# Proceedings of the 29th International Conference on Head-Driven Phrase Structure Grammar

Online (Nagoya/Tokyo)

Stefan Müller, Elodie Winckel (Editors)

2022

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# Contents

# Editor's note

The 29th International Conference on Head-Driven Phrase Structure Grammar (2022) took place as an online conference and was organized by David Y. Oshima (Nagoya University) and Yusuke Kubota (National Institute for Japanese Language and Linguistics).

The conference featured 2 invited talks and 13 papers selected by the program committee (Anne Abeillé, Sascha Bargmann, Emily M. Bender, Felix Bildhauer, Olivier Bonami, Francis Bond, Gosse Bouma, Rui Chaves, Berthold Crysmann, Thomas Hoffmann, Anke Holler, Jong-Bok Kim, Jean-Pierre Koenig, Yusuke Kubota, Andy Lücking, Antonio Machicao Y Priemer, Nurit Melnik, Stefan Müller, Tsuneko Nakazawa, Petya Osenova, David Yoshikazu Oshima, Rainer Osswald, Gerald Penn, Frank Richter, Manfred Sailer, Stephen Wechsler, Elodie Winckel (chair), Shuichi Yatabe, Eun-Jung Yoo, Olga Zamaraeva). There was a workshop on Computational Linguistics on East Asian Languages with one invited speaker and four regular papers.

We want to thank the program committee for putting these nice programs 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 are published by the University Library of Goethe-Universität, Frankfurt am Main.

The proceedings include all the papers of the conference and workshop except the ones by Francis Bond, Seiko Fujii, Petter Haugereid, Yusuke Kubota & Robert Levine, Nurit Melnik, Koji Mineshima, Giuseppe Samo & Xu Chen. Some of these papers will be published in journals.

# Part I
# Contributions to the Main Conference

# Non-*wh* relatives in English and Kurdish: Constraints on grammar and use

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**Abstract**

The paper looks at constraints on non-*wh* relatives in Sōrānī Kurdish (Iranian) and English (Germanic). We argue that some of them are grammatical, whereas others introduce social meaning. We present a basic, lexicalist syntactic analysis and expand it with social meaning constraints. We propose that classical sociolinguistic variables have the status of conventional implicatures and the overall assessment of a style is treated as a particularized conversational implicature.

# 1 Introduction

Sōrānī Kurdish (Iranian) has two formal types of relative clauses: bare relatives and relatives introduced by a relativizer, *ka*. This situation is analogous to what we find with non-*wh* relatives in English (Germanic), see (1).[1]

(1) a. Ali kətebakay (ka) Rezān nūsīwyetī deyxwenetawa
Ali book.DEF.EZ (that) Rezān wrote.3SG read.3SG
b. Ali read the book (that) Rezān wrote.

In both languages, the variation between the two types is subject to grammatical constraints, but also to regional variation, register variation, and prescriptive constraints, i.e., the choice between them carries *social meaning*.

We will first describe the situation in Sōrānī Kurdish (Section 2) and then look at the English data in Section 3. We will briefly look at previous HPSG work on relative clauses and sketch our own syntactic analysis in Section 4. Similarly, Section 5 contains a short review of previous work on social meaning in HPSG, followed by our own proposal. We end with a conclusion in Section 6.

# 2 Sōrānī relative clauses

Sōrānī is also known as Central Kurdish (MacKenzie, 1961). We will look at two varieties of Sōrānī: Mukrī and Səlemānī. Mukrī is a regional minority language in Northwest Iran, and, as such, in contact with Persian (Iranian) as superstrate language (Asadpour, 2021). Səlemānī is a regional majority language in Iraqi-Kurdistan and in contact with Iraqi Arabic (Semitic).

Sōrānī has no *wh* relatives, but bare relatives and relatives introduced by a non-inflecting particle *ka* (regionally: *ke*/*we*). Hassan (2021, Chapter 7) shows

[†]We would like to thank the reviewers and the audience for their comments, in particular Bob Borsley, Antonio Machicao y Priemer, and David Y. Oshima. Linda Kremer and Pascal Hohmann-Huet were of tremendous help with getting access to the literature. All errors are ours. Hiwa Asadpour was supported by the DAAD-JSPS grant PE21779 during his work on this paper.

[1]We follow the Leipzig glossing rules (https://www.eva.mpg.de/lingua/resources/glossing-rules.php). The following abbreviations appear in our glossings: COP copula, DEF definite, EZ Ezafe, IPFV imperfective, PL plural, PRS present tense, PVB preverb, SG singular.

that there is a striking similarity between Sōrānī and English concerning the alternation of embedded bare and *ka/that* clauses. As indicated above in (1), both *ka* and *that* are optional with restrictive relative clauses. Example (2) shows that both function words are also possible for declarative complement clauses. In (3) we see that the bare form is excluded in non-restrictive relatives. Finally, as indicated in (4), only the *ka/that*-marked form can be extraposed.

(2) Ali bīr dakā (ka) Rezān bərduyatyawa
Ali think does (that) Rezān won.3SG
'Ali thinks (that) Rezan won.'

(3) Ānnā, *(ka) kəč=ī mən=a, lera=ya
Anna (that) daughter=EZ I=is here=is
'Anna, *(who) is my daughter, is here.'

(4) šuša-ka šəkā *(ka) to kərību=t bo=m.
glass-DEF broke.3SG (that) you bought=2SG for=1SG
'The bottle broke *(that) you bought for me.'

Kim (2010) claims that *ka* is preferred when the relativized element is the local subject of the relative clause. However, Saady (2020) and Hassan (2021) find examples like (5) natural.

(5) aw šofer=a=y (ka) ba hewāšī otōmbel
DEM driver=DEM=EZ (that) with slowly automobile
le-da-xuř-et səłāmat=a.
PVB-IPFV-drive-3.SG safe=COP.PRS.3.SG
'The driver who drives cars slowly is safe.' (Saady (2020, 114), transliteration and glosses adapted from Hassan (2021, 216))

Hiwa Asadpour, a native speaker of Mukrī, conducted two informal interviews with Mukrī and Səlemānī speakers to explore the acceptability of bare or *ka*-marked restrictive relatives. He conducted the first interview with 40 Mukrī speakers and 20 Səlemānī speakers. He wrote down the relative clauses that they produced and asked them spontaneously whether they considered the bare form acceptable in formal and/or colloquial contexts. The results are given in Table 1. Səlemānī speakers generally reject bare relatives in formal situations, while Mukrī speakers are less categorical. Mukrī speakers accept bare relatives in colloquial situations. While Səlemānī speakers largely reject bare relatives in colloquial situations, their acceptance increases compared to formal situations.

For the second interview, Hiwa Asadpour isolated some of the spontaneously produced restrictive relative clauses from the first interviews and discussed them explicitly with ten Mukrī and ten Səlemānī informants. As before, all informants considered *ka* relatives adequate in both formal and colloquial settings. Their assessment of bare relatives is given in Table 2. The second interview

| | formal | | colloquial | |
|---|---|---|---|---|
| | Mukrī | Səlemānī | Mukrī | Səlemānī |
| bare? | ($N = 40$) | ($N = 20$) | ($N = 40$) | ($N = 20$) |
| ✓ | 3 (7.5%) | 0 (0%) | 39 (97.5%) | 5 (25%) |
| ✗ | 37 (92.5%) | 20 (100%) | 1 (2.5%) | 15 (75%) |

Table 1: Acceptability of bare relatives, assessed in passim

| | formal | | colloquial | |
|---|---|---|---|---|
| | Mukrī | Səlemānī | Mukrī | Səlemānī |
| bare? | ($N = 10$) | ($N = 10$) | ($N = 10$) | ($N = 10$) |
| ✓ | 3 (30%) | 0 (0%) | 5 (50%) | 3 (30%) |
| ✗ | 7 (70%) | 10 (100%) | 5 (50%) | 7 (70%) |

Table 2: Acceptability of bare relatives in explicit metalinguistic discussion

confirms the results of the first: A clear majority of our Mukrī informants prefer *ka* relatives in formal situations, but half of them are willing to accept bare relatives in colloquial situations. The Səlemānī speakers categorically rejected bare relatives in formal situations, but are more accepting in colloquial situations.

It should be noted that the results of these interviews should not be taken to mean that Səlemānī speakers generally reject bare relatives. Rather, the explicit metalinguistic nature of the interview can be taken as an indication that the judgments were given in the light of a prescriptive perspective. The fact that the researcher himself is a Mukrī speaker might have influenced Səlemānī speakers to give even more prescriptively influenced assessments.

Hiwa Asadpour's small scale informal interviews show that *ka* relatives are considered the prescriptively preferred form in both varieties, and that the use of bare relatives signals a colloquial way of speaking. Səlemānī speakers seem to have an additional constraint that bare relatives should be avoided in situations in which "proper," "correct" language use is considered adequate.

## 3 English bare and *that* relatives

English has *wh* relatives in addition to bare and *that* relatives. However, only *wh* relatives allow for complex relative constituents, see (6).[2]

[2]The only exception seems to be a possessive use of *that* as in "*the pencil* [*that's lead is broken*]" (Sag, 1997, 463). We lack precise data on the distribution of possessive relative *that's*. We tentatively propose here that it is a separate lexical element that is a determiner and marked as highly non-standard.

(6) the student [to whom/*to that I talked] ...

English *that* relatives can occur with a wide variety of antecedents and, in most constellations, there is free variation between the bare and the *that* form. As in Sōrānī, bare relatives are excluded in extraposed position, see example (4), and English also categorically excludes bare non-restrictive relatives, see Fabb (1990, 72) or Huddleston & Pullum (2002, 1056). Based on these similarities, Hassan (2021) pursues a parallel analysis for Sōrānī relatives and English non-*wh* relatives. Another similarity between the two languages is that the bare form is usually associated with more casual, informal speech situations and simpler/shorter sentences – see, for example, Finegan & Biber (1994) or Huddleston & Pullum (2002, 1056). Finegan & Biber (1994) characterize the bare form as *implicit*, whereas the *that* form is called *explicit* as it overtly marks a clause boundary. They argue that implicit forms are typical for colloquial, spontaneous, and spoken language use.

Many formal descriptions implement two additional restrictions on English relatives, which are absent from Sōrānī. First, *that* relatives are banned from non-restrictive uses, for example in the analysis in Arnold (2004). Second, bare relatives are excluded when the relativized element is the local subject of the relative clause – see, for example the analysis in Pollard & Sag (1994). We will argue that in both cases, we are dealing with extra-grammatical constraints, i.e., that the "banned" cases exist, but are associated with a social meaning that is not compatible with the variety often assumed as the basis for formal linguistic studies. We will start by looking at non-restrictive relatives.

The status of non-restrictive *that* relatives is not fully clear in the literature. Quirk et al. (1972, 872) say they occur "occasionally," providing example (7).

(7) I looked at Mary's sad face, that I had once so passionately admired.

Additional authentic instances of non-restrictive *that* relatives are given by Huddleston & Pullum (2002, 1052), Carey (2013), and Hassan (2021, Section 6.2). Hassan (2021, Section 6.3) presents a small-scale questionnaire study on the naturalness of some of these cases, such as example (8). It was judged as "natural" by the majority of her informants (Hassan, 2021, 181). Sentence (8) contains a restrictive and a non-restrictive *that* relative. We mark the latter in (8). This marking was, of course, not in the questionnaires. Taken together, these various sources confirm that non-restrictive *that* relatives are part of the English relative clause system.

(8) The big topic this week was this video that Mitt Romney uploaded on YouTube, [**that**, according to reliable sources, had been filmed during a private party] ... (COCA, Davies (2008–2017))

Nonetheless, a description of English relative clauses needs to capture the fact that speakers (and linguists) tend to exclude and/or avoid non-restrictive *that* relatives. For example, Biber (2010, 616) found no instance of them

in British and American news corpora. Before doing her questionnaire study, Shene Hassan posted some of her example sentences in a facebook group to get acceptability intuitions from native speakers. The majority of answers included very explicit prescriptive comments, advising her strongly against the use of such constructions. This shows that non-restrictive *that* relatives are seen as indications of a non-prescriptive language use.

Let us turn to the second constraint mentioned above. While excluded prescriptively, bare subject relative clauses appear to be grammatical in some colloquial varieties. Huddleston & Pullum (2002, 1055) provide the examples in (9), though they indicate them as not generally acceptable, and they consider (9c) as more non-standard than the other two examples. Pollard & Sag (1994, 222: fn. 6, and 350: fn. 7) and Arnold & Godard (2021, 632: fn. 45) acknowledge the existence of bare relatives with local subject gaps in some varieties of English and propose different constraints for those varieties.

(9) a. ? It was my father [did most of the talking].
b. ? There is someone at the door [wants to talk to you].
c. ?? Anyone [wants this] can have it.

In this paper, we will assume that, just like Sōrānī, the grammar of English allows for bare relatives with relativized local subjects in principle. However, such cases carry a strong social meaning – as highly colloquial and, probably in addition, as regional. This social meaning makes them inappropriate for situations requiring a more general form of English.

To sum up, bare relatives are excluded from extraposed uses and from non-restrictive uses. In other cases, they are considered an "implicit" form compared to *that* relatives. Bare relatives with local subject gaps are strongly marked as specific to a variety that is not generally used. The grammar allows for *that* relatives throughout, but non-restrictive uses are prescriptively banned.

# 4 The syntax of non-*wh* relatives

In this short paper, we cannot possibly do justice to the rich research on relative clauses in HPSG, let alone in formal grammar. We can merely try to justify some of the analytic decisions that we have made and refer to Arnold & Godard (2021) for an overview of HPSG approaches to relative clauses and to Hassan (2021) for a more in-dept presentation of our analysis. Consequently, we will only provide some pointers to the previous literature in Section 4.1 and sketch our own syntactic analysis in Section 4.2.

## 4.1 Previous HPSG analyses of non-*wh* relatives

Taghvaipour (2004, 2005) analyzes restrictive relative clauses in Persian. Like Sōrānī, Persian does not have *wh* relatives, but the non-inflecting function words

*ka* in relative clauses. Taghvaipour treats *ka* as a relativizer that acts as the head of a relative clause. While Taghvaipour (2005) only considers relatives with an overt relativizer, there is a regional register variation with respect to the presence or absence of the relativizer (Majidi & Naghzguy-Kohan, 2020). It is unclear if Taghvaipour would have assumed an empty relativizer for bare relatives. We will follow Taghvaipour's basic analysis in our treatment of Sōrānī, but add a phonologically empty relativizer for bare relatives. We acknowledge that a constructional variant might be equally conceivable, as proposed for English in Sag (1997) or Hoffmann (2010).

Matters are more complex in English because as it has *wh* relatives in addition to bare and *that* relatives. Some basic research questions include: (i) Do all non-*wh* relatives pattern alike or are some more closely related to *wh* relatives? (ii) How uniform can or should an analysis be and which tools should be employed (empty heads, special phrasal constructions, ...)?

As to the first question, Hoffmann (2010, Sections 5.1, 5.2) shows experimentally that *that* relatives pattern with bare relatives rather than with *wh* relatives: While pied piping is excluded for both relative *who* and relative *that* (*the student to whom/ *to who/ *to that/ *to* ∅ *I talked*), the judgements for P+*that* and P+∅ are like those for ungrammatical sentences, whereas P+*who* sequences are judged significantly more acceptable. Hoffmann (2010, 250) proposes that pied piping is not a grammatical option for bare and *that* relatives, but that pied piping with relative *who* is just stylistically marked. This suggests that non-*wh* relatives form a natural class, contrasting with *wh* relatives.

The second question can, probably, not be answered on purely empirical grounds. Pollard & Sag (1994, Chapter 5) present an HPSG analysis that uses a number of different empty heads for English relatives. They distinguish three types of English non-*wh* relatives: bare relatives (which exclude bare relatives with relativized local subjects), *that* relatives with a relativized local subject and other *that* relatives. In their approach, *that* is a relative pronoun in local subject relatives, but a complementizer in other cases. This heterogeneous analysis is not very appealing (Arnold & Godard, 2021, 621: fn. 35). Sag (1997) and Hoffmann (2010) pursue a constructional approach – with all occurrences of relative *that* being analyzed as a pronoun by Sag (1997, Section 5.4), and as a relativizer in Hoffmann (2010, 251–252). In both constructional approaches, special constructions are postulated for relative clauses with relativized local subjects. This might, again, be considered an undesirable aspect of the analyses – in particular since Levine & Hukari (2006) show that there is no need for such a fundamental distinction between the extraction of a local subject and the extraction of other constituents of a clause.

Local subjects behave in a special way in English and other languages, also outside the domain of relative clauses or unbounded dependencies in general. In particular, the information on the subject of a verb is sometimes needed by an element selecting a fully saturated projection of that verb. Höhle (2019, 558–559) introduces a head feature SMOR (for "subject morphology") to identify

the local subject of a verb. Sag (2012, 84) uses the feature XARG ("external argument") for the same purpose. In Sag's (2012, 84) implementation, the XARG value of a word is *none* if the word's SUBJ list is empty and identical with the element on the word's SUBJ list otherwise. This feature can be used, for example, to relate the subject of a tag question and the subject of the main clause, see (10). In Sag (2012, 151), the two clauses have NPs with identical indices as their XARG value. In our analysis, we will use this independently motivated feature XARG to model the restriction on local subject relatives.

(10) [S: [S: There$_i$ are two possibilities], [S: aren't there$_i$/*they$_j$]]?

Before closing this subsection, we need to say a few words on the distinction between restrictive and non-restrictive relative clauses. Arnold (2004, 2007) argues that the two types of relative clauses do not differ fundamentally in their internal and external syntax. According to him, restrictive relatives modify any nominal category, and non-restrictive relatives can modify any saturated phrase (Arnold, 2004, 43). The main difference between the two is, instead, semantic. Arnold (2004, 43) introduces subtypes of relative clause signs to encode this: *intersective-semantics* for restrictive relative clauses, and *global-scope-semantics* for non-restrictive relative clauses.

In this subsection, we mentioned the analytic ideas that have influenced our analysis and their main competitors.

## 4.2 Analysis of bare and *ka/that* relative clauses

We can now present our analysis of Sōrānī and English non-*wh* relatives. As the main focus of this paper is on the interplay of grammar and constraints on social meaning, we do not strongly commit to particular aspects of the syntactic analysis, though we propose one that is compatible with the data and parallel for the two investigated languages. We largely follow Hassan (2021) in the syntactic analysis and will gloss over all details of the semantic analysis. Her theory also extends to *wh* relatives.

Fattah (1997) argues in favor of an analysis of Sōrānī *ka* as a complementizer/relativizer rather than a relative pronoun. Therefore, we follow Taghvaipour (2005) and assume a functional head for relative clauses, which can be phonologically empty or realized as *ka*. The similarities between English *that* relatives and their Sōrānī counterparts, together with Hoffmann's (2010) experimental data support a relativizer analysis for *that* as well.

As mentioned above, Taghvaipour (2005) does not discuss bare relatives in Persian. To keep the structure of bare and non-bare relatives maximally similar, we assume bare relatives to be introduced by a phonologically empty relativizer.

The lexical entry of the Sōrānī and English relativizer is sketched in Figure 1. It is either phonologically empty or has the PHON value *ka/that*. The relativizer modifies some constituent with which it shares the INDEX value, $\boxed{1}$. It selects a clause on its COMPS list. This clause contains a gap that has the index $\boxed{1}$ as

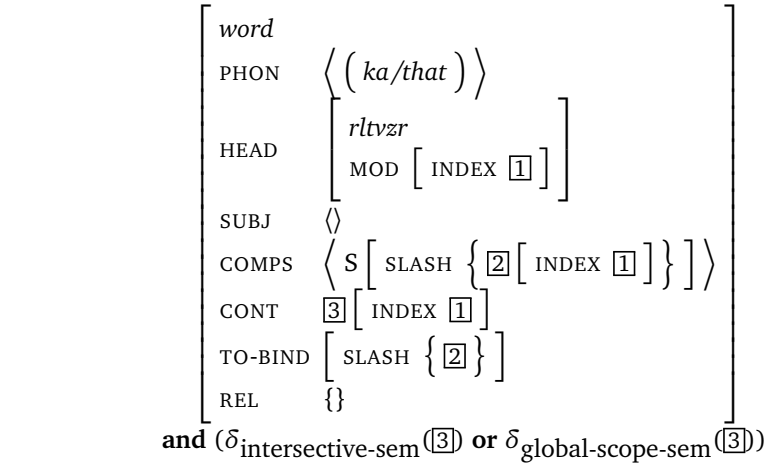



Figure 1: Lexical entry of the relativizer (Sōrānī and English)

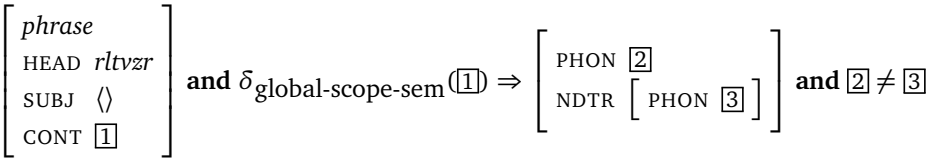



Figure 2: Ban on bare non-restrictive relatives (Sōrānī and English)

well.[3] The REL value of the relativizer is empty, as it does not contain a complex relative phrase. We add that the relativizer has a restrictive or a non-restrictive semantics. As we largely ignore the semantic analysis, we simply assume that there are descriptions $\delta_{\text{intersective-sem}}$ and $\delta_{\text{global-scope-sem}}$ that identify the type of content of the relativizer.[4]

The constraint in Figure 2 excludes an empty relativizer for non-restrictive relatives. It requires that, in a phrase that is headed by a relativizer with a non-restrictive semantics, the PHON value of the mother must not be identical with that of the nonhead daughter.[5]

This basic analysis allows for the full range of non-*wh* relatives discussed in Sections 2 and 3: Bare relatives are only allowed as restrictive relatives, but there is no constraint on the grammatical function of the relativized element.

[3] In Sōrānī the "gap" can take the form of a resumptive pronoun, see Fattah (1997, 254) and Hassan (2021, 220–225).

[4] See Hassan (2021, 249 and 263) for a concrete proposal for such descriptions.

[5] This constraint is compatible with an analysis of English *wh* relatives in which the fronted *wh* phrase is syntactically treated as a subject of the relativizer, as in Pollard & Sag (1994, 216).

# 5 Towards a modelling of constraints on social meaning

## 5.1 Previous HPSG approaches to social meaning

Pollard & Sag (1994) propose a basic treatment of context-dependent linguistic effects through their feature CONTEXT (CXT). This includes information on the participants of a discourse in the C-INDICES value, and a set of backgrounded propositions in the BACKGROUND (BGR) feature. In this architecture, only lexical elements introduce BGR elements. We will call this "lexical introduction." All such lexically introduced backgrounded propositions percolate to the highest node in a structure by the PRINCIPLE OF CONTEXTUAL CONSISTENCY. We will refer to this property as "global percolation." In the following, we will discuss these two properties and the general question of what information should be encoded as the social meaning contribution of a linguistic expression.

It is important to consult the sociolinguistic literature when addressing this general question. Current, third-wave, sociolinguistic research assumes that linguistic expressions are associated with some elements of social meaning and that the overall register or style assessment is a complex inference, influenced also by non-linguistic, contextual factors (Eckert, 2012). This means that we have a two-level system consisting first of individual linguistic properties, the classical sociolinguistic variables (Labov, 1984), and second of an overall categorization of a variety. Bender (2007) points out that the way in which third-wave sociolinguistic theory interprets such a system makes it very apt for an integration into a formal linguistic framework like HPSG: Speakers are seen as having (implicit) knowledge of the social meaning of individual sociolinguistic variables. They combine them in order to achieve a particular style in a given communicative situation.

Green (1994) proposes a model of speaker attitude and interlocutor relation within HPSG's CONTEXT value. Adopting the overall architecture of Pollard & Sag (1994), she encodes speaker attitudes as elements of the BGR set, i.e., as backgrounded propositions. For example, the word *dog* comes with a *mutual belief* among the speaker and the addressee that it is *normally believed* by members of the English speech community that the predicate **dog** is true for the INDEX value of the word.

While Green (1994) does not discuss social meaning as such, a similar, BGR-based system is used by Paolillo (2000) to model diglossia in Sinhala (Iranian). He explicitly distinguishes between the marking for a communicative attitude expressed by an individual lexical expression and the overall inference of a particular register (the High or Low variety, in the case of diglossia). The communicative attitudes express properties such as *edited*, *interactive*, *public*, and others. They are contributed by individual lexical signs in the form of a Green-style element into the BGR set. At the overall utterance level – and, more generally, at the text level – these attitudes are evaluated and lead to a highly context-specific assessment of the register. Paolillo describes this assessment as an implicature.

Paolillo (2000) encodes the social meaning of linguistic variables inside the grammar, but puts the level of the style evaluation outside grammar.

