\ \text{REL} & \boxed{5} \\ \text{QUE} & \boxed{6} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SS}|\text{NLOC} & \begin{bmatrix} \text{SLASH}|\text{APPEND} & \left\langle \boxed{1}, \boxed{4} \right\rangle \\ \text{REL}|\text{APPEND} & \left\langle \boxed{2}, \boxed{5} \right\rangle \\ \text{QUE}|\text{APPEND} & \left\langle \boxed{3}, \boxed{6} \right\rangle \end{bmatrix} \end{bmatrix}$$

(31)
$$\begin{bmatrix} \textit{unary-non-local-phrase} & \\ \text{DTR}|\text{SYNSEM}|\text{NON-LOCAL} & \begin{bmatrix} \text{SLASH} & \boxed{1} \\ \text{REL} & \boxed{2} \\ \text{QUE} & \boxed{3} \end{bmatrix} \\ \text{SYNSEM}|\text{NON-LOCAL} & \begin{bmatrix} \text{SLASH} & \boxed{1} \\ \text{REL} & \boxed{2} \\ \text{QUE} & \boxed{3} \end{bmatrix} \end{bmatrix}$$

(32)
$$\begin{bmatrix} \textit{extracted-subj-phrase} & \\ \text{SYNSEM} & \begin{bmatrix} \text{LOCAL}|\text{CAT}|\text{VAL}|\text{SUBJ} & \langle\rangle \\ \text{NON-LOCAL}|\text{SLASH}|\text{APPEND} & \left\langle \boxed{0}, \begin{bmatrix} \text{LIST} \left\langle \boxed{1} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{HEAD-DTR}|\text{SYNSEM} & \begin{bmatrix} \text{LOCAL}|\text{CAT}|\text{VAL}|\text{SUBJ} & \left\langle \begin{bmatrix} \textit{gap} \\ \text{LOCAL} \quad \boxed{1} \end{bmatrix} \right\rangle \\ \text{NON-LOCAL}|\text{SLASH} & \boxed{0} \end{bmatrix} \end{bmatrix}$$

(33)
$$\begin{bmatrix} \textit{extracted-comp-phrase} & \\ \text{SYNSEM} & \begin{bmatrix} \text{LOCAL}|\text{CAT}|\text{VAL}|\text{COMPS} & \boxed{0} \\ \text{NON-LOCAL}|\text{SLASH}|\text{APPEND} & \left\langle \boxed{1}, \begin{bmatrix} \text{LIST} \left\langle \boxed{2} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{HEAD-DTR}|\text{SYNSEM} & \begin{bmatrix} \text{LOCAL}|\text{CAT}|\text{VAL}|\text{COMPS} & \begin{bmatrix} \text{FIRST} & \begin{bmatrix} \textit{gap} \\ \text{LOCAL} \quad \boxed{2} \end{bmatrix} \\ \text{REST} & \boxed{0} \end{bmatrix} \\ \text{NON-LOCAL}|\text{SLASH} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

6 Testing

Analysis 2 is integrated in the Grammar Matrix and as such is in principle tested by all of the regression tests that are currently there.[16] This means in particular that any new types (28) or changes to any old types (24) must not result in any undesirable changes with respect to all the previous analyses, and the system still produces correctly behaving grammars for all previously analysed languages. There are currently 499 tests in the Grammar Matrix (including the Russian test discussed here).[17] Some of them rely on analyses actively involving NON-LOCAL features, particularly the 44 information structure typology tests added by Song (2014). We ensure that integrating our analysis of question fronting into the system does not negatively affect any of the existing analyses; all of the tests pass. Other tests do not always target NON-LOCAL features, in which case they "only" test that the new analyses presented here do not interfere with other analyses in unexpected ways — a crucial methodological point, in our view.

The constituent questions Matrix library (Zamaraeva, forth) adds 26 test suites, 5 of them for natural languages.[18] The results for three of them are shown in Table 1.[19] Russian has multiple fronting while English has strictly single fronting, (so for English, the length of SLASH in the filler-gap rule is restricted in the customization stage). Japanese is an *in situ* language and in that case we test that our extraction and filler-gap rules do not conflict with the *in situ* analysis.