A different way of encoding is chosen in Wilcock (1999) and Bender (2007). They propose a feature REGISTER or SOCIAL respectively, whose value is atomic and expresses the result of the overall register or style assessment. Individual linguistic forms, i.e. the variants of sociolinguistic variables, constrain which REGISTER/SOCIAL values they are compatible with. For example, in Wilcock (1999), the relative pronoun *whom* comes with the REGISTER value *formal*. Similarly, Bender (2007) assigns the phonologically empty version of the copula in African American English a certain SOCIAL specification. Wilcock (1999, his (11)) introduces a REGISTER AMALGAMATION CONSTRAINT which states that a head and all its dependents have the same REGISTER value. This explicitly excludes combining elements with conflicting register specifications.

Machicao y Priemer et al. (2022) work with a register value as well, but it is non-atomic, containing attributes REGISTER1, REGISTER2, ...– one attribute for each register. The value of each of these is a factor that determines the likelihood that a sign is used in that register. The occurrence of elements that are indexical of a particular register will boost its factor and may have a negative effect on the factors for other registers. The authors derive the number of registers and the register factors associated with individual linguistic forms from corpora. While Machicao y Priemer et al.'s paper is not very explicit with respect to the percolation of register values, it is clear that their architecture is more flexible than Wilcock's and Bender's. If an utterance contains only elements that agree with respect to the register they are pointing to, the likelihood that it is used in that register will be very high. If we have conflicting elements, this could promote or lower various mutually incompatible register factors. In either case, the utterance would be well-formed but would show an unclear result for which register it is most likely to occur in. Our main concern with that approach is that it might not be able to model social meaning variation that is more fine-grained than what is comprised under their notion of register.

To summarize the previous HPSG literature on social meaning with respect to what is encoded as social meaning, we find two camps: one that encodes the meaning of individual sociolinguistic variables explicitly in the grammar, and one that encodes register/style explicitly. In our interpretation of third-wave sociolinguistic literature, we tend to side with the first group.

Let us now turn to the question of which elements can contribute social meaning. Green (1994) briefly addresses the potential problem of lexical introduction and expresses the hope that this would not be an obstacle as HPSG is a lexicalist framework. In the analysis of relative clauses proposed in Section 4.2, we propose a single lexical entry for the non-*wh* relativizer, be it phonologically empty or filled. However, we saw in Sections 2 and 3 that bare and *ka/that* relatives come with different speaker attitudes. We also saw that, in English, non-restrictive *that* relatives have a different social meaning than restrictive *that* relatives. Nonetheless, we do not need distinct lexical entries for these

and, therefore, a Green-style lexical analysis is problematic.

Wilcock (1999) and Bender (2007) take a different approach. As they assume that all signs in an utterance have the same REGISTER/SOCIAL value, that value can be constrained anywhere in the structure. In their examples, they always attach a constraint on the register value on a linguistic type. In other words, every linguistic element that contributes to social meaning needs to be associated with a node in the type hierarchy. Bender (2007, 269–370) addresses this aspect and explicitly defends what she calls *redundant types* as cognitively motivated. We will show in Section 5.2 that this is not necessary and that we can add social meaning constraints to the analysis from Section 4.2 without introducing new constructional types. Furthermore, we suspect that the type-based approach faces difficulties when looking at social meaning that is not associated with complete signs but rather with parts of them – such as social meaning of particular phoneme realizations (like r-fullness or r-lessness, Labov 1966) or with particular interpretation strategies (like negative concord, Labov 1969).

Machicao y Priemer et al. (2022) argue that constructions can change the register value. In their example (7), it looks as if there can only be one register-sensitive constraint on any given phrase. This is potentially problematic in the light of our analysis of English bare relatives above: We would need one constraint on all bare relatives to promote the register factor for colloquial registers. If the relative clause, in addition, has its local subject as relativized element, the factors for all formal, prescriptive registers need to be strongly demoted.

We conclude that constraints on social meaning are not restricted to lexical items. Existing HPSG approaches seem to be limited in their ability to cope with the flexibility of attaching social meaning to any aspect of a linguistic expression.

Let us finally look at the question of global percolation. Paolillo (2000) shows that global percolation is at the same time not enough and too much. First, he argues that style is not a property of individual sentences but rather of an entire discourse. He proposes a DISCOURSE COHERENCE principle according to which the communicative attitude information percolates beyond individual sentences. Second, his data contain examples of Low-variety use in a quotation, embedded into an otherwise High-variety discourse – such as direct speech embedded in novels. He suggests some sort of EXCEPTIONAL INHERITANCE for these cases, i.e., a situation in which the communicative attitude does not project outside of a quote or embedded speech report.

This overview leaves us with three desiderata and a big question: First, we lack a clear notion of how to relate the two levels of analysis, the social value of individual variables and the overall assessment of a register, style, or variety. Second, we lack a possibility to assign social meaning to linguistic expressions independently of the rest of the grammar. Third, we need to account for percolation of social meaning as going both beyond the utterance level and below it. The big question is if the mechanisms needed to model social meaning are new or are rather instances of already established notions.

## 5.2 Formulating social meaning constraints

We propose that social meaning can be adequately modeled as various types of implicatures as presented in Grice (1975). In particular, we assume that linguistic expressions can trigger *conventional implicatures* (CI) which express the social meaning associated with a sociolinguistic variable. We will show that CIs have exactly the percolation properties within an utterance needed for our purpose. The overall, context-dependent evaluation of the social meaning will be treated as a *particularized conversational implicature* (PCI).

The CIs expressing social meaning have the form proposed in Green (1994), see (11). X and Y are typically the speaker and the addressee, Z is a speech community as conceptualized by the attitude holder(s), $E$ is any linguistic sign or part thereof, and $\phi$ is an arbitrary statement. In this paper, we will work with statements of the form "$E$ signals colloquial use," or "$E$ is incompatible with prescriptive use." However, other forms are possible such as some inference about the social relation between speaker and addressee (as with honorifics).[6]

(11) (X believes that) X and Y mutually believe that community Z normally believes that expression $E$ signals $\phi$.

Let us look at the projective properties of CIs. As noted in Grice (1975) and Potts (2005), CIs obligatorily project over negation and belief predicates. While is it often said that they project globally, Bach (1999) and others have pointed out that CIs don't necessarily project over embedded speech reports. Example (12) is taken from Bach (1999, 339). The word *but* triggers the CI that being huge and being agile are normally not compatible with each other. This contrast is inferrable in (12a), but not necessarily when the CI trigger is inside a speech report as in (12b). Bach (1999, 340: fn.19) shows that CIs do not project in direct quotes of individual words either.

(12) a. Shaq is huge but he is agile.
b. Marv said that Shaq is huge but he is agile.

We can show that social meaning has the same projective behavior. In English, the word *baba* 'bottle' comes with the social meaning that it indicates communication with a small child. Example (13a) shows that this word is inappropriate ("$") in inter-adult talk in simple affirmative or negated sentences, or when used under a belief predicate. However, when used as a direct quote, as in (13b), there is no inference that the speaker is addressing a small child.

(13) Two adults talking to one another:
a. $ (Alex believes that) Kim should (not) buy a new baba.
b. Kim should buy a new "baba."

[6]Thanks to Antonio Machicao y Priemer for suggesting the "X believes" part in (11). We will leave this implicit in the following, sticking closer to the formulation in Green (1994).

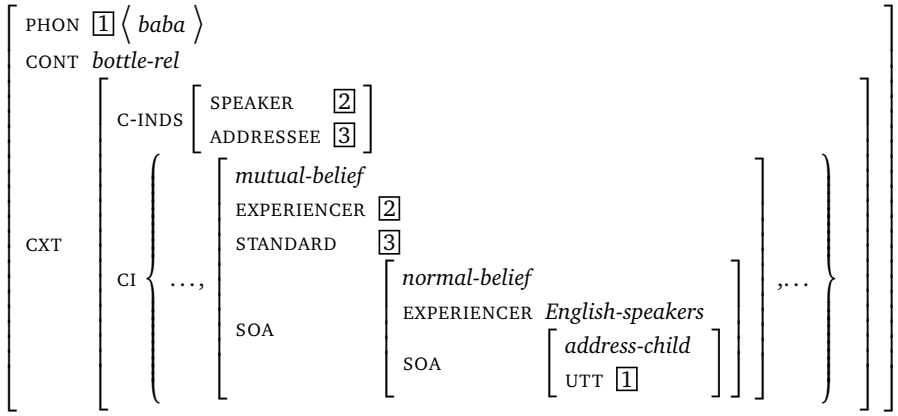



Figure 3: Lexical entry of the word *baba* 'bottle' including its social meaning

CIs have, of course, other properties as well. In particular, they are conventionally attached to a linguistic expression and, typically, express speaker-oriented side messages. These properties are also shared by the social meaning attached to linguistic expressions. The insight that the social meaning associated with a particular linguistic form has the status of a CI makes it unnecessary to postulate a special mechanism for the purpose of social meaning.

So far, there is little work on CIs in HPSG. We will simply follow the assumption in Sailer & Am-David (2016) that the BGR set of Pollard & Sag (1994) should be split into different sets, one for each type of projective meaning. In this paper, we assume a set-valued feature, CI, whose value contains all CIs attached to a sign. In (14) we formulate the CI PROJECTION PRINCIPLE. It determines that all CIs contributed by a phrase's daughters will project, unless they are retrieved, which can only happen in embedded speech constellations. The phrase can freely add more CIs.

(14) For each phrase, the CI value of the phrase is a superset of the union of the CI values of the daughters minus those that are integrated into the phrase's semantic representation.
CIs can be integrated into a semantic representation only in the scope of a speech act operator.

We can now look at an example encoding of the social meaning of the word *baba* as used in (13). The lexical entry of the word is sketched in Figure 3. Note that the element specified in the CI value has the form given in (11). It states that by using the word *baba* in the meaning of 'bottle', (the speaker believes that) speaker and addressee mutually believe that the English speech community normally believes that this word is used while talking to a child. This expresses an Eckert (2012)-style community belief of speaker/situation indexing as part of the linguistic competence of an individual. We think that this is in line with Bender's (2007) perspective of a formal integration of social meaning.

In this framework, we keep accumulating CIs with social meaning. Once we are at the level of the utterance, all of these CIs will be integrated into the utterance content, as proposed in Sailer (2021). The resulting enriched semantic representation will, then, be subject to evaluation of its discourse adequacy. In other words, it will be evaluated assuming Grice's COOPERATIVE PRINCIPLE through the application of *particularized conversational implicatures* (PCI). If a sign has several markers indicating colloquial speech and is used in a colloquial situation, then the Gricean maxims are met and no special PCI is inferred. If, however, the situation would require a more formal way of speaking, it will be assumed that the speaker is flouting maxims to achieve a particular effect.

Similarly, some registers seem to be mutually exclusive, such as the written formal and highly colloquial register, as also discussed in Paolillo (2000). Utterances with properties of both of them are not ungrammatical in our architecture. Instead, Gricean reasoning will be triggered to resolve this conflict by PCIs. However, the set of social meaning CIs can also be perceived as communicatively unresolvable, which then makes the utterance inappropriate.

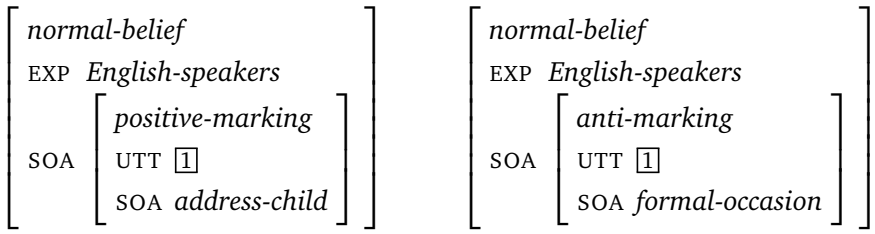
Example (15) illustrates the last situation. The sentence contains the word *baba* which triggers a CI of child-directed speech. At the same time, it contains a *wh* relative with a pied piped relative phrase containing *whom* and the rather technical term *dehydrated*. Unless we are in a very specific situation, sentence (15) is probably judged inadequate as there is no obvious way to imagine a situation in which all the social meaning CIs it contributes are satisfied.

(15) $ The person to whom I passed the baba nearly dehydrated.

Our inclusion of PCIs into the picture of social meaning also captures the discourse effect observed in Paolillo (2000), i.e., the idea of projection beyond individual utterances: Cooperative speakers are expected to utter sentences that are in line with the properties of dialogue participants and situation.

In order to model the social meaning restrictions relevant for non-*wh* relatives, we need to address a further detail of what social meaning CIs can look like. Linguistic expressions can be used to signal adequacy for a particular social meaning aspect, but also incompatibility with it. For example, elements of child-directed speech such as the word *baba* might also be marked as incompatible with use in formal occasions.[7] In order to express this positive or negative marking, we include yet another layer into our social meaning CIs. For example, the *normal-belief* object from Figure 3 needs to be changed into the left AVM in Figure 4. There would also be a further element on the CI list which specifies the normal believe of English speakers of an *anti-marking* object. This object indicates that the utterance of the word is anti-marked for a state of affairs of type *formal-occasion*, see the right AVM in Figure 4.

[7]Some social meaning categories might be ordered along a Horn scale. Then, incompatibility inferences might have the status of *generalized conversational implicatures* (Grice 1975, Levinson 2000). Sailer (2021) proposes how this type of implicature can be integrated into the present architecture as well. We are grateful to David Oshima (p.c.) for discussing similar cases with us.




a. Marking for child-directed speech b. Anti-marking for formal situations

Figure 4: Positive and anti-marking for social meaning for *baba* 'bottle'

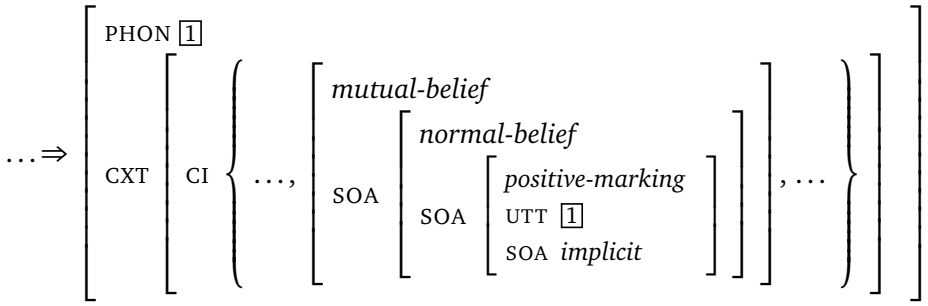



Figure 5: Constraint marking bare relatives as implicit (Sōrānī, English)

We can now formalize the social meaning constraints for Sōrānī and English non-*wh* relatives that we established in Sections 2 and 3. First, in both Sōrānī and English, bare relatives are marked as implicit forms and *ka/that* relatives as more explicit forms. We illustrate the constraint for bare relatives. A bare relative can be identified syntactically as a clause with HEAD value *rltvzr* whose PHON value is identical with that of its non-head daughter. This is the antecedent of the required constraint whose consequent we depict in Figure 5. The constraint for *ka/that* relatives will be analogous, just specifying non-identical PHON values in the antecedent and a positive marking for *explicit*.

In addition to these general constraints, bare relatives in Mukrī are also marked positively as *colloquial*. In Səlemānī, they are not only positively marked as *colloquial*, but also anti-marked for *prescriptive*. These constraints capture the data summarized in Section 2.

For English bare relatives, we want to formalize the constraint that they are a marker of a colloquial and non-prescriptive speech when used with a relativized local subject. To express this constraint, information on the local subject must be available at the clause level. We can use the feature XARG mentioned in Section 4.1 to identify a relative clause with a relativized local subject: Its lexical head's COMPS list contains a clause whose SLASH element is identical with its XARG value. In Figure 6 we only show the antecedent of this constraint. The consequent specifies two elements of the CI set, one with a positive marking for colloquial speech, one with an anti-marking for prescriptive speech.

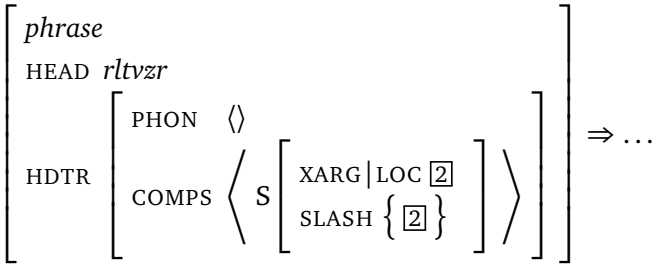



Figure 6: Antecedent of the constraint on English bare local subject relatives

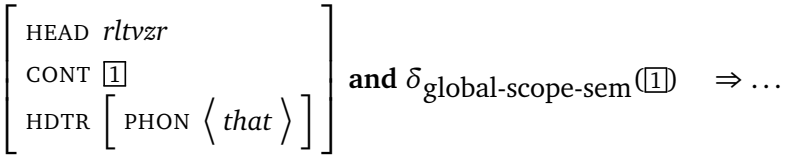



Figure 7: Antecedent of the constraint on English non-restrictive *that* relatives

Finally, we can turn to non-restrictive *that* relatives in English. A non-restrictive *that* relative can be identified as a phrase with HEAD value *rltvzr*, a head daughter with the phonology *that* and a global scope semantics, i.e., a CONTENT value that satisfies the description $\delta_{\text{global-scope-sem}}$. This antecedent is shown in Figure 7. The consequent of the constraint contains an anti-marking CI for prescriptive language use.

Before closing this section, a technical remark on the CI percolation mechanism should be made. In Section 5.1, we argued against the restriction to lexical introduction and against introducing new construction types for social meaning. In the principle in (14) we stated that the CI value of a phrase is a superset of the union of its daughters' CI sets (unless retrieved). We also always leave open whether there are elements on the CI set beyond the ones we specify in a constraint on phrases. This allows for phrases that contain elements on their CI set that are not inherited from the words they dominate, and yet we don't require explicit constructional types in the type hierarchy. For example, any non-restrictive *that* relative will not only have on its CI set the anti-marking for prescriptive from the constraint in Figure 7, but also the marking for explicit expression from the constraint mentioned in the discussion of Figure 5.

However, this also allows for additional background assumptions to be freely inserted anywhere in the structure. We propose to block this through the model theory of the grammar. The standard assumption in HPSG is that we consider all utterance-representing signs in a (minimal) exhaustive model of our grammar as constituting the described language (Richter, 2007, 2021). In such a model, we will have many signs representing the same utterance which are isomorphic except for their CI values. Among such signs we select only those that have a minimal number of elements in their CI value. This guarantees that register constraints that are enforced lexically or through constraints of the grammar always

appear, but randomly added ones are filtered out. Such a model-theoretic treatment seems justified as the CI value is assessed outside the grammar through PCIs. In other words, we are dealing with a phenomenon at the interface between grammar and the extra-linguistic interpretation of linguistic structures.[8]

## 6 Conclusion

We argued for a parallel treatment of the basic grammar of Sōrānī and English non-*wh* relatives. There are grammatical constraints – such as the ban on pied piping in non-*wh* relatives, and the ban on non-restrictive bare relatives. In addition, there are socially conditioned constraints: forms can be marked as signals of a particular register, but also as being incompatible with a certain register. We showed examples of either type of constraint.

While we restricted ourselves to non-*wh* relatives, English *wh* relatives can be included straightforwardly by allowing the relativizer to select the fronted relative constituent via its SUBJ value, analogously to the treatment in Pollard & Sag (1994). The constraint in Figure 2 predicts that *wh* relatives are compatible with the empty relativizer also in non-restrictive relatives.

Our formalization of social meaning as various types of implicatures seems to be in line with the two levels of analysis (variables and styles) of current variationist sociolinguistics. At the same time, it allows us to treat social meaning with formal tools that are needed independently.

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[8]Note that this solution is not directly compatible with the suggestion in Przepiórkowski (2021) to look at individual utterance-representing signs as models of the grammar, because we need to compare different utterance-representing signs.

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# On the structure of Welsh noun phrases

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**Abstract**

Welsh noun phrases have had much less attention than Welsh clauses, and there are unresolved issues about the nature of possessors, attributive adjectives, and the definite article and agreement clitics. There is evidence, especially from agreement, that possessors are complements, evidence that attributive adjectives are adjoined to a preceding [LEX+] nominal constituent, and evidence that the definite article and agreement clitics are specifiers. The last of these positions makes it fairly simple to capture the relation between the definite article and agreement clitics and possessors. It is not difficult to formalize these ideas within HPSG.

## 1. Introduction

The structure of Welsh clauses has been a major focus of research since the 1970s (see e.g. Awbery 1976, Jones & Thomas 1977, Sproat 1985, Rouveret 1994), but the structure of Welsh noun phrases has had much less attention. Some analytic issues are discussed in Jones & Thomas (1977: chapter VII), Sadler & Butt (1997), Willis (2006), and Borsley, Tallerman & Willis (2007: chapter 5), and analyses of some of the main features are outlined within Minimalism in Rouveret (1994: chapter 3), and within Lexical-Functional Grammar (LFG) in Sadler (2003), but major analytic questions remain unresolved. There are questions about possessors, attributive adjectives, and certain NP-initial elements, including the definite article and agreement clitics. As we will see, there are even questions about complements. All these questions are considered in the following pages. There are, of course, other questions about the structure of Welsh NPs, but hopefully the conclusions reached here will provide a sound foundation for their investigation.

## 2. Basic data

Welsh is a head-initial language, and unsurprisingly a noun is followed by any complements it takes, as in (1), and also by a possessor, as in (2):

(1) llyfr am Gymru
book about Wales
'a book about Wales'

* I am grateful to a number of colleagues for helpful discussion of the issues addressed here, and to Howard Edwards, Peredur Webb-Davies, and Bob Morris Jones for help with the Welsh data. I alone am responsible for what appears here.

(2) llyfr Rhiannon
book Rhiannon
'Rhiannon's book'

Where both a possessor and a complement are present, they come in that order:

(3) llyfr Rhiannon am Gymru
book Rhiannon about Wales
'Rhiannon's book about Wales'

This is reminiscent of the verb–subject–complement order in Welsh finite clauses:

(4) Ysgrifennodd Rhiannon am Gymru.
write.PAST.3.SG Rhiannon about Wales
'Rhiannon wrote about Wales.'

This suggests that NPs and clauses should have broadly similar analyses. Attributive adjectives also follow the noun and precede both possessors and complements:

(5) llyfr newydd am Gymru
book new about Wales
'a new book about Wales'
(6) llyfr newydd Rhiannon
book new Rhiannon
'Rhiannon's new book'
(7) llyfr newydd Rhiannon am Gymru
book new Rhiannon about Wales
'Rhiannon's new book about Wales'

Also important are certain elements occupying initial position in an NP. These include the definite article and certain agreement clitics:

(8) y llyfr
the book
'the book'
(9) ei lyfr o
3.SG.M book he
'his book'

The definite article takes the form *y* before a consonant and *yr* before a vowel (e.g. *yr afon* 'the river'), and there is also an enclitic form '*r*, discussed in section 5. There is no indefinite article, as (1) and (5) illustrate. A clitic appears

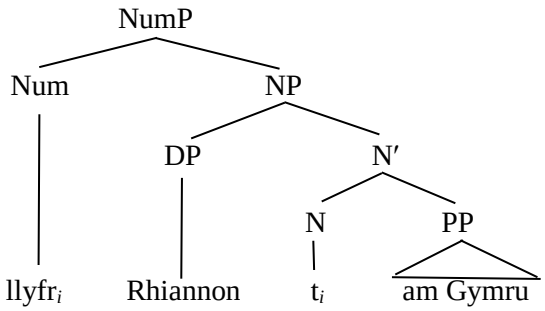
when the noun is followed by a pronominal possessor, which may be null in the literary language.[1] The third person singular masculine clitic triggers so-called soft mutation, which here replaces a voiceless lateral [ɬ] by a voiced lateral [l].[2] Mutation is a pervasive feature of Welsh, but I will ignore it in the following pages except where it is relevant to an issue I am addressing.

**3. Possessors**

For both Rouveret (1994) and Sadler (2003) possessors are specifiers, but within quite different analyses. For Rouveret a possessor precedes its sister, whereas for Sadler it follows.

Rouveret (1994) proposes a right branching structure, in which the possessor is a specifier in a nominal constituent from which the noun has been extracted by head-movement. For (3) this means the following structure:[3]

(10)




This is similar to the standard transformational analysis of Welsh finite clauses, in which the subject is a specifier in a verbal phrase from which the verb has been extracted by head-movement (see e.g. Sproat 1985, Rouveret 1994: chapter 1, Borsley, Tallerman & Willis 2007: chapter 2). A similar external head analysis could be proposed in any framework which has a mechanism allowing a word to appear outside the associated phrase, including versions of

[1] For some discussion of the relation between literary Welsh and other varieties, see Borsley, Tallerman & Willis (2007: section 1.3)

[2] The full set of changes that constitute soft mutation is as follows:

| | | |
|---|---|---|
| p > b | b > f ([v]) | m > f ([v]) |
| t > d | d > dd ([ð]) | ll ([ɬ]) > l |
| c ([k]) > g | g> ∅ | rh ([r$^h$]) > r |

[3] For Rouveret, the core of a nominal phrase is an NP. This is contained in a NumP, and a full nominal phrase is a DP.

HPSG which have such a mechanism.[4] If one assumes an external head analysis for finite clauses, as Rouveret does, it is perhaps natural to assume such an analysis for NPs. But, as we will see, Sadler, who assumes an external head analysis for finite clauses, rejects such an analysis for NPs.[5] However, if one is sceptical about an external head analysis for finite clauses, as I am (Borsley 2006), one will also be sceptical about such an analysis for NPs.

Perhaps the main argument for Rouveret's analysis comes from attributive adjectives. Rouveret highlights examples like (11), in which the order of adjectives is the same as in its English translation:

(11) cwpan mawr gwyrdd Sieineaidd
cup big green Chinese
'a big green Chinese cup'

He argues that this is expected if adjectives are adjoined to a following nominal constituent in Welsh as in English. However, as Willis (2006) shows in detail, the order of adjectives is not always the same as in English. In the following from Willis (2006: 1826), the order of adjectives is the mirror image of the English translation:

(12) caneuon newydd gwych eraill
songs new great other.PL
'other great new songs'

Thus, the order of attributive adjectives does not provide evidence for idea that they are adjoined to a following nominal constituent, as in Rouveret's analysis. Hence, this analysis seems dubious. Some evidence will be presented in section 4 below that attributive adjectives are in fact adjoined to a preceding nominal constituent, as proposed by Sadler (2003) and Borsley (2009: 3.2).

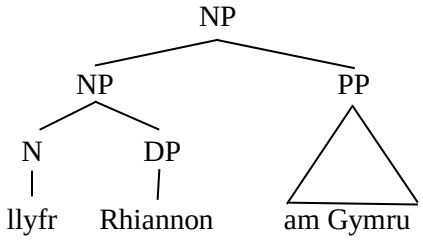
Sadler (2003) proposes a left branching structure, in which the possessor is a specifier following the associated head. This gives the following structure for (3):

---

[4] Much HPSG work, especially on German, uses a DOUBLE SLASH (DSL) feature to allow a word to appear outside the associated phrase. See e.g. Müller (2021: 5.1).

[5] Sadler (2003) notes that whereas verbs follow the associated subject when non-finite, nouns never follow a possessor. Thus, one type of argument that has been advanced for an external head analysis of finite clauses is not available for an external head analysis of NPs.

(13)




Given the fairly standard assumption that complements are lower in the structure than specifiers, inside a constituent with which a specifier combines, what we have viewed as complements cannot be complements. Sadler proposes that they are in fact adjuncts, noting that they are always optional. As noted earlier, she assumes an external head analysis of finite clauses. Thus, she assumes very different analyses for NPs and finite clauses. They differ in various ways, but the similarities cast doubt on any proposal for radically different analyses.

The idea that possessors are post-head specifiers seems problematic. It seems unlikely that Welsh has any other specifiers which follow the associated head. Other items that might be seen as specifiers are pre-head elements, e.g. pre-adjectival elements in comparatives:

(14) Dw i 'n fwy / llai cyfforddus na ti.
be.PRES.1.SG I PRED more less comfortable than you
'I am more/less comfortable than you.'

Subjects are also pre-head specifiers on the external head approach to finite clauses favoured by Sadler.

The adjunct analysis of apparent nominal complements is also problematic. With derived nominals, the supposed adjuncts generally reflect the complement selection properties of the related verb. Verbs and related derived nominals commonly combine with the same type of PP or clause, as the following illustrate:

(15) a. Dibynnai Heledd ar Llinos.
rely.COND.3.SG Heledd on Llinos
'Heledd relied on Llinos.'
b. dibyniaeth Heledd ar Llinos
reliance Heledd on Llinos
'Heledd's reliance on Llinos'

(16) a. Dadleuodd Heledd am wleidyddiaeth.
argue.COND.3.SG Heledd about politics
'Heledd argued about politics.'

b. dadl Heledd am wleidyddiaeth
argument Heledd about politics
'Heledd's argument about politics'

(17) a. Cytunodd Emrys i weithio oriau ychwanegol.
agree.COND.3.SG Emrys to work hours extra
'Emrys agreed to work extra hours.'

b. cytundeb Emrys i weithio oriau ychwanegol
agreement Emrys to work hours extra
Emrys' agreement to work extra hours'

(18) a. Credai Heledd mai ffŵl oedd Llinos.
believe.COND.3.SG Heledd COMP fool be.IMPF.3.SG Llinos
'Heledd believed that Llinos was a fool.'

b. cred Heledd mai ffŵl oedd Llinos
belief Heledd COMP fool be.IMPF.3.SG Llinos
'Heledd's belief that Llinos was a fool'

Thus, an adjunct analysis of apparent nominal complements requires the head-adjunct relation to somehow mimic complement selection. Clearly, this is dubious. Therefore, I will continue to assume, contrary to Sadler, that they are complements.

The problems that face these specifier analyses of possessives suggest that we should look for an alternative. An obvious alternative is a complement analysis (Borsley 1989, 1995). Possessors appear between a head and a complement, and one thing that can appear between a head and a complement in most frameworks is another complement.[6] In Welsh, possessors resemble clear examples of complements in two ways: (a) they follow the associated head, and (b) they trigger agreement. The second point requires some discussion.

As we have seen, possessors trigger agreement in the form of a preceding clitic, as shown by (9), repeated here for convenience:

(9) ei lyfr o
3.SG.M book he
'his book'

6 A complement analysis is probably not possible within Minimalism, where it has generally been assumed since Larson (1988) that the first of what looks like a pair of complements is actually a specifier following the associated head as a result of movement of the latter. However, as far as I can see, a complement analysis would be possible in LFG, and it is not clear to me why Sadler does not consider such an analysis.

Pronominal objects of non-finite verbs also trigger agreement in the form of a preceding clitic:[7]

(19) Ceisiodd Rhiannon [ei weld o].
try.PAST.3.SG Rhiannon 3.SG.M see he
'Rhiannon tried to see him.'

The bracketed non-finite verbal constituent in (19) looks quite like the noun phrase in (9). I assume that the noun in (9) and the non-finite verb in (19) agrees with the pronoun and that this is realized as a clitic.

Pronominal objects of many prepositions also trigger agreement, but in the form of a suffix:

(20) ar-no fo
on-3.SG.M he
'on him'

In all three cases, agreement also occurs with a pronoun which is the first conjunct of a coordinate structure in the relevant position, as the following illustrate:

(21) ei llyfr [o a hi]
3.SG.M book he and she
'his and her book'
(22) Gwnaeth Emrys ei weld [o a hi].
do.PAST.3.SG Emrys 3.SG.M see he and she
'Emrys saw him and her.'
(23) arno [fo a hi]
on.3.SG.M he and she
'on him and her'

These similarities are unsurprising if possessors, like objects of non-finite verbs and prepositions, are complements.

Finite subjects also follow the associated head and trigger agreement, as the following illustrate:

(24) Ysgrifennon nhw am Gymru.
write.PAST.3.PL they about Wales
'They wrote about Wales.'

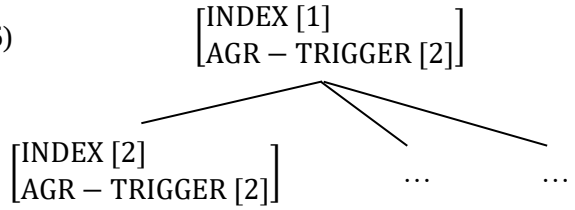
---

[7] The similarity between nouns and non-finite verbs with respect to agreement is the main reason why non-finite verbs are traditionally known as verb-nouns. See Borsley (1993) and Borsley, Tallerman & Willis (2007: section 3.1.2-3) for critical discussion of this terminology.

(25) Gweles [i a ti] ddafad.
see.PAST.1.SG I and you.SG sheep
'You and I saw a sheep.'

This suggests that they too are complements, as argued in Borsley (1989, 1995).

All four cases of agreement can be analyzed as agreement with the first member of a COMPS list. Following Borsley (2009), I assume that nouns, non-finite verbs, prepositions, and finite verbs have a feature AGR, whose value is an index or *none*, and I assume that the default value is *none*. Agreement is with a pronoun which is either a complement of the agreeing word or the first conjunct of a coordinate structure which is a complement. In the first case, the value of AGR is the index of the complement, but this is not so in the second case. To address this issue, I assume a feature AGR–TRIGGER. I assume that the default value is *none*, but that the value of AGR–TRIGGER for pronouns is the INDEX value. I also assume that the AGR-TRIGGER value for a coordinate structure is the same as the AGR-TRIGGER value of the first conjunct. This means structures of the following form when the first conjunct is a pronoun:[8]

(26)



Given these assumptions, AGR will have an index as its value in just the right situations if we assume the following constraint:

(27) [AGR [1], COMPS <[AGR–TRIGGER [2]], …>] ⇒ [1] = [2]

This says that where a head with the feature AGR has a first complement with the feature AGR-TRIGGER, the two features have the same value. It ensures *inter alia* that a noun with a pronominal possessor or a coordinate possessor with a pronominal first conjunct has an index as its AGR value. How agreement is realized as a clitic will be discussed in section 5.

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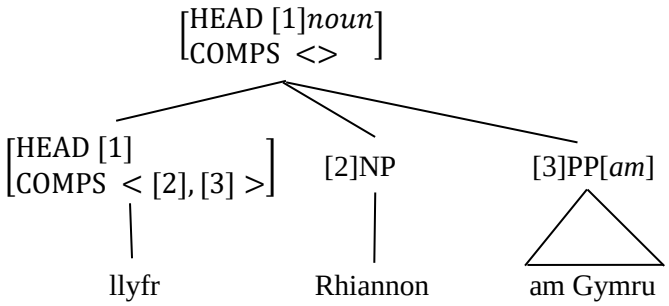
[8] In Borsley (2009: 256), I dealt with agreement with a first conjunct by assuming that agreement constraints refer to order domains in the sense of Kathol (2000) and that a coordinate structure appears in an order domain as a sequence of conjuncts and not as a single unit. In the absence of independent evidence for this treatment of coordinate structures, this approach seems rather dubious.

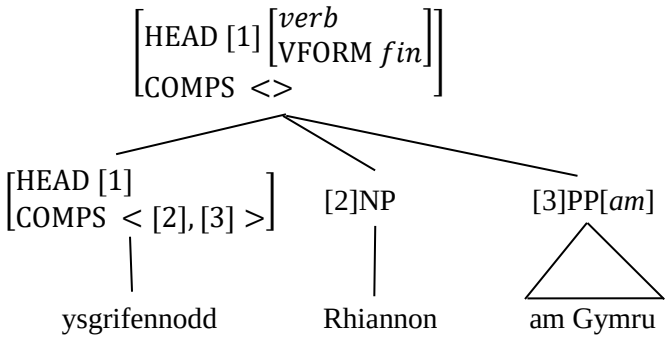
Given the assumption that possessors are complements, the example in (3), *llyfr Rhiannon am Gymru* 'Rhiannon's book about Wales', will be a head-complement structure of the following form: [9]

(28)




Finite clauses will have a similar structure with a verbal head and a number of complements. Here is a structure for (4), *Ysgrifennodd Rhiannon am Gymru* 'Rhiannon wrote about Wales':

(29)




As noted earlier, it seems desirable that NPs and finite clauses should have broadly similar analyses.

Before we can provide lexical descriptions for possessed nouns, we should note that there is evidence that an NP with a possessor is definite if the possessor is definite and indefinite if the possessor is indefinite.

One type of evidence comes from the form *oes*, which is a present tense form of the copula appearing in interrogative and conditional clauses with an indefinite subject. Thus, while (30a), with a simple indefinite subject, is fine, (30b), with a definite possessor, is unacceptable, but (30c), with an indefinite possessor, is also fine:

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[9] Complement analyses of post-nominal possessors have also been proposed for Arabic (Borsley 1995), Hebrew (Wintner 2000), and Persian (Samvelian 2007).

(30) a. Oes [llyfr] ar y bwrdd?
be.PRES.3.SG book on the table
'Is there a book on the table?'
b. *Oes [llyfr Rhiannon] ar y bwrdd?
be.PRES.3.SG book Rhiannon on the table
c. Oes [llyfr merch] ar y bwrdd.
be.PRES.3.SG book woman on the table
'Is there a woman's book on the table?'

Further evidence comes from the Welsh counterpart of an existential *there* sentence, in which *yna* 'there' appears between the copula and the notional subject. Again, a definite possessor is unacceptable, but an indefinite possessor is fine:

(31) a. Mae yna lyfr ar y bwrdd.
be.PRES.3.SG there book on the table
'There is a book on the table
b. *Mae yna lyfr Rhiannon ar y bwrdd.
be.PRES.3.SG there book Rhiannon on the table
c. Mae yna lyfr merch ar y bwrdd.
be.PRES.3.SG there book woman on the table
'There is a woman's book on the table.'

It seems, then, that a noun agrees in definiteness with a possessor. This suggests that while basic nouns have a representation of the form in (32), where L is a possibly empty list of ordinary complements, possessed nouns have a representation of the form in (33).

(32) [HEAD *noun*, COMPS L]
(33) [HEAD *noun*[DEF [1]], COMPS <NP[DEF [1]]> ⊕ L]

Representations for possessed nouns could be derived from representations for basic nouns by a lexical rule or they could be alternative realizations of a basic noun type.

## 4 Attributive adjectives

We turn now to attributive adjectives, which we can deal with fairly quickly. We have seen that there is no good evidence for an analysis of the kind proposed by Rouveret, in which they are adjoined to a following nominal constituent. So it seems reasonable to assume that they are adjoined to a preceding noun, forming a complex nominal constituent, as proposed by Sadler (2003) and Borsley (2009: 3.2).

Sadler notes that coordination provides evidence that a noun and a following attributive adjective form a constituent. She highlights examples like the following:

(34) gwallt du a llygaid gwyrdd Mair
hair back and eyes green Mair
'Mair's black hair and green eyes'

Such examples suggest rather strongly that attributive adjectives modify a preceding noun.

Borsley (2009: 3.2) argues that there is evidence for such an analysis from what is known as mutation – systems of word-initial consonant alternations, which are a prominent feature of Welsh and other Celtic languages. As (35) illustrates, an adjective undergoes soft mutation after a feminine singular noun. (The mutated adjective is given in bold and the basic form is given in brackets.)

(35) cath **fawr** (mawr)
cat big
'a big cat'

A second adjective is also mutated:

(36) cath **fawr** **ddu** (mawr, du)
cat big black
'a big black cat'

This is not surprising if adjectives are adjoined to a preceding nominal element. On this analysis, the second adjective follows a feminine singular nominal element just as much as the first, and so the mutation is only to be expected.

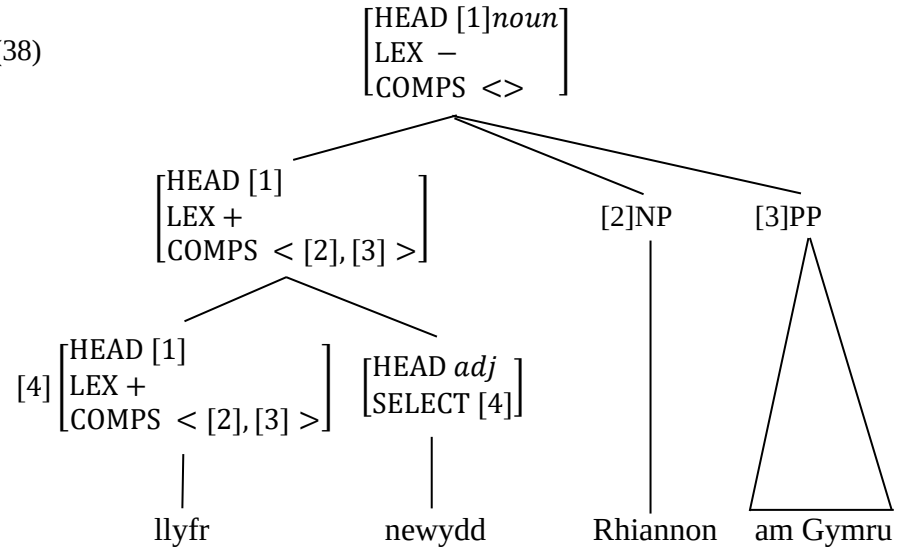
One might suppose that the positioning of attributive adjectives could be accounted for by assuming that they modify a preceding nominal constituent with a non-empty COMPS list. But this won't work because many nouns have an empty COMPS list. Instead, I will assume a distinction between [LEX +] expressions, which head head–complement phrases, and [LEX –] expressions, which are typical phrases, and propose that attributive adjectives modify a preceding [LEX +] nominal, creating a larger [LEX +] nominal (which can be modified by another attributive adjective). This means categories of the following form:[10]

[10] Most Welsh adjectives have a single form (ignoring mutations), but a few have distinct masculine, singular, and plural forms, e.g. *gwyn* 'white', which has the forms *gwyn* (masculine), *gwen* (feminine), and *gwynion* (plural). These forms can be associated with more specific values for SELECT.

(37) $\begin{bmatrix} \text{HEAD } adj \\ \text{LEX } - \\ \text{SELECT } \begin{bmatrix} \text{HEAD } noun \\ \text{LEX } - \end{bmatrix} \end{bmatrix}$

This will give the following schematic structure for the example in (7) with an attributive adjective, a possessor, and a complement:[11]

(38)




**5. NP-initial elements**

We now turn to NP-initial elements, especially the definite article and clitics. As we saw earlier, clitics appear when a noun is followed by a pronominal possessor or a coordinate possessor whose first conjunct is a pronoun. In contrast, the definite article only appears when there is no following possessor. Hence, while (39) is fine, (40) is unacceptable:

(39) y llyfr am Gymru
the book about Wales
'the book about Wales'

(40) *y llyfr Rhiannon
the book Rhiannon
'Rhiannon's book'

[11] I ignore here the question of whether *newydd* is just an adjective (hence [LEX +]) or an adjective phrase containing a single adjective (hence [LEX –]).

Thus, there are two dependencies between NP-initial elements and possessors that need to be accounted for. But before we can decide how this should be done, we need to determine what sort of elements clitics and the definite article are.

Pollard & Sag (1994: section 9.3), drawing on data in Borsley (1989), propose that clitics are nominal prefixes. One might propose the same for the definite article. This would account for the fact that both must be repeated in coordination:

(41) a. *ei fam a thad
3.SG.M mother and father
b. ei fam a ’i dad
3.SG.M mother and 3.SG.M father

(42) a. *y bachgen a geneth
the boy and girl
b. y bachgen a ’r eneth
the boy and the girl

It would also make ageement in the form of a clitic very similar to agreement in the form of a suffix.

It is clear, however, that clitics cannot be nominal prefixes, among other things because numerals and certain nonstandard adjectives may intervene between clitic and noun:

(43) ei dair gwahanol iaith
3.SG.M three.F various language
‘his three different languages’

(44) ei unig ddwy stori
3.SG.M only two.F story
‘his only two stories’

It is the same with the definite article:

(45) y tair gwahanol iaith
the three.F various language
‘the three different languages’

(46) yr unig ddwy stori
the only two.F story
‘the only two stories’

One might propose instead that the clitics and the article are edge inflections realizing certain properties of nominal phrases (and also non-finite verbal phrases in the case of clitics) in phrase-initial position. But it is not obvious how this would work. One might propose that the article appears at the left

edge of a nominal phrase which is [DEF +]. But, as noted in section 3, it is clear that nominal phrases containing a definite possessor are definite, but they do not allow the definite article. Hence, not all [DEF +] nominal phrases have the definite article.

There are also two other NP-initial elements, *pob* 'every, all' and *pa* 'which', which, like the definite article, cannot co-occur with a following possessor:[12]

(47) *pob llyfr Dafydd
every book Dafydd
(48) *pa lyfrau Dafydd
which book Dafydd

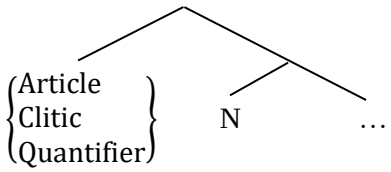
These do not need to be repeated in each conjunct, and there is no reason to doubt that they are words:

(49) pob mam ac thad
every mother and father
'every mother and father'
(50) pa fachgen a geneth
which boy and girl
'which boy and girl'

Hence, it seems reasonable to assume that the definite article and the clitics are also words.

Assuming all these elements are words, an important question is: are they high in the structure, as in (51), or low in the structure (as part of a complex head), as in (52)? (I use 'Quantifier' here to cover both *pa* and *pob*.)

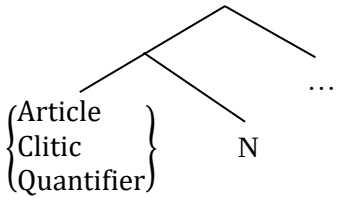
(51)




[12] The meanings that one might try to express with these examples can be expressed by the following:

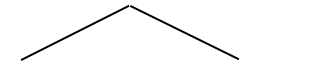
(i) pob un o lyfrau Dafydd
every one of books Dafydd
'every one of Dafydd's books'
(ii) p' un o lyfrau Dafydd
which one of books Dafydd
'which one of Dafydd's books'

(52)

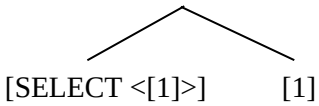



Sadler & Butt (1997) propose an analysis of clitics within LFG, in which they are low in the structure, but Sadler (2003) assumes that the article is high in the structure. A second question is: are NP-initial elements selected by the expression with which they combine as specifiers or do they select the expression with which they combine as markers? Do we have structures of the form in (53) or structures of the form in (54)?

(53)




(54)




Standardly both specifiers and markers are high in the structure combining with a constituent containing a head and its complements. (This was noted earlier in connection with specifiers.) However, this does not seem to be a necessary property of the two types of element. It looks, then, as if there are four possible analyses: high specifier, high marker, low specifier, and low marker.

A number of considerations argue against an analysis in which NP-initial elements are low in the structure. Firstly, the variety of elements that can appear between an NP-initial element and the noun, illustrated in (43)-(46), casts some doubt on the idea that there is a complex head here. Secondly, examples like the following are relevant:

(55) pob llyfr am Gymru
every book about Wales
'every book about Wales'

This refers to every member of the set of books about Wales. Thus, both the noun *llyfr* and the PP *am Gymru* are within the scope of *pob*. This is unsurprising if *pob* is high in the structure. as in (51), but is a complication if it is part of a complex head, as in (52). Finally, as seen in (41b) and (42b), both the article and the clitics are realized as enclitics when following certain vowel-final words, especially prepositions. Thus, we have pairs like the following (where mutated nouns appear in bold and the basic form appears in brackets):

(56) a. y **dre** (tre)
the town
'the town'
b. o 'r **dre** (tre)
from the town
'from the town'

(57) a. ei **dŷ** o (tŷ)
3.SG.M house he
'his house'
b. o 'i **dŷ** o (tŷ)
to 3.SG.M house he
'from his house'

It is not obvious what sort of analysis would be appropriate here. It could be that the enclitic examples involve nonstandard syntactic structures, in which special forms of prepositions take as complements constituents which would normally combine with the article or a clitic. But it could also be that they involve standard syntactic structures but some special phonological processes. It is in fact not clear that the same analysis is appropriate in all cases. The enclitic '*r* triggers soft mutation on a following feminine singular noun just like *y*(*r*), and '*i* triggers soft mutation on any following noun just like *ei*. Consider, however, the following:

(58) a. fy **nhŷ** i (tŷ)
1.SG house I
'the house'
b. o 'm tŷ i
from 1.SG house I
'from my house'

Whereas *fy* triggers nasal mutation, the enclitic '*m* triggers no mutation. It may be, then, that '*m* requires a different analysis from '*r* and '*i*. Thus, there is some uncertainty here. However, it is likely that it will be easier to offer a satisfactory account of the facts if the article and the clitics are high in the structure.