Language	Family	Gram./ungram.	cov%	overgen%	avg. ambig	*wh*-strategy
Russian	Indo-European	186/87	78.5	6.9	1.76	Multiple fronting
English	Indo-European	27/23	100	0	1.11	Single fronting
Japanese	Japonic	7/3	100	0	1.14	*In situ*

Table 1: Results for languages the analyses for which rely on SLASH

The Russian test suite includes not only various patterns of constituent and polar questions, including embedded questions and long distance dependencies, but also simple and complex propositions. The lack of coverage is primarily due

[16] Analysis 1 was also tested and deemed less preferable for the Grammar Matrix, though it could be preferable for e.g. a separate grammar of English or a language relying on complex morphology for interrogative marking, such as Yukaghir (Maslova, 2003, p.152). Under Analysis 1, the results are the same for English and Japanese as in Table 1, but for Russian the coverage is smaller (78.0%) because of the VP coordination issue mentioned in §5 and because sentences like (11) are not covered; the average number of analyses per sentence is larger (2.03) due to the multiple adjunct extraction rules which may apply spuriously, and the overgeneration is the same.

[17] The code with the complete analysis, all the test suites, and the testing software can be downloaded from: https://github.com/delph-in/matrix/releases/tag/HPSG2020-Zamaraeva-Emerson.

[18] More tests for natural languages will be added in the final evaluation stage of Zamaraeva forth.

[19] Table legend. *Gram./ungram.:* The number of grammatical and ungrammatical items in the test suite; *cov%:* The percentage of correctly parsed grammatical sentences; *overgen%:* The percentage of admitted ungrammatical sentences; *avg. ambig.:* Average number of trees per sentence (ambiguity can be both meaningful and spurious).

to interacting phenomena discussed in detail in Zamaraeva forth. The fact that we analysed question fronting as truly optional, allowing *wh*- words in declarative rules such as adjunct-head to accommodate *wh*-words in positions like in (9), accounts for most of the spurious ambiguity and for some of the overgeneration, including sentences like (7). This points us in the direction of reanalysing optional fronting in terms of information structure in the future, as discussed briefly below.

7 Future work

Easy modeling of flexible order in multiple extraction allows us to extend the existing analyses of information structure (Song, 2014) to model optional question fronting (9). Instead of allowing QUE-nonempty elements (*wh*-words) in declarative rules such as subject-head or adjunct-head, we can extract non-*wh*-arguments and then utilize topicalization-type filler-gap rules in the same derivation with the *wh*-question phrase.[20] This way background information (the personal pronoun in (9)) or contrastive topic or focus may appear in the front of the *wh-word* but without spurious derivations which arise from allowing QUE-nonempty elements in declarative rules and require additional features to avoid them. Such an analysis will require multiple additional filler-gap constructions, head initial and head final, to account for the plethora of possible information structures but we do not expect it to complicate the *wh*-fronting analysis which we presented here.

8 Conclusion

We showed that multiple extraction and fronting can be straightforwardly implemented in the DELPH-IN version of HPSG, including with flexible order, allowing us to account for Russian *wh*-questions. Unification remains the only natively defined operation under this analysis, and the new type *append-list* allows for easier grammar writing (compared to the previous practice of using difference lists). We test the analysis cross-linguistically using the Grammar Matrix framework and conclude that while it is possible to implement multiple extraction and fronting under the assumption that lexical entries amalgamate their arguments' non-local features (lexical threading), for the purposes of the multilingual Grammar Matrix project, we prefer an analysis which rejects lexical threading in favor of more flexibility in constructing SLASH lists. Information structure in clauses which appear to exhibit optional question fronting is one area where future work could focus.

[20] In the Minimalist tradition, it has long been suggested that examples like (9) be analysed as multiple movement (Bailyn, 2005).

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