If a low analysis is rejected, the various NP-initial elements should be analysed as either markers or specifiers high in the structure. High marker analyses seem problematic in two ways. Firstly, it is not obvious how to exclude the definite article from NPs that contain a possessor. It is likely that a nominal expression containing a possessor will have the same feature makeup as a nominal expression not containing a possessor, something like the following:

(59)
$$\begin{bmatrix} \text{HEAD } [1]noun \\ \text{LEX } - \\ \text{COMPS } <> \end{bmatrix}$$

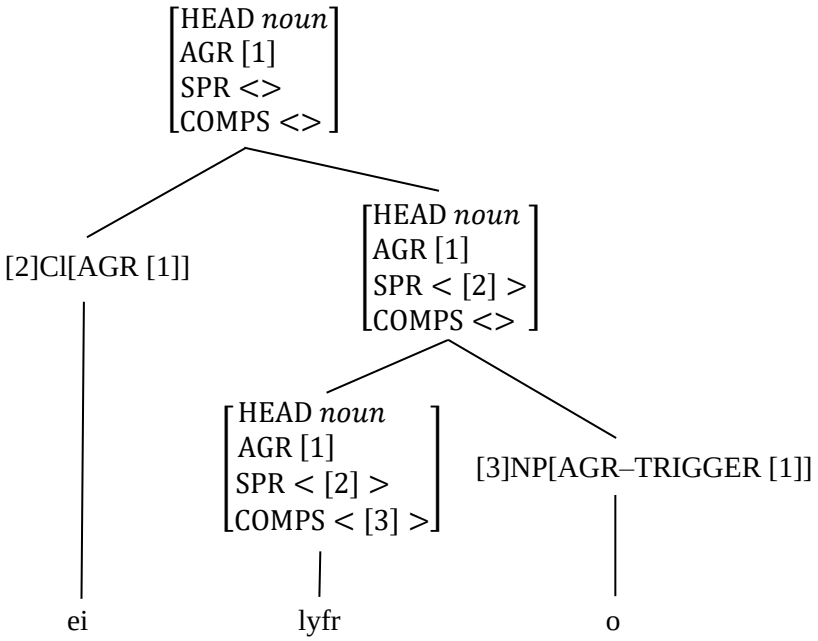
But if this is the case, there is no obvious way to exclude the definite article in the first case while allowing it in the second. Secondly, the fact that the clitics, like other realizations of agreement, are obligatory in formal Welsh seems problematic. Given the AGR feature on the noun and on phrases it heads, it should be possible to ensure that a clitic agrees with a pronominal possessor, but it is not obvious how to ensure that they are obligatory. It looks, then, as if a high specifier analysis should be preferred.

It is not too difficult to deal with the key facts within a specifier analysis. The constraint in (27) above ensures that a noun with a pronominal possessor or a coordinate possessor with a pronominal first conjunct has an index as its AGR value. To ensure that such a noun is preceded by an agreeing clitic, we can propose the following constraint:

(60) [HEAD *noun*, AGR [1]*index*] $\Rightarrow$ [SPR <Cl[AGR [1]>]

This says that where a noun has an index as its AGR value it takes a clitic with the same AGR value. Assuming this constraint, we will have the following structure for (9), *ei lyfr o* 'his book':

(61)



We saw earlier that agreement also takes the form of a clitic with non-finite verbs. This suggests that we actually need the following slightly more complex constraint:

(62) [HEAD *noun* ∨ *verb*[VFORM *inf*], AGR [1]*index*] ⇒
[SPR <Cl[AGR [1]>]

We also need a constraint to ensure that a noun with a non-pronominal possessor is not preceded by an article, clitic or quantifier. We can propose the following:

(63) [HEAD *noun*, COMPS <NP[AGR–TRIGGER *none*], …>] ⇒
[SPR <>]

This says that a noun with an NP complement which does not trigger agreement, i.e. neither a pronoun nor a coordinate structure whose first conjunct is a pronoun, does not take a specifier. It will rule out (17), (22), and (23), in which a possessor co-occurs with the definite article, *pob*, and *pa*. It is also necessary to rule out examples like (18a) and (19a), in which a coordinate nominal is preceded by the article and a clitic. This could be done by stipulating that a coordinate nominal can only take a quantifier as a specifier. Assuming coordinate structures are marked [COORD +], the necessary constraint might take the following form:

(64) [HEAD *noun*, COORD +] ⇒ [SPR <Quant> ∨ <>]

This requires a coordinate nominal to have either a quantifier as its specifier or no specifier at all.[13]

## 6. Concluding remarks

In the preceding pages, I have investigated the properties of Welsh NPs and argued for a number of positions. Firstly, I have argued, especially on the basis of agreement, that possessors are complements and not specifiers, as they were assumed to be in Rouveret (1994) and Sadler (2003). I have also argued that attributive adjectives are adjoined to a preceding [LEX +] nominal element and not an invisible following nominal, as proposed by Rouveret (1994: chaper 3).

[13] At least one more constraint is required to provide a reasonably full account of the facts that we have focused on here. A basic noun with no possessor allows the definite article or a quantifier as a specifier, but not a clitic. Clitics only appear when required by (59)/(61). I won't try to decide how exactly this restriction should be imposed, but there is clearly no difficulty here.

Finally, I have argued that the definite article and the clitics are specifiers and shown how this allows their relation to possessors to be captured.

There are of course, other aspects of Welsh NPs that need to be investigated, notably the numerals and other elements that intervene between NP-initial elements and noun and also quantifiers. There is an important discussion of the facts in Borsley, Tallerman & Willis (2007: chapter 5), but what sort of analysis would be appropriate for these elements remains to be determined. However, I have outlined analyses for what are arguably the most important features of Welsh NPs. Hopefully they will be a solid foundation for further research in this area.

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# Conjuncts-as-complements: A lexical approach to SGF coordination in German

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**Abstract**

In this paper[1], I shall discuss a peculiar coordination construction in German, where the shared subject of the two conjuncts is not found peripheral, but is contained within the first conjunct. Following Höhle (1983, 2019a), this construction is called "Subject Gaps in Finite/Fronted" clauses (SGF).

I shall discuss previous accounts, both symmetric coordination approaches (Frank, 2002; Kathol, 1999), as well as asymmetric adjunction approaches (Büring & Hartmann, 1998). The analysis I shall propose will treat the construction as coordination semantically, yet assume a head complement structure that combines the licensing first conjunct with an incomplete (=slashed) coordinate structure complement. I shall show how this addresses the ATB condition, permits straightforward licensing of the subject gap, and provides better control over the second conjunct, thereby improving over the adjunct analysis.

# 1 SGF coordination: The challenge

In this paper, I shall discuss a particular coordinate construction in German called *Subject Gaps in Finite/Fronted clauses*, more commonly known as SGF-coordination.

(1) [In den Wald ging *der Jäger*] und [fing einen Hasen].
into the woods went the hunter and caught a rabbit
'Into the woods went the hunter and caught a rabbit.' (Wunderlich, 1988, 289)

(2) [In Italien schätzt *man* Rotwein] und [haßt die Franzosen].
in Italy appreciates one red wine and hates the French.
'In Italy, one appreciates red wine and hates the French.' (Büring & Hartmann, 1998, 173)

In a nutshell, SGF-coordination can be characterised as an asymmetric clause-level coordination, where the verb-initial second conjunct is missing a subject and the overt subject is contained (medially) within the first conjunct. Importantly, the missing subject of the second conjunct is interpreted coreferent with the subject of the first.

[1]This paper has been presented at the HPSG conference in summer 2022, as well as the seminar of the Laboratoire de linguistique formelle in October of the same year. I would like to thank the respective audiences for their comments and discussion, in particular Felix Bildhauer, Jakob Maché, Caterina Donati, Lisa Brunetti and Adam Przepiorkówski. A great many thanks also go to Stefan Müller for extensive comments on a pre-final draft. The research reported here has benefited 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 Paris Cité – ANR-18-IDEX-0001.

## 1.1 Structural properties

In terms of phrase structure, the construction displays some quite specific properties: while the second conjunct is invariably a verb-initial clause, the first conjunct can be of any possible clause type.

As witnessed already in (1–2), the first conjunct may be a V2 structure, featuring a non-subject filler in the *Vorfeld*, but it may equally well be a V1 structure, as shown by the yes/no question of example (1) given in (3).

(3) [Ging *der Jäger* in den Wald] und [fing einen Hasen]?
went the hunter into the woods and caught a rabbit
'Did the hunter go into the woods and catch a rabbit?'

Furthermore, similarly asymmetric coordinations can be found with complementiser-introduced verb last clauses, as illustrated by example (4), due to Wunderlich (1988):

(4) [Wenn *Du* in ein Kaufhaus gehst] und [hast kein Geld], kannst Du
if you in a store go and have no money can you
Dir nichts kaufen.
yourself nothing buy
'If you go to a store and have no money, you cannot buy yourself anything.'
(Frank, 2002, 176)

Although the second conjunct in (4) misses both a subject and a complementiser, the structure cannot be treated in terms of peripheral sharing, since reconstruction of complementiser and subject with the verb-initial second conjunct yields an ungrammatical string, cf. (5):

(5) * ... wenn Du hast kein Geld
if you have no money

## 1.2 Restriction to subjects

The construction is also special in that the missing grammatical function in the second conjunct can only be the subject, as illustrated by the ungrammaticality of object sharing in (6).

(6) * Gestern kaufte Hans *den Wagen*$_i$ und meldete sein Sohn $e_i$ an
Yesterday bought Hans the car$_i$ and registered his son $e_i$
'Yesterday Hans bought the car and his son registered (it)'
(Frank, 2002, 180)

The restriction to subject function contrasts quite sharply with ATB extraction, where every grammatical function can be factored out, as shown in (7).

(7) Rotwein [liebt der Franzose] und [trint der Italiener].
red wine loves the French and drinks the Italian
'Red wine, the French love and the Italians drink.' (Frank, 2002, 189)

Despite their conjunct-internal surface realisation, the shared subject in SGF coordinations takes wide scope over coordination, a point highlighted by Büring & Hartmann (1998).

(8) [Daher kaufen die wenigsten Leute ein Auto] und [fahren mit dem Bus].
therefore buys almost no one a car and take the bus
'Therefore, almost no one buys a car and takes the bus.' (Frank, 2002, 181)

### 1.3 Asymmetric *Vorfeld*

As it turns out, SGF coordination constitutes quite an unusual coordinate structure: while peripheral material does not get shared across conjuncts, non-peripheral subjects do get shared, with wide scope interpretation. Furthermore, if the initial conjunct is a verb second clause, the *Vorfeld*-constituent may be an exclusive argument of the first conjunct, as witnessed with e.g. the directional PP in (1). By contrast, even if the filler bears an argument structure relation with the first conjunct only, it may nevertheless serve to signal sentence mood for the entire coordinate structure, as suggested by (9).

(9) [Wohin ging *der Jäger*] und [fing einen Hasen].
whither went the hunter and caught a rabbit
'Where did the hunter go to and catch a rabbit.'

Thus, we are confronted with the analytical paradox that the first conjuncts *Vorfeld*-constituent may determine properties of the entire coordination, while the *Vorfeld* constituent itself must be assumed to be asymmetrically extracted from the first conjunct only.

## 2 Some previous approaches

The analytical paradox presented by German SGF coordination lies with the fact that the asymmetric extraction from the first conjunct suggests high coordination of what would be called a CP in mainstream generative grammar, yet such a high coordination would make subject sharing and the associated wide scope difficult to capture.

### 2.1 Asymmetric projection of GDF (Frank, 2002)

Frank (2002) proposes an LFG analysis which is indeed symmetric at the level of constituent structure, assuming coordination of two CPs, where the specifier of the second CP is an empty NP (or DP). Since both conjuncts are assumed to be full

CPs, extractions apply within each conjunct, avoiding any violation of the Coordinate Structure Constraint. Projection of $f$-structure, however, is asymmetric, where grammaticalised discourse functions (TOPIC, FOCUS, SUBJ) of the coordinate structure are projected from the first conjunct only, as given by the annotated $c$-structure rule in (10).

(10) CP → CP Conj CP
↓∈↑ ↑=↓ ↓∈↑
((↓ GDF) = (↑ GDF))

The interesting case here is GDF being SUBJ: by way of the annotation in (10), the first conjuncts SUBJ will be the SUBJ value of the $f$-structure containing the set of coordinated $f$-structures. According to standard LFG assumptions (Dalrymple, 2001), this property is then distributed of all set members, accounting for the identity of subjects across the two conjuncts. Frank (2002) further argues that the resulting $f$-structure is identical, in all relevant aspects, to the one obtained for ATB extraction of subjects, such that the same wide scope readings can be derived in semantics. The LFG assumption regarding the availability of grammatical functions beyond the point where they get saturated/instantiated provides crucial for her analysis, making it possible to reconcile subject sharing with CP coordination. Frank (2002) further shows that sharing of variables is sufficient to account for the wide scope effect observed by Büring & Hartmann (1998).

One drawback of the analysis is that it crucially builds on LFG-specific assumptions regarding the representation of grammatical function, which are not shared by frameworks such as HPSG or CG that build on valence cancellation. The closest we can get is using semantics: while subcategorisation information is filled in LFG, yet cancelled in HPSG, we still built up semantics in tandem with phrase structure. Consequently, in order to account for sharing of the subject's individual variable, an HPSG analysis will operate at the syntax-semantics interface.

## 2.2 HPSG analyses

Within HPSG, the only published account of SGF-construction is the linearisation-based analysis proposed by Kathol (1995, 2000) for German, as well as a similar analysis for English by Kathol & Levine (1992).

The fundamental idea behind Kathol's approach is that SGF-coordination constitutes a mere word order variation of a *Vorfeld*-subject. Drawing on the distinction made in linearisation-based approaches between tecto-grammar and phenogrammar, Kathol suggests that SGF-coordination can be understood as VP coordination, essentially factoring out the shared subject, which will be peripheral to both conjuncts at the tecto-grammatical level. The surface patterns are derived by exceptionally linearising the subject into the *Mittelfeld* of the first conjunct only. While the basic idea has some initial plausibility, Kathol needs to invoke a special condition for subjects in order to work around the problem that the first conjunct's subject does not seamlessly linearise with the domain list of the second conjunct.

Frank (2002) argues rather convincingly that this condition lacks any independent motivation.

In an unpublished presentation (Crysmann, 2006), I reported on the implementation of SGF coordination in a DELPH-IN grammar of German (Müller & Kasper, 2000; Crysmann, 2003, 2007). I suggested to build on the UDC analysis of topic-drop already present in the grammar (Müller, 2004) and proposed an asymmetric, construction-specific coordination schema that combines a slashed verb-first clause on the right with a fully saturated clause on the left. While it captures the empirical facts, this analysis is rather ad hoc, using construction-specific features to ensure the sharing of indices. Furthermore, it postulates coordinate structures that are in blatant violation of the Coordinate Structure Constraint (Ross, 1967).

# 3 Analysis

## 3.1 The second conjunct

In previous work (Crysmann, 2006), I have suggested that the subject-less verb-initial structure of the second conjunct shares some similarity with topic-drop, an independently attested construction of German where a discourse-salient *Vorfeld*-constituent can be dropped (cf. also Wilder 1996). I.e., topic-drop represents a non-interrogative V1 clause with an empty *Vorfeld* and a missing subject or object, or even a missing modifier.

(11) (ich) bin schon da!
I am already there
'I'm here already!'

(12) (das) kenn ich schon.
that know I already
'I know it already.'

While there is certainly some similarity between the two constructions, it should be kept in mind that topic-drop is both more general and more specific than the verb-initial second conjunct in SGF coordinations: while topic-drop does not observe any restriction regarding grammatical function, SGF-coordination restricts licensing to subjects. Conversely, as pointed out by Jacob Maché (p.c.), SGF-coordination works with indefinite pronominals such as *man* 'one', cf. example (2), whereas topic-drop supposedly does not.

To make sense of this partial overlap, I shall tentatively assume that the two constructions differ in their licensing mechanisms: topic-drop, as a root phenomenon, is a discourse phenomenon, which should account for the definiteness restriction. SGF licensing, while possibly drawing on similar syntactic representations, is not restricted to root contexts, as witnessed e.g. by (4), and licensing is syntactic.

## 3.2 The first conjunct

The particularly challenging nature of SGF coordination is mainly due to the fact that the licensing overt subject is not peripheral, but rather contained within the first conjunct. A priori, this state of affairs conflicts with wide-spread notions of the locality of subcategorisation, as made in HPSG and shared with other frameworks, such as GB or the Minimalism.

Subjects, however, have received a somewhat exceptional status with HPSG's theory of locality: in Minimal Recursion Semantics (=MRS Copestake et al., 2001), an XARG feature serves to expose, for purposes of composition, the index of the external argument, alongside INDEX and LTOP. Sag (2012) argues for a *sign*-valued (=*synsem*-valued) feature exposing the entire syntacto-semantic properties of a realised subject (EXT-ARG), in order to account for copy-raising in English.

For German, Kathol (2003) suggested percolation of ARG-ST to access subject properties in partial VP fronting. More recently, Machicao y Priemer & Müller (2021) crucially rely on a Sag-style syntacto-semantic EXT-ARG feature within German NP syntax. For SGF coordination, it appears to be sufficient, though, to expose the semantic index of the licensing subject.

## 3.3 CP vs. C′ coordination

The analysis of the second conjunct as a verb-initial finite clause with a subject in SLASH still leaves open two possible analyses in terms of the constituents being coordinated: a CP analysis, where the constituents being combined are ultimately completely saturated finite verbal phrases (=empty valence lists and empty SLASH), or a C' analysis where the second constituent is a saturated finite verbal phrase with a non-empty SLASH.

An analysis of the second conjunct as a verb first clause with the subject in SLASH should be compatible with either C' or CP: if it is C', the second conjunct is a finite clause with a slashed subject, but without a *Vorfeld*. If it is CP, we will have an empty *Vorfeld*, which can either be derived by means of an empty filler, or else by a unary rule that saturates the slashed subject.

While a CP analysis will not have a problem with the ATB condition, with the filler being contained within each conjunct, it raises issues about licensing of the empty subject: first, how to ensure that the filler be indeed empty? Once SLASH has been saturated, properties of the filler are not visible anymore from outside the CP. Since we cannot detect the presence or the properties of the filler, we cannot capture the fact that the filler must correspond to the subject of the second conjunct. Furthermore, it remains unclear how to project e.g. sentence mood asymmetrically from the left conjunct.

If, however, we assume a coordination of two C' constituents, we will not fare much better, however, for different reasons: while we should have direct access to the properties in the second conjunct's SLASH, making it easy to capture that it is indeed the subject and that it is locally missing, we will inevitably incur an ATB

violation, since the second conjunct's SLASH is by necessity distinct from that of the first, as is most clear when dealing with yes/no questions as in (3) or complementiser-introduced verb-last clauses, as in (4).

### 3.4 Towards an analysis

Having seen the kind of problems SGF coordination proposes for a symmetric coordination analysis, regardless of whether we assume the coordination to combine two CPs or two C' constituents, I shall now pursue an alternative approach.

There is no reason to doubt that the SGF construction has just ordinary coordination semantics. Although most of our examples used the conjunction *und* 'and', we can equally well use disjunctive *oder* 'or', as in (13) or the exclusively disjunctive *entweder ... oder* 'either ... or' in (14), which do not seem to be amenable to an analysis in terms of comitatives as *und* 'and' would be.

(13) [Wenn Du in ein Kaufhaus gehst] oder [bestellst im Internet], solltest
if you in a store go or order in.the internet should
Du besser Geld auf dem Konto haben.
you better money on the account have
'Whether you go to a department store or order on the internet, you'd better have some money in your account.'

(14) Entweder ist der Jäger wieder im Wald oder hat gestern schon
either is the hunter again in.the woods or has yesterday already
genug Hasen geschossen.
enough rabbits shot
'Either the hunter is in the woods again, or has shot enough rabbits yesterday.'

The syntax of the SGF construction, by contrast, does not look like coordination: the licensing conditions favour an analysis where the second conjunct must be slashed, but nothing similar appears to hold for the first conjunct. Not only are the two conjuncts disparate, but the difference in SLASH specifications inevitable leads to ATB violations. Furthermore, sharing of arguments in coordinate structure typically involves arguments which are structurally or linearly peripheral. In the SGF construction, however, the shared argument is medial, and peripheral material is not shared. Finally, the first conjunct appears to function as the syntactic head, determining, inter alia sentence mood.

A possible alternative has been proposed by Büring & Hartmann (1998). Semantically, they treat the second conjunct as an open proposition which is syntactically attached as an adjunct. While such an analysis could in part be motivated by the functional similarity of conjunctive *und* with comitatives, it remains unclear what kind of motivation can be given for disjunctive coordinations, as in (13) and (14) above. Furthermore, recursive SGF coordination, which I shall address in Section 3.7 would make for highly unusual adjuncts. The most serious criticism, how-

ever, has been raised by Frank (2002): if the second conjunct is treated as an adjunct, there is no way to ensure it cannot be extracted. Fronting of the second conjunct in an SGF-construction, however, is illicit.

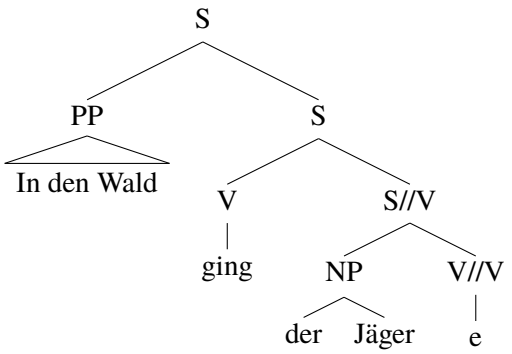
While I concur with the general idea that the first conjunct functions as a head, we do seem to need better control over the realisation of the second conjunct. I shall therefore propose a head-complement analysis where the second conjunct is "type-raised" to become a complement of the first conjunct's initial verb/complementiser. This analysis shall neatly account for the observation that the first conjunct behaves like a syntactic head and that the initial verb or complementiser assumes a pivotal role in licensing the construction. Finally, complement status shall permit much more fine-grained control over the second conjunct than what seems possible under an adjunct analysis.

## 3.5 V1/V2 in German

In the analysis I am going to propose, the initial verb or complementiser of the first conjunct plays a central role. Therefore, before we enter into the formal account of the SGF construction, I shall briefly outline the basic treatment of verb second in German.

German is an SOV language with a verb-second/verb-first effect. Most treatments within HPSG follow previous works in Transformational Grammar (Thiersch, 1978) and assume simulated head movement (Kiss & Wesche, 1991; Müller & Kasper, 2000; Müller, 2005).[2]

(15)




Technically, this is achieved by postulating a verb trace in the right sentence bracket that acts as the head of the verb-final *Mittelfeld*. This trace has a special head-feature DSL or // that crucially percolates valence information and features relevant for semantic composition, i.e. HOOK features in MRS. A sample lexical entry for the trace is given in (16).

[2] An alternative analysis using flat structures has been proposed by Uszkoreit (1987). See also Reape (1990, 1994) and Kathol (1995, 2000) for linearisation-based accounts. See Müller (2020) for detailed discussion of approaches to verb second in German.

(16)
$$\begin{bmatrix} \textsc{ph} & \langle\rangle \\ \textsc{hd} & \begin{bmatrix} \textit{verb} & \\ \textsc{ini} & - \\ \textsc{dsl} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{subj} & \boxed{s} \\ \textsc{comps} & \boxed{c} \end{bmatrix} \\ \textsc{cont} & \begin{bmatrix} \textsc{hook} & \boxed{h} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \textsc{subj} & \boxed{s} \\ \textsc{comps} & \boxed{c} \\ \textsc{hook} & \boxed{h} \end{bmatrix}$$

As the verb trace combines with complements and modifiers, properties of these dependents are recorded on the head: e.g. if a complement combines with the verb trace, its SYNSEM is unified with an element on the trace's COMPS. But as valence lists are shared under DSL, information about the complements will be percolated along the head projection path. Thus, whenever the actual initial verb combines with the projection of the verb trace, it will be able to see what arguments are present and match it against its lexical valence requirements.

The initial verb in the left sentence bracket needs to combine with a saturated constituent projected from its own trace. Typically this is achieved by means of a lexical rule like the one given in (17).

(17)
$$\begin{bmatrix} \textsc{ss} & \begin{bmatrix} \textsc{loc} & \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textit{verb} & \\ \textsc{ini} & + \end{bmatrix} \\ \textsc{comps} & \left\langle \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textsc{dsl} & \boxed{l} \end{bmatrix} \\ \textsc{subj} & \langle\rangle \\ \textsc{comps} & \langle\rangle \\ \textsc{hook} & \boxed{h} \end{bmatrix} \right\rangle \end{bmatrix} \\ \textsc{cont} & \begin{bmatrix} \textsc{hook} & \boxed{h} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \textsc{dtr} & \begin{bmatrix} \textsc{ss} & \begin{bmatrix} \textsc{loc} & \boxed{l} \begin{bmatrix} \textsc{cat} & \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textit{verb} & \\ \textsc{vform} & \textit{fin} \\ \textsc{ini} & - \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Essentially, this rule takes as its daughter a lexical finite head-final verb and projects from it a head-initial verb that selects a single complement, namely the saturated projection of its trace. Crucially, the lexical verb's valence information (SUBJ, COMPS) is structure-shared with the valence information in the DSL feature of its sole complement. This ensures that any arguments realised in the *Mittelfeld* will actually have to unify with the valence requirements of the initial lexical verb.

For the purposes of our proposal, it is important to point out that the standard analysis of verb fronting has an initial verb that selected for the entire remainder of

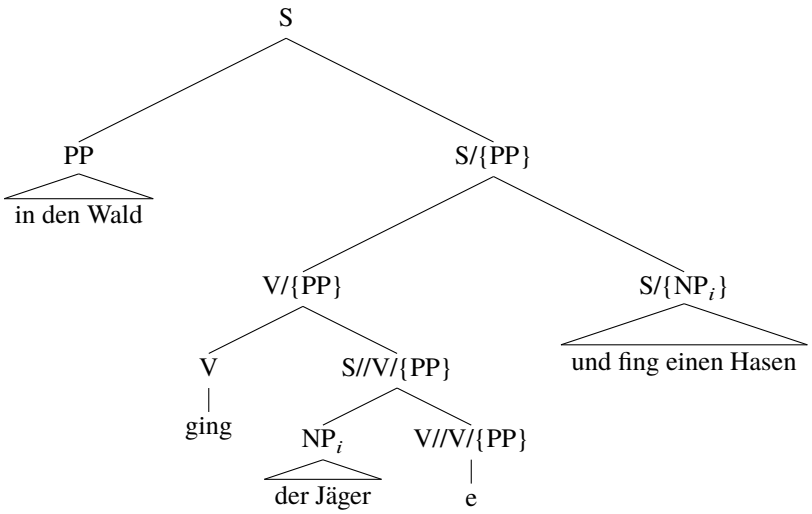
the clause as a single argument. This is highly similar to complementisers, such as *wenn*, which also take a single clausal argument.

## 3.6 SGF coordination as complementation

Having all the necessary ingredients in place, we can now turn to the formal analysis of SGF coordination.

I shall propose to analyse the conjuncts in the SGF constructions as syntactic co-complements. Semantically, however, the construction will be treated as ordinary coordination, embedding the semantic contribution of the two conjuncts under the conjunction provided by the second conjunct.

(18)




As we have seen in the previous section, simulated head movement likens the representation of initial verbs in German to that of complementisers, cf. Höhle (2019b), both taking a single complement that corresponds to the remainder of the clause.

Conjunct-to-complement "type-raising" will be effected by the lexical rule given in (19): this rule takes an initial verb or complementiser and expands its singleton COMPS list with a second complement corresponding to the second conjunct.

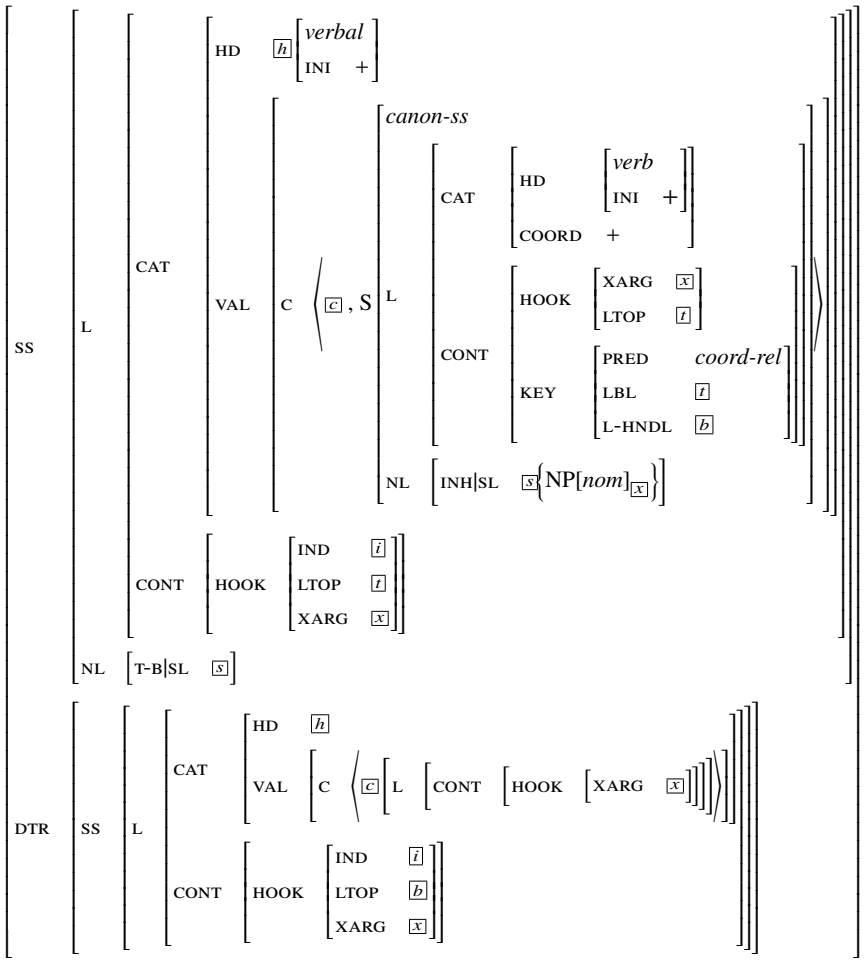
This second complement is constrained to be verb-initial and to have a nominative NP in its SLASH value, which is bound by the head of the construction (SS|NL|T-B|SL). The index of this NP is further constrained to be shared with the XARG of both complements, thereby establishing coreference of subjects in both conjunct clauses. Furthermore, this second complement is semantically constrained to have a coordination relation as its highest predication.

Syntactically, the augmented verb or complementiser will combine with its original complement, followed by the conjunct. Since both conjuncts are now dependents of the initial verb, crucial properties of the entire construction will be projected from that verb, including the head value. Furthermore, since the initial verb lexically binds the SLASH value of the second conjunct, amalgamation will only

propagate SLASH elements originating in the first complement, thereby capturing the asymmetric extraction facts.

Coordination semantics is equally provided by the lexical rule. In essence, all it takes is to embed the semantic contribution of the daughter under the L-HNDL of the coordination relation and, in turn, equate the LTOP of the mother with the LBL of the coordination relation (i.e. the LTOP of the second complement/conjunct).

(19)




## 3.7 Recursive coordination

In the general case, coordinate structures are recursive, and SGF coordinations make no exception here, as shown in (20).

(20) [In den Wald ging *der Jäger*], [fing einen Hasen] und [zog ihm das
into the woods went the hunter caught a rabbit and pulled him the
Fell ab].
fur off
'Into the woods went the hunter, caught a rabbit, and skinned it.'

Under the conjunct-as-complement approach proposed here, it is in fact only the first conjunct that really receives special treatment. The internal structure of the second conjunct, by contrast, is no different from any other second conjunct. The head of the first conjunct selects for an incomplete coordinate structure that consists of the second conjunct only, and contributes its own VP//{V} complement to function semantically as the first conjunct.

In order to generalise the approach from binary coordinations to *n*-ary coordinations, all it takes is to ensure that the representation of a recursive coordination lacking the first conjunct is the same as the representation of the second conjunct in the binary case we have considered so far. Thus, conjuncts 2..*n* will be considered an ordinary (recursive) coordination of slashed verb-initial clauses, observing the ATB condition. However, the missing first conjunct will be provided by the lexical rule.

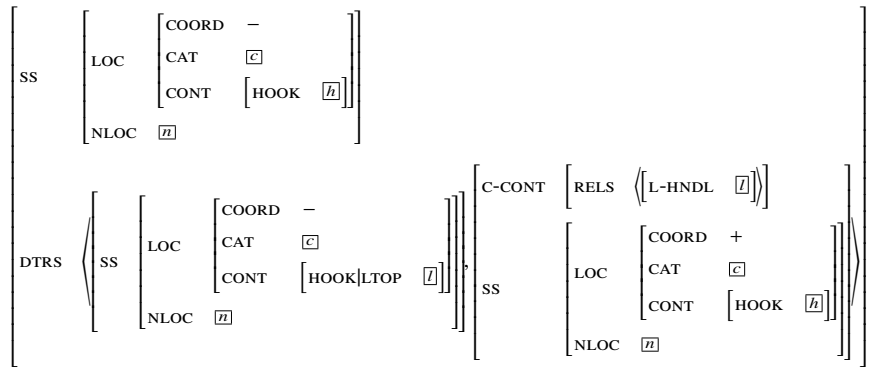
The following discussion will be led against the backdrop of the treatment of coordinate structures in the LinGO Grammar Matrix (Bender et al., 2010), which supports a typologically wide range of coordination strategies, including monosyndetic coordination, as typical in German, as well as asyndetic, polysyndetic, and omnisyndetic strategies. Furthermore, the coordination rule types provided by the Matrix already provide semantic composition using Minimal Recursion Semantics (Copestake et al., 2005).

The Grammar Matrix recognises different rule types for the basic and the recursive step in monosyndetic coordination. The basic rule type combines a right daughter semantically headed by coordinating relations with the left conjunct and semantically embeds the content of that conjunct under the coordination relation. The recursive rule type takes as its right daughter a coordinate structure and adds its left daughter as an additional conjunct. type combines The crucial difference between these two rule types is that the recursive type also provides an implicit coordination relation as constructional content, whereas the basic coordination rule type relies on the right hand daughter to provide that relation.

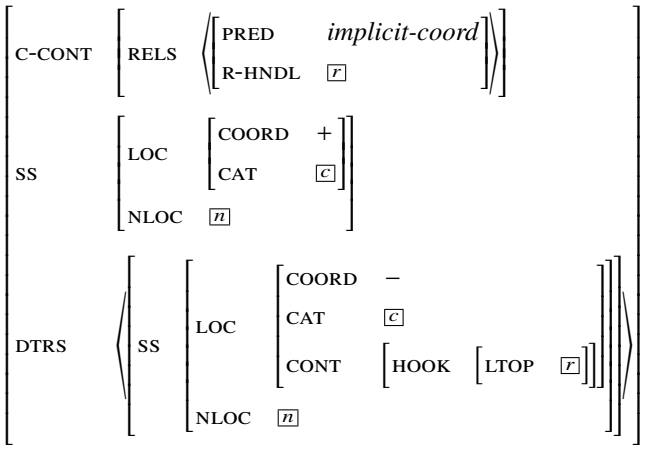
Furthermore, the Matrix coordination rule types employ a Boolean feature COORD that serves to register whether a coordinate structure is still incomplete, as e.g., the combination of conjunction with the right conjunct (COORD +), or complete (COORD −). The latter specification is the same as found with non-coordinate structures.

Given that the crucial difference between basic and recursive rule types lies with the constructional introduction of an implicit coordination relation, all it takes is to remove the constructional content from the binary recursive coordination rule itself and ship it out to a unary rule instead. Once we do this, we can use the same binary rule for both the basic step and the recursive step. Thus, instead of using different coordination rules, we shall use a single such rule, cf. (21), plus a unary rule that addresses the introduction of the implicit coordination for the recursive step, cf. (22).

(21)




(22)




The unary rule in (22), which introduces the implicit coordination relation, takes a complete coordinate structure as its daughter and semantically embeds it under the R-HNDL argument of the *implicit-coord-rel*. The resulting phrase now is an incomplete coordinate structure, still lacking the left conjunct. This intermediate status is registered by means of the COORD + specification, akin to the specification introduced by lexical coordinating conjunctions found in the basic step of monosyndetic coordination. Consequently, the general binary coordination rule takes as its right hand daughter such an intermediate coordinate structure and combines it with a left conjunct to yield a complete coordinate phrase.

# 4 Conclusion

I have argued that SGF–coordination in German is characterised by rather unusual syntax, where shared material is contained within the first conjunct, yet peripheral material is not shared.

The present conjunct-as-complement approach, which is implemented by means of a lexical rule, combines a syntactic head-complement structure with coordination semantics. Under this perspective, the first conjunct is enjoys the status of syntactic head, accounting for the fact that sentence-initial fillers eschew the ATB condition.

Moreover, the asymmetric approach advocated here straightforwardly captures the fact that the first conjunct alone determines sentence mood.

The second conjunct is analysed as a verb-first structure with a non-empty SLASH representing the missing subject and the missing *Vorfeld*, similar, but not identical to topic-drop. This SLASH value is bound by the initial verb of the first conjunct, which functions as the head of the entire construction. Identity of subjects is imposed using the index-valued MRS hook feature XARG.

The analysis suggested here is similar in spirit to the adjunct analysis by Büring & Hartmann (1998)., Complement status, however, provides better control for obligatory in situ realisation, scales up to recursive coordination, and preserves a standard coordination analysis in semantics.

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# Accounting for the variation in West Benue resultative constructions

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**Abstract**

This paper investigates the variation of resultative serial verb constructions in Benue-Kwa languages. The main claim is that the variation can be explained assuming three versions of general lexical rules which turn main verbs into complex predicates selecting for a second verb and attracting its arguments. Each language has a language specific version of these lexical rules, enriched with language specific peculiarities to account for the specific behaviour of verbal inflection. The fact that not all of the lexical rules do operate in each languages is another source of variation.

# 1 Introduction

There is broad agreement that serial verb constructions (SVC) in Benue-Kwa languages fall into a variety of syntactic subclasses such as (instrumental) 'take'-SVCs, (benefactive) 'give'-SVCs, 'say'-SVCs, comparative SVCs and some others (cf. Baker 1989, Lefebvre 1991, Lawal 1993, Déchaine 1993 and Shluinsky 2017). Among these are also the so-called resultative SVCs (RSVC), which in West Benue languages minimally consist of two verbs or verbal roots $V_1$ and $V_2$, where typically $V_1$ is some agentive or inchoative predicate and where $V_2$ is an unaccusative inchoative or stative predicate (cf. Baker 1989: 529–532). In Ìgbo, resultatives are realised as compounds rather than SVCs. In the remainder of this article, the term resultatives or resultative verb construction (RVS) will be used as to refer to the super class consisting of both RSVC and resultative compounds (RCOM).

## 1.1 Variation accros languages

Since the work by Lord (1975: 24–28), Déchaine (1993: 807), Stewart (2001: 152–154) and Manfredi (2005), it has been shown that West Benue languages fall into two groups as regards to the expression of resultative concepts: Whereas in languages such as Yorùbá or Ẹ̀dóid languages resultatives exhibit a word order typical for serial verb constructions, namely $NP_{subj}$ $V_1$ $NP_{obj}$ $V_2$ (1–2), Ìgbo resultatives surface as compounds (or root serialisations) with the corresponding linear order $NP_{subj}$ $V_1$ $V_2$ $NP_{obj}$ (3):

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(1) Ẹniọlá á jẹ [ọbẹ̀ ewédú] tán.[1]
Ẹniọlá HTS eat soup jute.leaf be.finished
'Ẹniọlá finished the ewédú.' YORÙBÁ

a. Ẹniọlá á jẹ [ọbẹ̀ ewédú].
Ẹniọlá HTS eat soup jute.leaf
'Ẹniọlá ate ewédú.'

b. [Ọbẹ̀] ewédú ú tán.
soup jute.leaf HTS be.finished
'The ewédú soup is finished.'

(2) Òjè họ́ọ́ [ọ́lí úkpùn] fúán.[2]
Òjè wash DET.S cloth be.clean
'Òjè washed the cloth clean.' EMAI

a. Òjè họ́ọ́ [ọ́lí úkpùn].
Òjè wash DET.S cloth
'Òjè washed the cloth.'

b. [ọ́lí úkpùn] fúán-ì.
DET.S cloth be.clean-FACT
' the cloth is clean.'

(3) ọ́ tụ́-fù-rù [ákwụ́kwọ́].[3]
3S throw-be.lost-rV paper
'He threw away the paper.' ÌGBO

a. ọ́ tụ̀-rụ̀ [ákwụ́kwọ́].
3S throw-rV paper
'He threw the paper.'

b. [ákwụ́kwọ́] fù-rù.
paper be.lost-rV
'The paper got lost'

All the languages under investigation involve some markers, which largely translate as some sort of past or perfect marker. The way these markers interact with RVC in each of the relevant languages is also subject to variation, see also Manfredi (2005) for similar observations (cf. his description 3c).

As shown by Bisang & Sonaiya (1999) the so-called *high tone syllable* (HTS) in Yorùbá precedes $V_1$ and is mostly limited to veridical contexts. Emai

[1] Examples provided by Olúwadára Ọmọtọ̀ṣọ́ and Abídémi Jimoh.

[2] As quoted in Schaefer & Egbokhare (2017: 698–701).

[3] As quoted in Lord (1975: 24–25). In the original, Lord spells the $V_2$ as *fù*. As ointed out by Victor Manfredi, this seems to be a confusion of two phonetically similar verbs *fù* 'get.lost' and *fụ̀* 'exit'

and other Ẹ̀dóid have a so-called *factative* suffix (-*ì* in Emai, -rV in Ẹ̀dó ), which attaches to past intransitive verbs and transitive verbs whose NP was fronted (2b). Whenever an intransitive verb is part of a RSVC, it fails to bear the factative suffix (cf. Schaefer & Egbokhare 2017: 27–29, Ogie 2009: 83–103).

In contrast, Ìgbo has the factative -rV suffix, which attaches to all eventive verbs with past interpretation and most stative verbs with present interpretation (cf. Nwachukwu 1984, Ọnụkawa 1994, Mbah & Evelyn 2014). It consists of the sonorant [r] and a copy of the stem vowel of the verb to which it belongs (3a–3b). It does not occur with the copulas and small subclass of stative verbs in the present tense but, rather it would yield a past tense interpretation with these verbs. It also attaches to $V_2$ of resultative compounds and mirrors its stem vowel (cf. Nwachukwu 1984: 92–94, Emenanjo 2015: 457–459).

Despite all the variation discussed above, RVC in Benue-Kwa languages are characterised by the features typical of SVCs, such as (i) shared value of polarity, (ii) shared TAM values (cf. Stahlke 1970: 60, 78, 80).

The aim of the study presented here is to provide an analysis which accounts for both the general characteristic of RVC in Western Benue languages and the cross linguistic variation among them.

## 2 Some syntactic properties

### 2.1 The status of the shared THEME-NP

One of the first questions which arises is how the shared THEME-NPs *ọbẹ̀ ewédú* 'Ewédú soup'/*ọ́lí úkpùn* 'the cloth'/*ákwụ́kwọ́* 'paper' in the examples (1–3) above are adequately analysed. The transitive $V_1$ and and the unaccusative $V_2$ have altogether three argument slots, but the sentence only contains two phonetically realised NPs. The main question is whether the second NP is now the object of $V_1$ or the subject of $V_2$ or both at the same time. As shown below, the pronominalisation of this NP reveals its status.

Most Benue language have developed case in their pronominal paradigm which distinguishes subject case, object case and possessor case (cf. Stahlke 1973: 192–193, Pulleyblank & Orie 2009: 874; Ogie 2009: 19, Schaefer & Egbokhare 2017: 236–237; Atoyebi 2009: 170–184; Déchaine 1993: 812, Emenanjo 2015: 303–306, 358). As data from Yorùbá (4), Ọ̀kọ (5), Ìgbo (6) demonstrate, the THEME argument in RVC surfaces with object case, indicating it has a stronger link to the transitive $V_1$ whose object it is, rather than to the $V_2$ whose subject it is.

(4) Ebí pa á/*ó kú.[4]
hunger kill 3S.O/3S.S die
'Hunger killed him.' YORÙBÁ
'He was extremely hungry.'

(5) Àde tă-mọ ẹba falẹ.[5]
Àde push-1S.O hand fall
'Àde pushed me down.' ỌKỌ

(6) ó rì-chà-rà yá/*ó.[6]
3S.S eat-be.finished-rV 3S.O/3S.S
'He ate it up.' ÌGBO

Thus the pronominalisation test shows that the shared THEME-NP is case marked as the object of $V_1$, thus the subject of $V_2$ is not phonetically expressed. The underlying mechanism of how the referent is identified will be investigated in the next section.

## 2.2 Subject-oriented vs. object-oriented interpretations

So far the present article only discussed RVC in which the subject of $V_2$ is co-referential with the object of $V_1$. But apart from that there are RVC in which the subject of $V_2$ co-referential with the subject of $V_1$ (cf. Lord 1975: 24–28, Déchaine 1993: 807, Stewart 2001: 145–146 and Manfredi 2005). In the remainder of this paper the former type is referred to as 'object-oriented' and the later as 'subject-oriented'. The second type has two subtypes which need to be distinguished: cases, where $V_1$ is intransitive and cases where $V_1$ is transitive and introduces a further NP as object.

Since Schachter's (1974: 254–256) analysis of the Àkán RSVC *daadaa* X *kɔɔe* 'trick X into leaving'/'trick X and leave', it is generally assumed that RSVC are systematically ambiguous between an object-oriented and a subject-oriented interpretation, consider the examples for Yorùbá (7) and Ẹ̀dó (8) below. Note that in these languages the subject of $V_1$ can bind the phonetically unrealised subject of $V_2$ across the object NP, which is an intervening potential antecedent:

(7) Olú$_i$ lu màálù$_j$ $\_{}_{i/j}$ kú.[7]
Olú beat cow die
a. ' Olú beat the cow dead.' YORÙBÁ
b. ' Olú beat the cow and died.'

[4]Example provided by Olúwadára Ọmọtọ̀ṣọ́ and Abídémi Jimoh.
[5]As quoted in Atoyebi 2009: 291–292.
[6]Example provided by Chinedu Úchèchúkwu.
[7]As quoted in Baker (1989: 547) (=ex. 69).

(8) Òzó$_i$ gbé ẹ̀khù$_j$ $\_i/j$ làá òwá.[8]
Òzó hit door enter house
a. ‘ Òzó hit the door into the house.’ ỊDÓ
b. ‘ Òzó hit the door and entered the house’

However, Lord (1974: 199–200) argues that the RSVC in Yorùbá *ti* X *ṣubú* ‘push X fall’ only allows for an object-oriented interpretation, due to some lexical restrictions of the verbs involved. But she also suggests for Yorùbá that both subject-oriented and object-oriented readings “are possible for any serial construction”. At some later point, Lord’s judgement of the Yorùbá example above was rejected and this same RSVC is now considered to have a subject-oriented interpretation, too (cf. Stewart 1998: 176).[9]

Based on Lániràn’s assessments, Baker (1989: 547) assumes that native speakers prefer object-oriented over subject-oriented interpretation in the ambiguous examples. But the fact that there instances of RSVC with transitive $V_1$ which only allow for a subject-oriented reading shows that this binding across an intervening object is by no means a very uncommon phenomenon (9):

(9) Ó$_i$ mu omi$_j$ $\_i/*j$ yó.[10]
3SG drink water be.full/be.satisfied
‘She drank water until full/satisfied.’ YORÙBÁ

The situation in Ìgbo is slightly different. On the one hand side, Ìgbo allows for both object-oriented (10) and subject-oriented compounds (11), and on the other hand side, it does only when $V_1$ does not have an object. Unlike RSVC with transitive $V_1$ in languages like Yorùbá or Ẹ̀dóid languages, which are systematically ambiguous between a subject-oriented and an object-oriented interpretation, resultative compounds in Ìgbo do not have a subject-oriented interpretation if $V_1$ is transitive.

(10) ọ́ tụ̀-fù-rù ákwụ́kwọ́.[11]
3S throw-be.lost-rV paper
‘He threw away the paper.’ ÌGBO
#‘He threw the paper and he got lost.’

(11) ọ́ gbá-fù-rù.[12]
3S.S go-be.lost-rV
‘He ran away.’ ÌGBO

[8] As quoted in Stewart (2001: 145) (=ex. 1).

[9] The early controversy on the systematic ambiguity of RSVC was pointed out to me by Victor Manfredi.

[10] As quoted in Déchaine (1993: 807).

[11] As quoted in Lord (1975: 25) (ex.4), assessment for subject-oriented reading by Mary Chimaobi Amaechi.

[12] As quoted in Lord (1975: 26) (11).

Considering these data from resultative compounds in Ìgbo, there are good reasons to assume that subject-oriented interpretations of 'RSVC' with transitive $V_1$ are some pattern entirely different from RVC. Stewart (2001: 14, 145–148) claims that they are not SVCs but instances of covert coordination.

As suggested in Section 2.1, it is the subject argument of $V_2$, which remains phonetically unexpressed. So far we explored here the different alternatives how that subject referent can be identified with clause internal antecedents. However, the question whether it could theoretically also refer to some antecedent which was not mentioned in the clause was not properly addressed yet. Based on data from Àkán , Hellan et al. (2003) concludes that the subject argument cannot be identified with a clause external referent (cf. the author's examples 7b & 8).

## 2.3 Headedness

There is a long controversy whether the verbs involved in SVCs stand in any hierarchical relation to each other or whether they are conjuncts with same syntactic status. Some authors such as Hyman (1971) suggest that all SVCs uniformly are coordinated clauses, others argue that at least some classes of SVCs are head-adjunct structures (cf. Bamgboṣe 1974: 34–36), or even all of them (cf. Déchaine 1993), and even others consider some or all SVC classes as head-complement structures, such as Baker (1989).

As shown below, resultative verb constructions in Yorùbá display typical behaviour of headed structures in imperatives. The overall construction in (12) can form an imperative and it inherits this property from its $V_1$ (13), whereas $V_2$ (14) in contrast cannot be used as an imperative.

(12) Jẹ ọbẹ̀ ewédú tán!
eat soup jute.leaf be.finished
'Finish up the ewédú!' YORÙBÁ

(13) Jẹ ọbẹ̀ ewédú!
eat soup jute.leaf
'Eat the ewédú!' YORÙBÁ

(14) # tán!
be.finished
Intended:'Be finished!' YORÙBÁ

From this it follows that the syntactic properties of the overall construction is determined by $V_1$, which thus acts as the head. Similar classifications were suggested by Déchaine (1993: 803–807, 811–812) and Ogie (2009: 476–479). However, only the latter considers RVCs as head complement structures, whereas the former assumes they are head adjunct structures. Here, we follow Ogie's spirit because $V_2$ involve unrealised arguments which have to be bound by some argument of the head $V_1$, which is reminiscent of control structures.

## 2.4 Structural case

Note that NPs with structural case are independently necessary for Benue-Kwa languages in order to explain the fact that there are at least 50 verbal lexemes listed in Abraham's (1958) dictionary for Yorùbá that involve a causative-inchoative alternation in which the THEME-argument can surface either as the direct object of the causative transitive variant or as the subject of the inchoative unaccusative variant. As Déchaine (1993: 807) following Awóbùlúyì (1971) pointed out, these verbs with alternation can even be the $V_1$ in resultatives, such as the light verb use of *pa* 'become.amalgated, get.in.contact' (cf. Abraham 1958: 538), as illustrated in the examples (15a–15b) below. There are similar alternations with verb in Ìgbo, which can be found as $V_1$ compounds, as shown by Manfredi (2005: 9) and Williams (2015: 209) (cf. 16a–16b):

(15) a. Ó pa ìlẹ̀kùn yìí dé.[13]
3SG strike door this close
'S/he shut the door.' YORÙBÁ

b. Ìlẹ̀kùn yìí pa dé.
door this;HTS strike close
'This door is shut.' YORÙBÁ

(16) a. Ọ sọ-ji-ri osisi m[14]
3S.S poke-snap-rV wood 1S.POSS
'S/he made my stick snap from poking.' ÌGBO

b. osisi m sọ-ji-ri asọji
wood 1S.POSS poke-snap-rV NMLZ-poke-snap
'My stick snapped from poking.' ÌGBO

The fact that the THEME-NP *ìlẹ̀kùn yìí* 'this door' is promoted to the subject position of *pa* once no AGENT is realised indicates that it must be assigned structural case by $V_1$. Inchoative-causative alternations with zero affixation are documented for other Benue-Kwa languages as well (cf. Stahlke 1970: 66–68; Ogie 2009: 21–22).

Apart from that there are RVC with unaccusitive $V_1$, which do not necessarily exhibit the alternation discussed above. As Baker (1989: 532–533) argues, a $V_1$ can be unaccusative as long as $V_2$ is unaccusative.

(17) Ó pọ́n rà.[15]
it ripen rot
'It ripened to the point of rotting.'

[13] As quoted in Déchaine (1993: 807).
[14] As quoted in Williams (2015: 209).
[15] As quoted in Baker (1989: 532–533).

(18) Wón jáde lọ.[16]
they enter go
'They went out.'

The realisation of case is governed by the case principle as suggested suggested Meurers (1999), Przepiórkowski (1999) or Müller (2002: (15) then.

## 2.5 Aspectual and temporal restrictions

As has been observed at various occasions, SVCs in Benue-Kwa stand out against other clauses that contain multiple verbs in that all the verbal components share the same values of polarity and tense, aspect and mood (cf. Stahlke 1970: 60, 78, 80, Baker 1989: 513, Déchaine 1993: 799–800, Collins 1997: 486, Aikhenvald 2006: 1, Bisang 2009, Aboh 2009: 3 and Shluinsky 2017: 379). This property applies to RVC too.

Stewart (2001: 75–78) argues that there are additional aspectual restrictions, which hold at least for RSVC in Ẹ̀dó : First of all, the first verb cannot be a stative predicate (19) and secondly object-oriented RSVC in Ẹ̀dó fail to embed unergative predicates as $V_2$ (20), and finally, recursion of RSVCs as $V_1$ is not possible in Ẹ̀dó . *sùá* X *dé* 'push X fall' cannot be the transitive base for another RVSC, which has *wú* as its unaccusative $V_2$ (21):

(19) * Òzó hòẹ́mweẹ́n Àdésúwà$_j$ $\_j$ wú.[17]
Òzó love Àdésúwà die
Intended: 'Òzó loved Àdésúwà to death.' ẸDÓ

(20) Òzó$_i$ sùá Úyì$_j$ $\_i/*j$ só.[18]
Òzó push Úyì cry
Intended: 'Òzó pushed Úyì till he cried' ẸDÓ
OK as: 'Òzó pushed Úyì and Òzó cried '

(21) * Òzó sùá ọ̀mọ́$_j$ $\_i/*j$ dé wú.[19]
Òzó push child fall die
Intended: 'Òzó pushed the child down to its death' ẸDÓ

Nevertheless, RSVCs can occur as components of other SVCs, as in 'take'-SVCs (22):

(22) Ẹniọlá á fi ṣíbí jẹ [ọbẹ̀ ewédú] tán.[20]
Ẹniọlá HTS use spoon eat soup jute.leaf be.finished
'Ẹniọlá finished the ewédú.' YORÙBÁ

[16] As quoted in Baker (1989: 532–533).
[18] As quoted in Stewart (2001: 12–13) (=ex. 9d).
[19] As quoted in Stewart (2001: 77–78) (=ex. 104b).
[20] Examples provided by Abídémi Jimoh.

# 3 Ìgbo compounds and suffixation

Apart from their diverging word order (cf. Section 1.1) and their lack of subject-oriented interpretations with transitive $V_1$ (cf. Section 2.2), resultative compounds in Ìgbo are distinguished from RSVCs by yet another property: Their $V_2$ tend to grammaticalise to a stronger degree than the one in RSVCs. Note that the position which immediately follows $V_1$ is the designated slot to express grammatical meaning; Emenanjo (2015: 240–255) lists more than 90 suffixes which contribute an aspectual, modal, temporal, manner or directional interpretation of the event encoded by the $V_1$.

In this light, it is not surprising that the suffix *-chà*, which express the terminal state of some event in resultative compounds (23), has a lexical meaning when used a main verb, namely 'be.ripe' (24). This is in clear contrast to Yorùbá where the stative verb *tán* 'finish/be.finished' has constantly the same meaning as main verb and as $V_2$ in resultatives (1).

(23) ó rìchà-rà únèrè áhụ̀.[21]
3S.S eat-be.finished-rV banana DEM
'He ate up that banana.'

(24) únèrè áhụ̀ chà-rà.[22]
banana DEM be.ripe-rV
'That banana is ripe.'

The tight relation between $V_1$ and $V_2$ in Ìgbo resultative compounds is illustrated by their interaction with negation. As shown by Obiamalu (2014: 44), negation in ÌGBO is formed by a circumfix-like structure consisting of the harmonising prefix *e-/a-* and the suffix *ghí* embracing the verbal root, like the stative verb *mà* 'be.beautiful', (25). Turning to compounds, it can be seen that these circumfixes embrace the entire sequence of $V_1$ *rì* 'eat' and $V_2$ *chà* 'be.finished', demonstrating that the two verbal components are not seperable (26).

(25) Àda a-mā-ghí mmā[23]
Ada PFX-be.beautiful-NEG beauty
'Ada is not beautiful.'

(26) Àda é-ríchá-ghí únèrè áhụ̀.[24]
Ada PFX-eat-be.finished-NEG banana DEM
'Ada didn't eat up the banana.'

[21] As quoted in Lord (1975: 32).
[22] As quoted in Lord (1975: 32).
[23] As quoted in Obiamalu (2014: 44), example (2b).
[24] Chinedu Úchèchúkwu (pers. comm).

Yet the fact that most compounds do not involve vowel harmony between $V_1$ and $V_2$ indicates that these two verbs still constitute independent phonological words (Victor Manfredi pers. commun.).

# 4 Previous Analyses in derivationalist and functionalist frameworks

Most derivational approaches face serious challenges in providing an analysis for object-oriented RSVCs and resultative compounds. In particular, it is not entirely clear how the unrealised subjects of $V_2$, eg. *tán* 'be.finished' and *chà* 'be.ripe/finished' are to be analysed. These patterns tempt various authors into making assumptions which contradict some of the core principles of their own frameworks: Baker (1989: 529–532) and Baker & Stewart (1999: 17–20) consider RSVCs involving doubly headed VPs, Déchaine (1993: 811–812) assume head movement from an $VP_2$, which is adjoined to $VP_1$, to $V_1$. Collins (1997: 482, 484–485, 494) postulates object control structures with small pro as phonologically empty subject. However, this account makes the false prediction that the subject of $V_2$, being a common subject pronoun, should be able to refer to clause external referents, just like arbitrary PRO does. As illustrated by Hellan et al. (2003), this option is not available, at least for Àkán (cf. Section 2.2 in the present paper). Finally, Aboh (2009) can only account for SVCs in which the $V_1$ is a semantically bleached light verb, yet under such circumstances it would be impossible for $V_1$ to have an NP object and assign object case to it.

Lord (1975: 26–27, 30–32, 33–35, 41–43) demonstrated that derivational analyses encounter further difficulties in predicting the properties of RVC, which largely concern idiomaticity and word order, but which cannot be exemplified here due to restrictions of space.

# 5 A lexicalist analysis

As already demonstrated by Lord (1975), derivational approaches towards resultative compounds in Ìgbo face a row of serious challenges which can be tackled more easily by a lexicalist analysis.

## 5.1 Previous analyses in HPSG

Within the framework of HPSG, a variety of different syntactic analyses for SVCs have been suggested. Some authors assume a uniform structure for all types of SVCs, others assume that there are distinct subclasses of SVCs, which involve different syntactic configurations. The first large group of accounts considers (some classes of) SVCs as *head-adjunct* structures such as Hellan et al. (2003). They consider 'take'-SVCs, RSVCs and other types to

be structures in which $V_1$ acts as head and $V_2$ as adjunct modifier of $V_1$. Yet this analysis does not cover the aspect of how TAM inflection is organised in different languages and whether adjuncts can be the morphemes which carry the main inflection.

The second group of analyses treats (some classes of) SVCs as *head-complement* structures or structures in which a verbal head selects the other verb and forms a complex predicate with it. Song (2007: 442), Kim et al. (2010: 442–444) argue for Korean 'SVCs' that $V_2$ is the head, which selects $V_1$ constituting a complex predicate, which also allows for constructional, non-compositional semantics. Their main argument for the assumption of such a configuration is the fact that $V_2$ is always the verb which bears tense and aspect suffixes. As Korean is an SOV language, unlike Benue-Kwa which is SVO, many of the details of their analysis are not relevant here. Moreover, Korean SVCs are restricted to non-stative predicates (Kim et al. 2010: 442–443), and thus they cannot have the same type of resultative verb constructions as prevalent in Benue-Kwa. Note that all the examples given by the authors involve constructions in which the two verbs are not separated by intervening arguments, as as it is the case with serialising SOV languages such as Ijaw (Williamson 1965: 53–56, Carstens 2002), but they rather form clause final compounds. Therefore, it may be objected whether the term serial verb construction is really appropriate here and whether these constructions are not complex predicates of the type found in other (S)OV languages such as German (Müller 2002). Moreover there is an *head-complement* analysis of Ẹ̀dó RSVC developed by Ogie (2009: 476–480).

The last group treats (some classes of) SVCs as covert coordination such as Müller & Lipenkova's (2009) analysis of Mandarin *ba* SVCs.

## 5.2 Word order and argument linking

Following the spirit of Müller's (2002: 241, 2006: 873, 2013: 359) analysis, it is assumed here that RSVC are a result of applying a lexical rule to a certain class of lexical full verbs which alters their valency by adding a resultative predicate to their ARGUMENT-STRUCTURE-list, turning them into complex predicates which attract the subject argument of the unaccusative $V_2$ and assigns object case to them. Unlike some previous analyses, that lexical rule is assumed to operate on the ARG-ST rather than COMPS-list, as the former invariably is the most central representation of the argument structure of some lexical word (Sag & Wasow 1999: 152–154).

Precisely speaking, it is suggested here that three version of the lexical rule are necessary to accommodate the different scenarios: (A) transitive $V_1$ + unaccusative $V_2$ (object-oriented), (B) unaccusative $V_1$ + unaccusative $V_2$ (subject-oriented), and (C) a less specified subject-oriented case. Despite the fact that scenario A and B intuitively seem to be closely related in that they involve a shared NP which is the THEME of $V_1$ and of $V_2$, it is not a

trivial task to conflate this into a single rule, as already noticed by Müller (2002: 240–247) for German. For the sake of simplicity and legibility we will resort to assuming two separate rules here. The fact that there are certain constructions which are not compatible with the scenario C, such as Ìgbo compounds, or constructions which have unergative $V_2$ (cf. ex. 20 in Section provided by Stewart 2001: 12–13), makes it necessary to assume distinct lexical rules for A and B on the one hand side and C on the other hand. Stewart (2001: 14, 145–148) even claims that subject-oriented interpretations of type C are not SVCs but some entirely different construction named 'covert coordination'. Yet, it remains to be checked whether there are languages or constructions which are only subject to rule A but not to rule B or vice versa.[25]

After all, it is plausible to conclude that there is a more general type for each of these three lexical rules which hold across all Benue-Kwa languages as illustrated in Figures 1–3, which in turn are possibly only inherited by three more universal rules. Each of the individual Benue-Kwa languages is considered to have more specified version, which contains language specific idiosyncrasies and which inherit the features they have in common from the general rule via an inheritance hierarchy. These language specific rules will be discussed in great detail in Section 5.3.

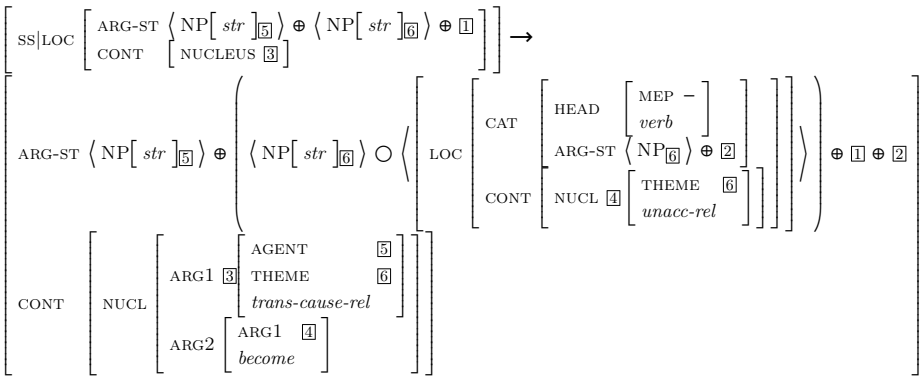


Figure 1: Unified lexical rule for object-oriented RVCs with transitive $V_1$ in Benue (cf. Müller 2002: 241–243, 2006: 873, 2013: 359)

Turning to the lexical rule for object-oriented RVCs, the basic idea is that it yields resultative which are *head-complements* or *head-cluster* structures, in which $V_1$ is the syntactic head and $V_2$ is its complement, as already demonstrated in Section 2.3. The general lexical rule for Benue-Kwa languages

[25]The German resultatives based on unaccusative $V_1$ gathered by Müller (2002: 230–232) involve above all verbs which take PPs as their result state predicate such as *in Stuecke brechen* 'to break into pieces', *zu Wachs schmelzen* 'to melt into wax', *zu einer Pfütze schmelzen* 'to melt into a puddle', *zu einem Block frieren* 'to freeze into a block'. In contrast, there are many resultative based on transitive $V_1$ which combine with adjectives. This contrast could justify the existence of two distinct rules.

determines the essential properties of RVC in these languages, as illustrated in Figure 1. Firstly, the ARG-ST-list of the overall RVC contains a shuffle operator, as proposed by Bender (2008), which connects the THEME-argument with the index 6 and the embedded unaccusative predicate. This shuffle operator allows to account for the word order variation in among RVC in these languages either realised as $NP_{subj}$ $V_1$ $NP_{obj}$ $V_2$ (Yorùbá or Emai type) or as $NP_{subj}$ $V_1$ $V_2$ $NP_{obj}$ (Ìgbo type). Note that the parentheses here do not mark optionality but they indicate the arguments of the shuffle operator. Secondly, this rule enables RVCs to attract the complements introduced by $V_2$ (cf. argument marked by 2) into its own ARG-ST-list. Thirdly, it accounts for the examples in Ìgbo discussed by Lord (1975: 33), in which the overall RVC can retain inherent verb complements of $V_1$ (cf. argument marked by 1). In its use as a simple verb, *lụ̀* 'fight' always requires the presence of an cognate object *ọ̀gụ̀* 'fight', whose realisation remains mandatory even in RVCs (27).

(27) Há lụ̀-sò-rò ànyí ọ̀gụ̀.
3P.S fight-against-rV 1P.O fight
'They fought against us.' ÌGBO

Finally, this lexical rule is capable of accounting for the well known fundamental properties of RVCs in Benue-Kwa, according to which all the verbal components share the same values polarity and TAM (Stahlke 1970: 60,78,80, Baker 1989: 513, Aikhenvald 2006: 1, Bisang 2009 or Shluinsky 2017: 379). Bohnemeyer et al. (2007: 497, 502–508) and Bohnemeyer & Van Valin (2017: 144–148) argue that syntactic constructions differ with respect to whether or not they have the macro-event property (MEP). A construction $C$ has the MEP if all its sub-events are always necessarily in the scope of time-positional adverbials such as *at 11:13 am*.

(28) Macro-event property (MEP)
A construction $C$ that encodes a (Neo-) Davidsonian event description $\exists e.P(e)$ ('There is an event e of type/property $P$') has the MEP iff $C$ has no constituent $C'$ that describes a proper subevent $e'$ of $e$ such that $C'$ is compatible with time-positional modifiers that locate the runtime of $e'$, but not that of the larger event $e$.

In their studies, Bohnemeyer et al. (2007: 506–507, 509–511) and Bohnemeyer & Van Valin (2017: 171–177) demonstrate that simple SVCs in Kwa languages have the MEP. Accordingly, RVC in Benue languages are considered here to exhibit the MEP, too.

In cases where the RVC is not embedded in another SVC the head of entire must be specified as MEP+. In contrast, verbs (or serial verbs) which can be component of an (other) SVCs have to be underspecified for the MEP: If they are selected as component of an SVC they bear the feature MEP−

(cf. ex. 22 in Section 5.2), as they fail to be modified by time-positional adverbs.[26]If they occur as a single main verb, they exhibit the specification MEP+, in order to be able to be modified by time-positional adverbs. As it seems here, it is the distinctive property of languages which allow SVCs that (some) verbs can be specified as MEP−. Taking this into account, the lexical rule can be modelled as follows: As the $V_1$ in RVCs functions as the head of the overall construction and as it cannot be independently modified without the modifier taking scope over $V_2$ too, $V_1$ is specifed for MEP+. In opposition, the component $V_2$ itself does not constitute a macro-event, thus specified as MEP−, as shown in Figure 1.

Note that what is considered as a (macro)-event in a given language is not defined by a general objective ontology. Since each observable event can be decomposed into sub-events, it is impossible to define a repertoire of universally and cross-culturally accepted 'atomic' events. The event of eating for instance involves the movement of several muscles in the body and physiologically complex processes of digestion, which each can be split up into chemical reactions such as reorganising molecular structures et cetera. As proposed by Durie (1997: 322) and Aikhenvald (2006: 10–12), what may be perceived as linguistically relevant (macro-)event differs culturally. Any verb which can participate in SVCs in these languages have an underspecified MEP feature, verbs which do not participate in SVC formation because they always constitute macro-events by themselves are marked as MEP+. In order to account for both types of subject-oriented RVCs, the relevant lexical rule are almost identical: in the case of subject-oriented RVCs with unaccusative $V_1$, the output returns a $V_1$ whose THEME subject argument is co-referential with the THEME subject argument of $V_2$ (cf. Figure 2), in the case of subject-oriented RVCs with unergative $V_1$, the output yields a $V_1$ whose subject argument is co-referential with the subject argument of $V_2$, whereas the type of semantic role remains unspecified in both cases (cf. Figure 3).

Returning to the grammatical properties of SVCs, it was already mentioned that negation cannot scope over separate verbal SVC components, in a similar manner as time-positional modifiers. Thus negation is considered to be limited to modify verbal elements which are specified for MEP+,

Given the negation's selectional restrictions, it becomes evident why $V_2$, bearing the feature MEP−, cannot be independently negated. A parallel analysis can be assumed for the remaining TAM markers. In order to ensure that simple verbs outside RVC can be negated, they are considered to have the macro-event property, hence MEP+.

The analysis presented here builds on Lord's (1975: 43–46) assumption on Ìgbo resultative compounds, according to which both the complete compound

[26]The fact that SVCs have to be underspecified with respect to MEP in order to be embeddable in other SVCs was pointed out to me by Antonio Machicao y Priemer.

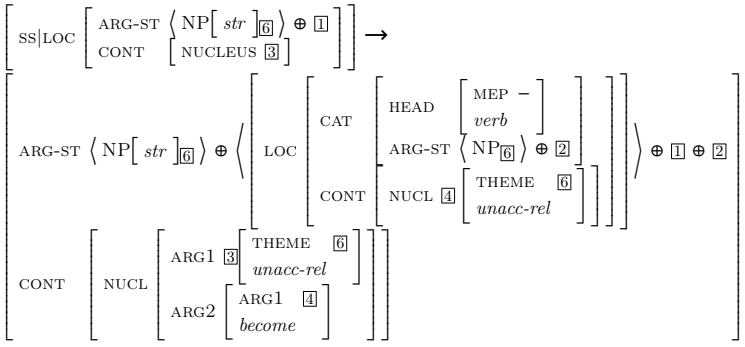


Figure 2: Unified lexical rule for subject-oriented RVCs with unaccusative $V_1$ in Benue (cf. Müller 2002: 241–244, 2006: 873, 2013: 359)

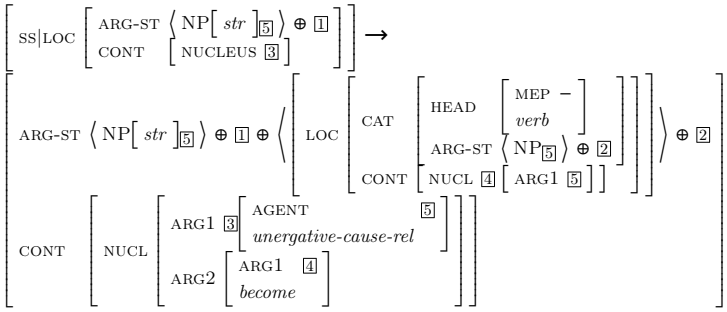


Figure 3: Lexical rule for subject-oriented constructions with unergative $V_1$, in Benue (cf. Müller 2002: 241–243, 2006: 873, 2013: 359)

as well as its components $V_1$ and $V_2$ are listed in the lexicon. Furthermore, she concludes that compounds with compositional meaning are related to components by means of redundancy rules. The analysis consists of two major parts: firstly a lexical rule inspired by Müller (2002: 241, 2006: 873, 2013: 359), which turns a transitive verb into a complex predicate, as already specified above, and secondly, ID-schemes inspired by Godard & Samvelian (2021: 441–443). On closer inspection, it turns out that the contrast between Yorùbá and Ẹ̀dóid RSVC on the one hand side and compounds in Ìgbo on the other is fairly reminiscent of the contrast between complex predicates of the Italian type and Spanish type, as described in Godard & Samvelian (2021: 436–440). Yorùbá and Ẹ̀dóid RSVC are complex predicates with flat argument structure, in which $V_1$ and $V_2$ do not form a constituent, much similar to the Italian type but with diverging word order. In contrast Ìgbo compounds form a verb cluster. The typological difference between RSVC in Yorùbá and Ẹ̀dóid and resultative compounds in ÌGBO is mainly caused by the application of different ID-schemata, as suggested by Müller (2002: 87) and Godard & Samvelian (2021: 441–446): Whereas RSVC are licensed by the *head-complements*-scheme,resultative compounds are licensed

by the *head-cluster*-scheme. The crucial difference relies on the specification of the feature LEX introduced by Hinrichs & Nakazawa (1989, 1994) and further developed by Müller (2013: 243–246) in order to account for predicate complex formation in German: Embedded predicates which bear the value LEX+, have COMPS-list that are not yet saturated when it is combined with the head daughter. In contrast, predicates specified as LEX− have an empty COMPS-list and all their complements already realised prior they are combined with a light verb or auxiliary.

It should be noted that Godard & Samvelian (2021: 423) explicitly doubt whether Ẹ̀dó SVCs like *sàán rrá* 'jump cross' are to be analysed as complex predicates. However, as illustrated in great detail by Déchaine (1993) and Ogie (2009) what is dubbed as SVC in literature on Benue-Kwa languages encompasses a wide array of syntactically fairly diverse constructions. As shown above, RVCs in these languages display beyond any doubt properties of complex predication such as: argument attraction, shared polarity and TAM values.

### 5.3 Inflection

Finally, the variation in verbal inflection can be accommodated by language specific lexical rules for the formation of resultatives, which inherits from the general lexical rule 1. In both Ẹ̀dóid and Ìgbo, it is assumed that the presence of the FACTATIVE or *r*V-suffix is modelled by a boolean HEAD feature. As shown by Schaefer & Egbokhare (2017: 27–29) for Emai, the factative *i̇*-suffix is only present with verbs which are not followed by a NP-complement. Such verbs would be marked with FACT+. In contrast, $V_1$ and $V_2$ in SVCs can never bear that suffix. This is achieved by the output of the lexical rule for Emai illustrated in Figure 4: both the head $V_1$ and the embedded $V_2$ bear the feature FACT−. Alternatively, the distribution of the factative suffix in Ẹ̀dó can be derived from the COMPS-list value of the verb, as sketched by Ogie (2009: 92–95). In similar vein, Ìgbo has the boolean HEAD feature RV. As the *r*V-suffix always attaches to the last verbal element, the output of the lexical rule sketched in Figure 5 yields a head $V_1$ specified for RV− and a complement $V_2$ specified for RV+. The language specific lexical rules for Yorùbá only needs the boolean feature HTS in order to motivate the lack of the high tone syllable on $V_2$, as illustrated in Figure 6.

## 6 Conclusion

Summing up, the variation in West Benue RSVC is the result of the interaction of contrasts at different levels of grammar: Firstly, there are at least three different lexical rules which yield resultative verb constructions or some thing related. Not all of the lexical rules can be applied in each languages to each construction. Secondly the shuffle operator in the general lexical rule

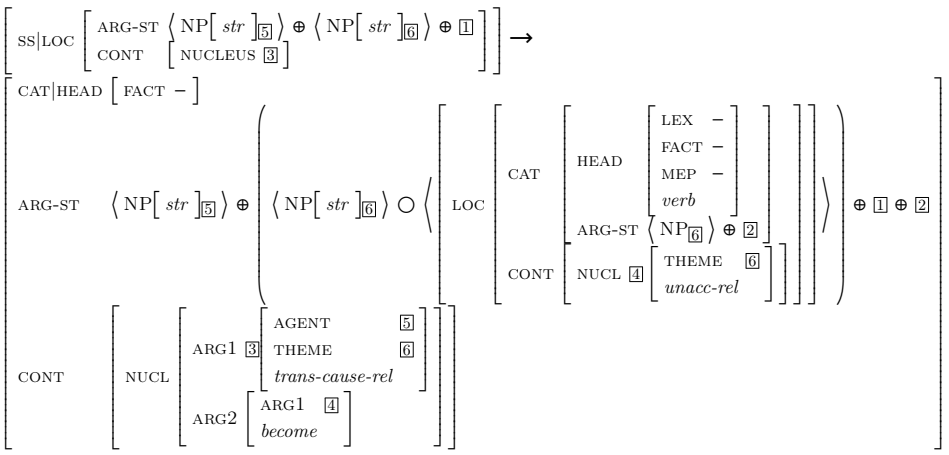


Figure 4: Language specific lexical rule for object-oriented RSVC with transitive $V_1$ in Emai

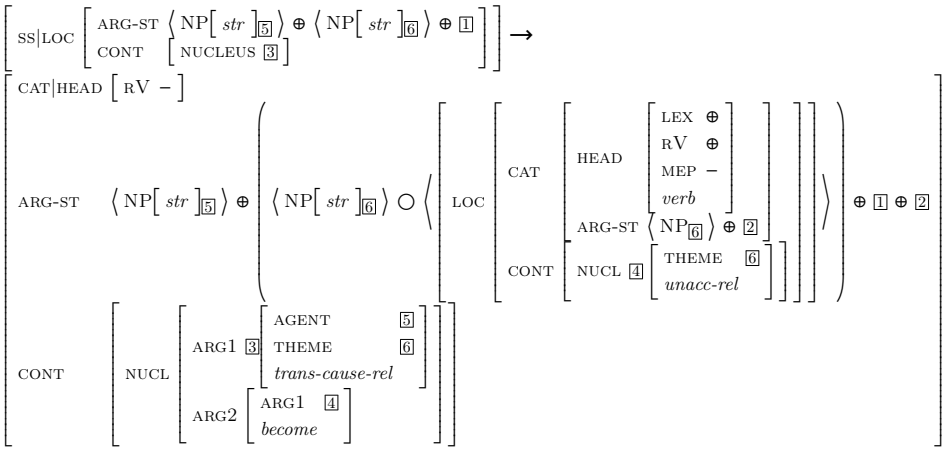


Figure 5: Language specific lexical rule for object-oriented compounds with transitive $V_1$ in Ìgbo

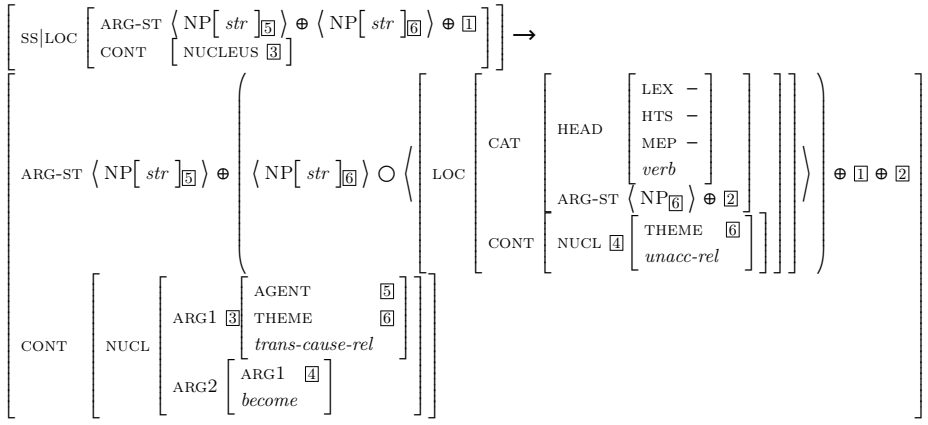

Figure 6: Language specific lexical rule for object oriented RSVC with transitive $V_1$ in Yorùbá

allows for a variation of word order sequences over the different languages. Thirdly, there are language specific versions of these rules which inherit from the general rules and enrich them with language specific peculiarities for inflection or argument realisation.

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# Towards a treatment of register phenomena in HPSG

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**Abstract**

In this paper, we deal with register-driven variation from a probabilistic perspective, as proposed in Schäfer, Bildhauer, Pankratz & Müller (2022). We compare two approaches to analyse this variation within HPSG. On the one hand, we consider a multiple-grammars approach and combine it with the architecture proposed in the CoreGram project (Müller, 2015) – discussing its advantages and disadvantages. On the other hand, we take into account a single-grammar approach and argue that it appears to be superior due to its computational efficiency and cognitive plausibility.

# 1 Introduction

It is not only important what we say when making utterances, but also how we say it. Language users use and recognize a range of *registers* in communicative situations. For instance, people talk differently to a cab driver during a ride, in a job interview, and to their friends in a pub. While there is a research tradition on registers in formal frameworks (e. g., Paolillo, 2000; Bender, 2007; Adger, 2006; Asadpour et al., 2022), there is probably no such thing as a taxonomy of registers for a given language that most researchers would agree on (let alone a cross-linguistic inventory of registers, see Schäfer, Bildhauer, Pankratz & Müller 2022). Considerable confusion exists regarding the delineation of registers and related categories such as style and genre. Furthermore, the most likely fuzzy boundaries between registers make it notoriously difficult to even agree on necessary and/or sufficient conditions (such as the occurrence of particular linguistic features) for category membership (Biber & Conrad 2009; see Argamon 2019). However, it is obvious that all parts of the linguistic system that have been studied in HPSG play a role in modelling register phenomena (Bender, 2007, 354). For instance, in phonology and morphology: whether reduced forms of words are used or not as in (1); in the lexicon connecting phonology, syntax, semantics: whether formal or less formal vocabulary is used as in (2); in syntax: whether complex and elaborated relative clauses are used or not (cf. Asadpour et al., 2022); in semantics: whether we use a precise or imprecise expression as in (3).

(1) Ich { *habe es* / *hab's*} gekauft.
I have it have.it bought
'I have bought it.'

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(2) Meine Frau ist { *Polizistin* / *Bulle* }.
my wife is policewoman cop
'My wife is a policewoman.'

(3) I will arrive at {*3:32* / *half past 3*}. (cf. Solt, 2015)

In a data-driven analysis to be reported elsewhere (Schäfer, Bildhauer, Pankratz & Müller, 2022), we have used Bayesian generative models (Latent Dirichlet Allocation, Blei et al. 2003) to infer potential registers (instantiated in clusters of documents) from a large corpus of German based on the distribution of linguistic signs in the documents. While superficially similar to work by Douglas Biber (e.g., Biber 1988, 1995), our approach differs significantly from Biber's. It is fully probabilistic and allows for many-to-many associations between linguistic signs, registers, and documents, and it does not rely on available a priori register taxonomies. In a further step of manual annotation, we managed to reliably identify situational-functional parameters such as a higher level of education, proximity, or interactivity for the potential registers. We find, for example, that some registers are associated with a high probability of occurrences of adverbs, certain tense forms, or more complex phenomena like passives and clausal pre-fields.

In this paper, we discuss and provide an implementation of such findings in a formal grammar – an issue that has been largely neglected in formal theories of grammar (e. g. Labov, 1969; Guy, 1996; Hudson, 1997; Bender, 2001, 2007; Fasold & Preston, 2007). HPSG is highly suitable for the task at hand because its multi-level architecture allows us to formulate constraints on all levels of linguistic description. Furthermore, by virtue of constraint underspecification, it enables us to add register information to more general grammatical constraints that are assumed for independent reasons.

From the perspective of both grammar theory and psycholinguistics, one overarching question is how variation in grammar (including register variation) is encoded in speakers' grammars, and how speakers use it (cf. Lüdeling et al., 2022). Different (more or less explicit) answers to the variation issue have been given in various frameworks (cf. Paolillo, 2000; Adger, 2006; Jackendoff & Audring, 2020 for examples in HPSG, Minimalism, and Parallel Architecture, respectively) and with respect to diverse sub-components of grammar and regarding extra-grammatical components. One option is to assume that speakers deal with different registers by using a set of distinct grammars or a single grammar with a separate module encoding variation (Yang, 2002; Adger, 2006). In contrast, it is also conceivable that speakers use a single grammar with all information about the variation encoded in it (Paolillo, 2000; Bender, 2001, 2007; Pierrehumbert, 2008; Hilpert, 2013). While it cannot be known whether such questions can ultimately be answered based on empirical evidence available today, the goal of this paper is to explore ways in which either approach could be implemented in HPSG.

It should be noted that using different grammars for different registers is technically reminiscent of the approach presented in Søgaard & Haugereid (2007), who propose a grammar for Scandinavian containing subgrammars for Danish, Norwegian and Swedish. The authors use a LANGUAGE feature that serves to identify the language (or languages) of a linguistic object. However, such a model of different languages is not necessarily related to cognitive reality, simply because many speakers only speak one of the three languages. Register variation is fundamentally different in this respect since competent speakers are able to understand and produce utterances in various registers.

In this paper, we compare two potential approaches to register modelling in HPSG, one assuming multiple grammars for multiple registers (Section 2), and one assuming only one grammar including information about several registers (Section 3).

## 2 Multiple grammars for multiple registers

As pointed out in the introduction, speakers/hearers are able to use and detect various registers. This is reminiscent of multilingualism, and hence an obvious route to take is to have a look at multi-lingual grammar engineering projects within the HPSG framework and their potential to be adapted to modelling register variation.

A register-aware grammar does not need to distinguish between the *grammaticality* of utterances in different situations because even register-mismatched utterances are grammatical. It should rather model their *adequacy* in these situations. Judgements of register adequacy are scalar (not binary like grammaticality judgements), and they have therefore been analysed as felicity conditions (cf. Paolillo, 2000; Bender, 2007; Asadpour et al., 2022). An utterance that can be used in a rather informal register – let's call it Register I – can also be used in a rather formal register – let's call it Register F. This utterance does not need to be ruled out by the grammar, but its use is simply less adequate. It might violate felicity conditions imposed by the context, but it can be used and will be understood in a formal situation. For instance, (4)[1] shows an utterance from Joschka Fischer, a member of the German parliament in 1984, in a parliament session. While the word *Arschloch* 'asshole' belongs to Register I, other elements in the utterance (e.g. *mit Verlaub* 'with respect') clearly signal Register F, i.e. leading to a so-called register clash (cf. Jackendoff & Audring, 2020, 248).

(4) Herr Präsident, Sie sind ein Arschloch, mit Verlaub!
'With respect, Mr. President, you are an asshole!'

[1] https://www.sueddeutsche.de/politik/parlamentarisches-schimpfbuch-auf-den-strich-gehe-ich-nicht-1.389241

In a multiple-grammars approach, the individual grammars (i. e., one for each register) interact with each other, allowing elements of one grammar (word, syntactic rules, etc.) to be combined with elements of another grammar. That is, every grammar needs to share constraints on linguistic signs with the others. The predictions to be made by such a system should not be (as mentioned already) grammaticality decisions but rather quantifications of the *probability of utterances in a given register*. However, cross-linguistic grammar implementation could provide a general framework for an implementation of register grammars in HPSG.

There are two main approaches to multi-lingual grammar engineering within HPSG: the Grammar Matrix (cf. Bender et al., 2002; Flickinger et al., 2000; Flickinger, 2000)[2] and the CoreGram project (Müller, 2015). Due to its explicit goal to implement grammars that are organised using interacting sets of constraints, in this paper we concentrate on the architecture proposed in the CoreGram project. Theoretically at least, this architecture is well suited to our needs, since such sets could also be used to model register phenomena in the context of a multiple-grammars approach.

Müller (2015, 2014) explains the general CoreGram approach with respect to German and Dutch grammars as follows. German and Dutch are rather similar: they are both SOV languages, both are V2 languages, both have verbal complexes, and they share many other common properties. The argument structure constructions and linking are very similar (see Davis et al. 2021 on linking). Of course, the lexical items and the pronunciation are different, there are differences in the specific way the verbal complexes are organised in Dutch and (Standard) German, and so on (compare the work of Bouma & van Noord 1998 and Hinrichs & Nakazawa 1994; Kiss 1995; Meurers 2000; Müller 2013).

The organisation of constraint sets is illustrated in Figure 1. All shared constraints between the two grammars (e. g. constraints dealing with argument structure, verb-second order, SOV constituent order, verbal complexes, and the Head-Filler Schema) are in Set 3. Those constraints that apply only to German are in Set 1 and those particular to Dutch in Set 2. That is, Set 1 and 2 contain (among other things) the lexicons of the respective languages.

When we add a third related language such as Danish, the picture gets more complex. German, Dutch and Danish share the property of being V2 languages, and they share linking and argument structure constraints. Danish is an SVO language, and it does not have verbal complexes. Hence, all constraints that are specific to Danish are in Set 6 in Figure 2. Obviously, when other SVO languages like English and French are added, new constraint sets will emerge.

It is worth mentioning that although Figure 2 looks like an inheritance

[2]The Grammar Matrix approach could also work to model the multiple-grammars as well as the single-grammar approach.

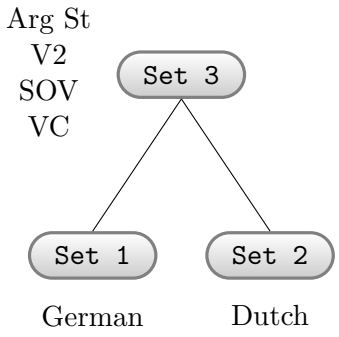


Figure 1: Shared properties of German and Dutch

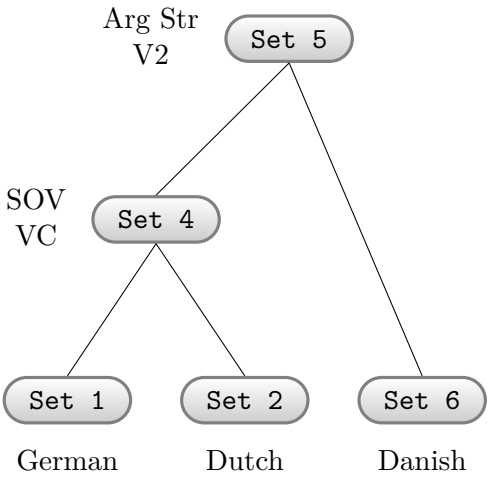


Figure 2: Shared Properties of German, Dutch, and Danish

hierarchy, it is not. It is a depiction of inclusion relations, where more specific sets include the more general sets. That is, Set 4 includes Set 5, and Set 2 includes Set 4. Due to this property, the Dutch grammar (in Figure 2) needs to include Set 2 only since it also includes the constraints specified in Set 4 and Set 5.

Now, this approach could also be applied in a top-down way to model register phenomena. The most general constraint set would be Set 1 in Figure 3, which represents a general grammar of German – as illustrated in Figure 2. There would be (at least) two further sets, let's call them Set 1-F and Set 1-I, for two different registers: a rather formal and a rather informal register. These sets include all constraints from Set 1, the general grammar of German, and specific constraints related to their particular register type.[3]

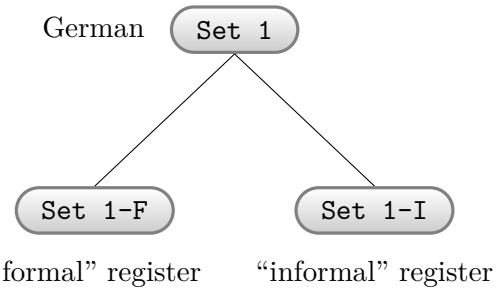


Figure 3: Modelling two registers of German

For example, certain words, aspects of meaning, constructions, or constraints could be associated with either of the two registers. For instance, the German word *Kohle* (lit. 'coal') can be used referring to 'money' in informal communication (cf. *dough* in English). Therefore, one might assign it to Set 1-I, that is, to the informal register. Alternatively, the meaning of the word *Kohle* could be 'coal_or_money' in Set 1, and it would be further constrained such that the meaning 'money' is ruled out (or rather be assigned a very low probability, see below) in Set 1-F but not in Set 1-I.

One main aspect of register variation that has to be taken into account is that the occurrence of register-sensitive linguistic features is usually not a matter of all-or-nothing (see e.g. Biber & Conrad, 2009, 53–54 as discussed in Section 1). Therefore, our approach – in line with the assumptions underlying our exploratory Bayesian analysis (cf. Schäfer, Bildhauer, Pankratz & Müller, 2022) – assumes a *probability distribution* for linguistic features spe-

[3]As mentioned in Section 1, there is no agreement within the linguistic community with respect to an inventory or taxonomy of existing registers. We work with registers that have been identified by analysing the distributions of linguistic signs in corpus data, and which have been associated with situational-functional properties through manual annotation (following Schäfer, Bildhauer, Pankratz & Müller, 2022). In the present paper, concrete registers are only chosen for illustrative purposes since we only discuss fundamental problems of formal implementations of register grammars.

cific to each register. This can be captured in HPSG by attaching weights or probabilities to register-sensitive entities, including lexemes, inflectional and derivational lexical rules and syntactic schemata.

For instance, in the informal register (Set 1-I), the word *Kohle* 'money' could have higher probability than the more neutral word *Geld* 'money', and *Geld* could have a higher probability than the word *Kohle* 'money' in the formal register (Set 1-F). When two or more linguistic objects are combined, the weight/probability of the mother is computed from the weight/probability of the daughters and the register value of the schema/rule that licenses the combination. Unfortunately, the mathematics behind probabilistic HPSG is not completely worked out yet, but there are promising initial ideas (Brew, 1995; Abney, 1997; Miyao & Tsujii, 2008; Guzmán Naranjo, 2015). It is worth noting that this approach understands the usage component of language as a part of the grammar, rather than treating it as a factor external to language – in line with usage-based approaches (contra e.g. Newmeyer, 2003).

The approach described above also works for syntactic phenomena. For instance, in our identification of registers in the data-driven analysis, the complexity of constituents in clause initial position (in the so-called *Vorfeld*) turned out to be a good indicator of registers requiring an elevated level of education. Since German is a Verb Second language, any constituent can occupy the Vorfeld, including full clauses (5c). The syntax of German contains a Filler-Head Schema that is not restrictive as far as the filler daughter is concerned. The actual filler is determined by what is missing in the rest of the sentence. It can be an NP (5a), a PP, an adverb (5b), a verbal projection (5c), or one of many other types of constituents.

(5) a. [Den Nachbarn]$_i$ hat Tina gestern $\__i$ gefragt, ob
the.ACC neighbour.ACC has Tina yesterday asked whether
er sie kennt.
he her knows

b. Gestern$_i$ hat Tina $\__i$ den Nachbarn gefragt, ob er sie
yesterday has Tina the neighbour asked whether he her
kennt.
knows

c. [Ob er sie kennt]$_i$, hat Tina gestern den Nachbarn
whether he her knows has Tina yesterday the neighbour
gefragt $\__i$.
asked

'Yesterday, Tina has asked the neighbour whether he knows her.'

This is covered by the fact that the only constraint on the filler daughter that is specified in the Filler-Head Schema (cf. (6)) is that the LOCAL value of the filler has to match the element in SLASH.

(6) Filler-Head Schema according to Müller (2013, 169):

*head-filler-phrase* ⇒

$$\begin{bmatrix} \textsc{nonloc}|\textsc{slash} & \langle\rangle \\ \textsc{head-dtr}|\textsc{synsem} & \begin{bmatrix} \textsc{loc}|\textsc{cat} & \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textit{verb} \\ \textsc{vform} & \textit{fin} \\ \textsc{initial} & + \end{bmatrix} \\ \textsc{subcat} & \langle\rangle \end{bmatrix} \\ \textsc{nonloc}|\textsc{slash} & \left\langle \boxed{1} \right\rangle \end{bmatrix} \\ \textsc{non-head-dtrs} & \left\langle \begin{bmatrix} \textsc{synsem} & \begin{bmatrix} \textsc{loc} & \boxed{1} \\ \textsc{nonloc}|\textsc{slash} & \langle\rangle \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

We can now use additional constraints on *head-filler-phrase* to encode register knowledge. Assume that we are currently analysing a sentence using a set of constraints that corresponds to a rather formal register (e.g. Set 1-F above). If we see a *head-filler-phrase* with a filler-daughter that is a finite verbal projection (a clause), then we know that within the formal register at hand, its probability of occurrence is (relatively) high. For the purpose of illustration, let us assume that it is 0.05. In (7), we expand the feature geometry of signs by assuming a REGISTER attribute whose value specifies the type of register (as a value of TYPE) and its probability in this type of register (as a value of WEIGHT).

(7)
$$\begin{bmatrix} \textit{head-filler-phrase} \\ \textsc{non-head-dtrs} & \left\langle \begin{bmatrix} \textsc{synsem}|\textsc{loc}|\textsc{cat}|\textsc{head} & \begin{bmatrix} \textit{verb} \\ \textsc{vform} & \textit{fin} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \Rightarrow \begin{bmatrix} \textsc{c-cont}|\textsc{reg} & \begin{bmatrix} \textsc{type} & \textit{1-F} \\ \textsc{weight} & \textit{0.05} \end{bmatrix} \end{bmatrix}$$

A set of constraints corresponding to a different register (e.g. Set 1-I above) would contain a different version of this constraint, thus assigning a different probability, i.e. a different value of WEIGHT, to REGISTER.

Under this approach, each sentence can be analysed relative to a particular register grammar (i.e. a particular probability distribution over register-relevant features). In addition to an analysis of the syntax and semantics of the sentence, the weight/probability of the topmost node can then be interpreted as the register score of that sentence, reflecting the probability (and therefore perhaps also the appropriateness) of that sentence with respect to that register.

An interesting feature of this approach to register-modelling is that, in principle, different subtypes of registers can also be modelled, possibly reflecting different stages in language acquisition. The stage at which we acquire a specific *word* or a *grammatical constraint* and the stage at which we acquire the appropriateness constraints to its *use in specific situations* do not need to overlap. Usage constraints are more dynamic than grammatical constraints – they change easier over time than the latter ones do. Furthermore, usage constraints are closely related to social interactions and the rules imposed by them. Therefore, it is to be expected that in new social interactions new weights or probabilities will arise. For example, at some point in our development we might discover a distinction between the grammatical (informal) constructions we use with our friends and with our parents (e.g. the use of *Digga* 'bro' in contemporary German youth language), cf. Figure 4. Similarly, at a later point in our development, we might distinguish subtypes of formal language in academic situations, in a job interview, etc. The analyses of such properties and the formal constraints derived from them have to be valid in the light of empirical data (corpus or experimental) and constraints from the linguistics–sociology–psychology interface (cf. Lüdeling et al., 2022).

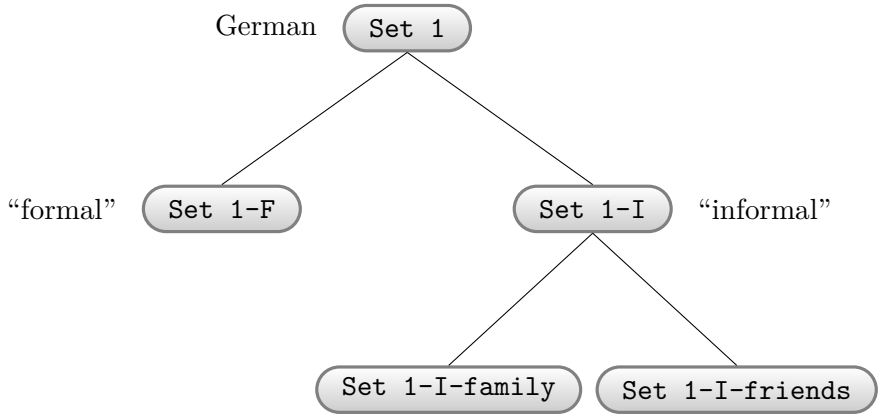


Figure 4: Modelling three registers of German

The downside of this approach is that in order to compare the appropriateness of a sentence across different registers, it is necessary to parse the sentence once for each register, each time using the set of constraints corresponding to the respective register. From a psycholinguistic point of view, it seems rather implausible that humans parse a given sentence using a number of different grammars in parallel. However, under a model that assumes multiple grammars to model variation, we see no way around this. Therefore, we suggest a different approach using one grammar that includes all information about known/acquired registers and that deals with all aspects mentioned in this section.

## 3 One grammar with information about several registers

The alternative approach assumes that there is a single grammar enriched with information about any sign's probability distribution *across* registers. For this purpose, we introduce a REGISTER feature next to PHON and SYNSEM on the outer level of the sign, cf. (8). In comparison to other register approaches in HPSG (cf. Paolillo, 2000; Bender, 2001, 2007; Asadpour et al., 2022), the values we propose for the REGISTER attribute do not say anything about social meaning, and are therefore not contained within CONTEXT. What our exploratory approach provides are merely the probabilities of a sign in all registers recovered from the corpus (see Schäfer, Bildhauer, Pankratz & Müller 2022). Up to this point, we are agnostic about whether or not a sign has a social meaning, and if so, how it can be characterized (cf. "*not educated*" in Bender, 2007 or "*correct*" in Paolillo, 2000). If present, this information may be stored as part of the CONTEXT attribute, as elaborated recently by Asadpour et al. (2022).

As in the approach sketched in the previous section, we assume that all signs bear information about registers, thus the REGISTER feature is appropriate for lexemes, for inflectional, and derivational lexical rules as well as for syntactic schemata. In contrast to the multiple-grammar approach, however, all signs carry information about all registers, not only about one particular register. Assuming (for instance) that there are seven registers, the architecture of a sign would look as follows:[4]

(8)
$$\begin{bmatrix} \textsc{phon} & \textit{list of phonemes} \\ \textsc{synsem} & \textit{synsem} \\ \textsc{register} & \begin{bmatrix} \textit{reg} & \\ \textsc{register}1 & \textit{value} \\ \textsc{register}2 & \textit{value} \\ \ldots & \\ \textsc{register}7 & \textit{value} \end{bmatrix} \end{bmatrix}$$

Similarly to the approach using multiple grammars, we need a way to determine the weights/probabilities of the mother from the corresponding values of the daughters and of the schema/rule that licenses the combination.[5] In the single-grammar approach (as well as in the multiple-grammars

[4]The number of registers (as pointed out in Section 2) has to be inferred empirically, and an implementation of such an inference procedure is described in Schäfer, Bildhauer, Pankratz & Müller (2022). The number or registers in (8) is arbitrary and was chosen for the purpose of illustration.

[5]In other accounts dealing with register connected to social meaning (e.g. Paolillo, 2000), the register information of the mother is computed by the set union of the register

approach) these computations can be accomplished by a function *reg*. This function collects the values of REGISTER1, …, REGISTER7 of every daughter and of the constraint licensing their combination, and calculates the values of REGISTER1, …, REGISTER7 of the mother.[6] In the full implementation, the function *reg* will be interpreted as a Bayesian update function adjusting the probabilities readers/hearers assign to the set of registers.

In contrast to the approach outlined in the previous section, a full representation of a sentence includes weights/probabilities for each register. Register appropriateness can then be compared across different registers with one parse. For this advantage, the single-grammar approach appears as superior to the multiple-grammars approach not only in terms of computational efficiency, but also regarding cognitive plausibility.

## 4 Conclusion

In this paper, we have discussed multiple-grammar and single-grammar approaches to language-internal variation such as register in HPSG. We showed that an architecture similar to the CoreGram project can be adapted to the development of subgrammars encoding different registers of one language. Due to the probabilistic nature of register knowledge, probabilities of linguistic signs need to be specified in the subgrammars for each register. An alternative single-grammar approach was also sketched, where the discrete probability distributions over the set of registers are stored with each sign. We argued that the single-grammar approach is preferable, because it allows us to evaluate the register properties of each sentence with a single parse instead of one parse per register. These fundamental considerations are part of the foundations for a planned long-term project wherein fine-grained register distinctions as discovered in our data-driven work (Schäfer, Bildhauer, Pankratz & Müller, 2022) are implemented in a register-aware probabilistic HPSG.

It is worth mentioning that the study of register-driven variation in conjunction with deep morphosyntactic analyses still has unresolved issues, but at the same time it raises promising research questions, such as: (i) How can frequentist or probabilistic approaches be integrated into the grammatical component (a question we partially answer here)? (ii) How can social-

values of the daughters to see whether an utterance satisfies or not the felicity conditions of the register. In that sense, our approach – if combined with social meaning – can be seen as a way to *quantify* to which extent the utterance satisfies the felicity conditions.

[6] Manfred Sailer (p.c. 2022) pointed out to us that it is important that *reg* does not take into account the *order* in which constraints are applied, otherwise leading to register constraints that would be fundamentally different from ordinary constraints in HPSG. As mentioned in Section 2, the mathematics behind our account are not worked out yet, but the importance of the order-independent application of constraints has to be taken into account.

meaning approaches be combined with probabilistic approaches in order to account for register-driven variation (and is this necessary)? (iii) How can the feature-geometry of HPSG be extended to include discourse-level phenomena, since register-driven variation is often influenced by discourse factors?

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# Chinese quantifier scope, concord, and Lexical Resource Semantics

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**Abstract**

This paper considers Chinese quantifier scope, an important, outstanding area of Chinese linguistics. In particular, there are two open questions on the subject: (1) the guiding principles that determine (a) the scopal readings of quantifiers and (b) the sometimes mandatory co-occurrence of the universal quantifier *mei* (every) and the universal adverb *dou*, and (2) the semantic functions of *mei* and *dou* and their connection to the co-occurrence of these words.

We reappraise three prior accounts of these subjects, reason through their consequences on some exemplary data, offer a new explanation based upon concord, a mechanism that is commonplace in many languages, and formulate it in lexical resource semantics (LRS). We use two principles adapted from Richter & Sailer's (2004) analysis of negative concord, expanded with a new quantifier order constraint to generate a coherent answer to the two aforementioned questions.

# 1 Introduction

Chinese quantifier scope is one of the most provocative areas of Chinese linguistics. In this article, we will examine the universal *mei*-NP (every-NP), the existential *yi*-NP (one-NP), and the multi-functional adverb *dou* in Mandarin Chinese. *mei*-NPs take the form of *mei*-(*yi*)-CL-N (every-(one)-classifier-N), with the number *yi* (one) being optional. *yi*-NPs take the form of *yi*-CL-N (one-classifier-N).

Chinese quantifier scope is intriguing because of its cosmetic resemblance to logical form. Unlike in English, where both the surface scope reading and the inverse scope reading are available at all times (1), the availability of scopings in Chinese is asymmetric. When the existential quantifier phrase (QP) precedes the universal QP (2a), only the surface reading is available; however, when the two QPs are flipped (2b), the inverse reading becomes available. Furthermore, topicalisation drastically changes the availability of readings (2c, 2d).

(1) a. Every student read a book.
$(\forall > \exists)$ $(\exists > \forall)$

b. A student read every book.
$(\exists > \forall)$ $(\forall > \exists)$

(2) a. 一个 学生 读过 每本 书
yī-gè xuéshēng dú-guò měi-běn shū
one-CL student read-ASP every-CL book
$(\exists > \forall)$ $(*\forall > \exists)$

b. 每个 学生 都 读过 一本 书
měi-gè xuéshēng dōu dú-guò yī-běn shū
every-CL student DOU read-ASP one-CL book
$(\forall > \exists)$ $(\exists > \forall)$

c. 一本 书 每个 学生 *(都) 读过
yī-běn shū měi-gè xuéshēng dōu dú-guò
one-CL book every-CL student DOU read-ASP
($\exists > \forall$) (*$\forall > \exists$)

d. 一个 学生 每本 书 *(都) 读过
yī-gè xuéshēng měi-běn shū dōu dú-guò
one-CL student every-CL book DOU read-ASP
($\exists > \forall$) (*$\forall > \exists$)

What are the guiding principles that determine quantifier scope readings?

More controversially, the adverb *dou* (often glossed as ALL) often co-occurs with *mei* (3a). This co-occurrence is puzzling as both *mei* and *dou* imply a universal quantifier. In other languages, English for example, *every* and *all* cannot co-occur (3b). Furthermore, what is the semantic function of *dou*? Does it affect the rendering of quantifier scope?

(3) a. 每个 三年级 学生 *(都) 来了
měi-gè sānniánjí xuéshēng *(dōu) lái-le
every-CL third-grade student DOU come-ASP
'Every third grade student came.'

b. Every third grade student (*all) came. (Liu (2021), ex.6)

Wu (2019) explained Chinese quantifier scope as a product of principles of economy. Lin (1998) presented a decompositional analysis of *mei* and *dou* and argued that this phenomenon should be analysed as a matter of distributivity rather than quantifier scope. Liu (2021) more recently defended the opposite view, in which a quantifier-scope analysis is necessary, and analysed *dou* as pragmatic. Here, we propose a novel theory that the placement of Chinese *dou* can be understood as an instance of concordant universality. We argue that the co-occurrence of *mei* and *dou* is analogous to negative concord in languages such as Polish; negation also exhibits scoping effects. This novel approach leads to a massively simplified analysis. Finally, we are able to present a simple but effective lexical resource semantics (LRS) analysis of Chinese quantifier scope.

# 2 Chinese Quantifier Scope

## 2.1 Principles of Economy and Topic Prominence

Fox's (2000) analysis, based on principles of economy, is one of the theories proposed to explain quantifier scoping. He gave a detailed account of how an English sentence such as (1b) can yield both the surface scope ($\exists > \forall$) and the inverse scope ($\exists > \forall$) through a series of scope-shifting operations (SSO). The Chinese sentence (2a) has a parallel syntax to its English counterpart (1b), however, and yet the inverse scope reading is not available for the Chinese sentence.

Wu (2019) argued that this mismatch is not a refutation of Fox's (2000) theory. Instead, it suggests that "Mandarin matrix transitives do not have the same syntactic structure as English matrix transitives have." Expanding upon the well-known observation that Chinese is a topic-prominent language (Chao, 1968), Wu (2019) further argues that Chinese is topic-prominent in the sense that there exists a TopP projection above the TP for matrix clauses. The presence of this extra layer of TopP makes the optional QR or QL impossible, because they violate scope economy. As those optional QR and QL were the source of the quantifier scope ambiguity, the example (2a) now becomes unambiguous.

The economy analysis on the other hand fails to predict the available quantifier scopings of the doubly topicalised sentence (2d). Since both QPs are topicalised, the semantics-changing QR should be allowed to happen. Therefore, under Wu's (2019) theory, (2d) should have both the surface and inverse quantifier scope readings. But this never comes to light — Wu (2019) limits itself to analysing only sentences in which the existential QP precedes the universal quantifier, and also ignores any sentences that have the multi-functional adverb *dou*. If such sentences are also considered, one can easily find counterexamples to this analysis. While (2b) has the same linear order of parts of speech as (2a), the sentence becomes scope-ambiguous if only the quantifier placement is reversed (universal precedes existential). Wu (2019) argues that these sentences are not evidence of scope ambiguity, because the inverse scope reading implies the surface reading: if every student read the same book, then every student did read a book. The existence of the inverse reading is merely an instance of the more general reading. Under this view, many English sentences are also not scope-ambiguous, however.

Nevertheless, there are sentences in which only the surface reading is available. As pointed out by Lin (2020), the co-occurrence of *dou* and *mei* is not always mandatory. When *dou* is omitted, the sentence (4) can only yield the surface-scope reading. This important observation shows that understanding the semantic function of *dou* and its interaction with the quantifier *mei* are crucial for analysing Chinese quantifier scope.

(4) 每个 学生 读过 一本 书
měi-gè xuéshēng dú-guò yī-běn shū
every-CL student read-ASP one-CL book
($\forall > \exists$) (*$\exists > \forall$)

## 2.2 Decompositional Account of *mei* and *dou*

Liu (2021) considers "the puzzle of co-occurring *mei* and *dou*." Both the quantifier *mei* and the multi-functional adverb *dou* introduce universal quantifiers, and therefore it is puzzling why *mei* and *dou* need to co-occur, let alone mandatorily in some situations. After all, the co-occurrence of *every* and *all* is not allowed in English (3).

One intriguing solution to this puzzle is presented by Lin (1998, 2020). He

suggests that *mei* is not inherently quantificational. In his framework, *mei* has a semantics similar to the definite article *the*, which marks an NP as a "maximally plural" entity. Then Lin (1998) defines *dou* as a distributive operator (Link, 1987). Thus, the puzzle is solved by analysing the sentences not through the lens of quantifier scoping, but through distributivity.

(5) a. [[*mei*]] = $f$, such that $\forall P \in D_{<e,t>}, f(P) = \cup||P||$ (Lin (1998): (68))
b. [[*dou*]] = $\lambda P.\lambda x.\forall y.[y \leq_{atom} x \rightarrow P(y)]$ (Link, 1987)

## 2.3 Presuppositional Account of *dou*

Liu (2021) posits a view opposite to Lin's (1998) decompositional solution, after laying out a detailed list of damning evidence that *mei*-NPs must indeed be quantificational. While we shall not reiterate all of the evidence here, one interesting observation is that when *mei*-NPs appear in a post-verbal position, *dou* is not allowed to appear, cf. example (2a).

Having concluded that *mei* is quantificational, Liu (2021) posits that "*dou* is truth-conditionally vacuous but carries a presupposition that its prejacent is the strongest among its alternatives." This almost suggests that the appearance of *dou* is optional, however, and yet we know that the co-occurrence of *mei* and *dou* is often mandatory (2a, 3a). To address the phenomenon of obligatory *dou*, Liu (2021) resorts to a pragmatic analysis of *obligatory presupposition* (Amsili & Beyssade, 2010).

There are certain aspects of the occurrence of *dou* that cannot be purely explained with pragmatics. Firstly, the scope-reading difference between (2b) and (4) cannot be explained as a difference between whether presuppositions are specified. The semantic difference between the two suggests that *dou* possesses a genuinely semantical import of universality. Secondly, while (6a) is ungrammatical regardless of whether *dou* occurs, (6b) is grammatical only with an obligatory *dou*. The only difference between the two sentences is that the subject of (6a) is existentially quantified, and (6b) has a proper noun as its subject that does not introduce any new quantifier. But the two sentences have no difference in what Liu (2021) terms their "propositional alternatives," as the existential quantifier does not introduce plurality, and therefore according to Liu (2021), both sentences should be grammatical with an obligatory *dou*.

(6) a. * 每本 书 一个 学生 (都) 读过
měi-běn shū yī-gè xuéshēng dōu dú-guò
every-CL book one-CL student DOU read-ASP

b. 每本 书 张三 *(都) 读过
měi-běn shū zhāngsān dōu dú-guò
every-CL book Zhangsan DOU read-ASP

## 3 *mei* and *dou* are Multi-functional

Nevertheless, we would not claim that *mei* and *dou* are purely quantificational. On the contrary, there does appear to be a distinction between decompositional *mei* for dependent indefinites and the quantificational *mei* that co-occurs with *dou*, and between a pragmatic, presuppositional *dou* and the quantificational *dou* that co-occurs with *mei*. We dispute Lin (1998, 2020) and Liu's (2021) goal of formulating a unified account of the three functions.

The analysis in this paper only considers quantificational *mei* and *dou*. When the subject NP is a dependent indefinite (7a), a decompostional analysis should apply. Dependent indefinites are discussed at length in Lin (2020). A dependent indefinite NP takes the form of *mei*-num-CL (7a). When the number is greater than one, then the NP is unambiguously dependent indefinite. Sentences with these dependent indefinite NPs are drastically different from the regular quantificational *mei*-NPs that we have examined so far. For dependent-indefinite NPs, *dou* is forbidden, and they cannot undergo any topicalisation (7b). They are also more restrictive about the order in which their quantification can be read relative to other QPs: only universal preceding existential is allowed (7c). Because of all of these differences and, more crucially, the lack of the presence of *dou*, it remains exceptional. It is also worth noting that when the number is one in *mei*-num-CL, the NP is ambiguous between being a dependent indefinite and a regular quantificational *mei*-NP; recall that *yi* (one) is optional in regular *mei*-NPs.

(7) a. 每三个 学生 (* 都) 读过 一本 书
měi-sān-gè xuéshēng (*dōu) dú-guò yī-běn shū
every-3-CL student DOU read-ASP one-CL book
($\forall > \exists$) (*$\exists > \forall$)

b. * 一本 书 每三个 学生 读过
yī-běn shū měi-sān-gè xuéshēng dú-guò
one-CL book every-3-CL student read-ASP

c. * 一个 学生 读过 每三本 书
yī-gè xuéshēng dú-guò měi-sān-běn shū
one-CL student read-ASP every-3-CL book

d. 每 (一) 个 学生 (都) 读过 一本 书
měi-(yī)-gè xuéshēng (dōu) dú-guò yī-běn shū
every-(1)-CL student DOU read-ASP one-CL book

As we have discussed, the co-occurrence of *mei* and *dou* is not purely pragmatic. There is, however, a purely presuppositional usage of *dou*, shown in (8). This presuppositional *dou* does not introduce any genuinely semantical import. Unless it is a part of another presuppositional construction (e.g., the *lian-dou* construction in (8c)), adding or removing *dou* does not change syntactic well-formedness (8a, 8b). Presuppositional *dou* is certainly different from quantificational *dou*. As shown in

(8d), if the subject of the sentence is a universal QP (*mei-ge xuesheng*, *every student*), the sentence cannot be grammatical. This demonstrates a clear distinction between the different senses of *dou*; it is impractical to pursue a unified analysis of them.

(8) a. 张三 找到 工作 了
zhāngsān zhǎo-dào gōngzuò le
Zhangsan found job ASP
Zhangsan has found a job.

b. 张三 都 找到 工作 了
zhāngsān dōu zhǎo-dào gōngzuò le
Zhangsan DOU found job ASP
Even Zhangsan has found a job.

c. 连 张三 *(都) 找到 工作 了
lián zhāngsān *(dōu) zhǎo-dào gōngzuò le
LIAN Zhangsan DOU found job ASP
Even Zhangsan has found a job.

d. * 连 每个 学生 (都) 找到 工作 了
lián měi-gè xuéshēng (dōu) zhǎo-dào gōngzuò le
LIAN every student DOU found job ASP

## 4 "Universal Concord"

Both Lin (1998) and Liu (2021) saw the co-occurrence of *mei* and *dou* as a puzzling anomaly that is unique to Chinese, and yet the phenomenon of multiple words being allowed or even required to repeat a single semantic contribution in different parts of a sentence is commonplace in many languages. For example, negative concord (Sailer & Richter, 2021; Richter & Sailer, 2004) is a well-known phenomenon expressed typically in Polish (9a). Polish n-words (such as *nikt*, *nobody*) inherently express negativity. When an n-word appears in a clause, however, the verb must be marked by the Polish negative marker *nie*, often glossed as NM. Furthermore, the repeated negation does not yield a doubly negated reading ($\neg\neg(\exists x.\texttt{human}(x) \wedge \texttt{came}(x))$), but rather only a *negative-concord* reading ($\neg(\exists x.\texttt{human}(x) \wedge \texttt{came}(x))$) that is semantically equivalent to a simple negation. Negative concord is expressed colloquially in English as well; (9b) is logically equivalent to "I don't know anything."

(9) a. Nikt nie przyszedł.
nobody NM came
'Nobody came.'

b. I don't know nothing.

c. 没 人　　没 来
méi rén　méi lái
NM person NM come
'Nobody didn't come.'

Liu (2021) and Lin (1998) both used the incompatibility of *every* and *all* in English as evidence that the co-occurrence of *mei* and *dou* are problematic, and indeed concord can be idiosyncratic. For example, Chinese expresses no negative concord; (9c) can only have the doubly negated reading ($\neg\neg(\exists x.\texttt{human}(x) \wedge \texttt{came}(x))$), in which "everybody came."[1] A language expresses concord as the result of language-specific constraints. LRS provides us a simple but powerful framework to analyse and describe these language-specific constraints. In the following section, starting from our Polish negation reference, we present an analysis of example (2b): *mei-ge xuesheng dou du-guo yi-ben shu* (*every*-CL *student* DOU *read one*-CL *book*).

# 5 The Analysis

**Building the NP** We can start our analysis by constructing the two NPs *mei-ge xuesheng* (*every student*). The relevant parts of the lexical entries of the quantifier (*yi-ben*, *a*) and the noun (*shu*, *book*) can be found in (10). The internal content (INCONT) expresses the semantic composition of a sign. It is the scopally lowest semantic contribution of the semantic head. The external content (EXCONT), on the other hand, expresses the contribution of the maximal projection of the sign. The symbol $\lhd$ indicates a subterm relationship: $\boxed{2} \lhd \boxed{3}$ means that $\boxed{2}$ is a subterm of $\boxed{3}$. As a shorthand, we also use square brackets to denote a subterm relationship (the subterm appears inside the brackets as a description of the superterm). The conjunction in $\boxed{1}$, $([y] \wedge [y])$, means that the bounded variable $y$ is a subterm of both the left- and right-hand conjuncts, i.e., it is a shorthand for $(\alpha \wedge \beta)$ & $y \lhd \alpha$ & $y \lhd \beta$. Finally, the content of the PARTS list is determined by the Incont Principle (IContP) and the Excont Principle (EContP). The IContP states that the INCONT value is an

[1] A participant at the conference asked us whether there is other evidence of concord in Chinese. The closest that we have found are occurrences of *suiran …danshi* (*although …but*) and *yinwei …suoyi* (*because …therefore*):

(1) (虽然)　我 很　丑　但是　我 很　温柔
(suīrán)　wǒ hěn　chǒu dànshì wǒ hěn　wēnróu
(although) I　very ugly but　I　very kind
Although I am ugly, I am kind.

(2) (因为)　我 很　穷　所以　我 没　钱　吃饭
(yīnwèi)　wǒ hěn　qióng suǒyǐ　wǒ méi qián　chīfàn
(because) I　very poor therefore I　no　money eat
Because I am poor, I can't afford food.

These appear more coordinated than concordant, however, and the occurrence of both *suiran* and *yinwei* is optional.

element of the PARTS list and a component of the EXCONT value. Therefore, we can know that in *yi-ben* (*a*), $\boxed{1} \lhd \boxed{2}$ and $\boxed{1}$ is a member of PARTS; and for the noun *shu* (*book*), $\boxed{3} \lhd \boxed{4}$ and $\boxed{3}$ is in its PARTS list. The EContP stated that every subexpression of the EXCONT value is an element of the utterance's PARTS list. Therefore, the unbound variable Y and the non-logical constant book are both in the PARTS list of the noun. For the classifier phrase *yi-ben*, the bound variable $y$ and the conjunction $\boxed{1a}\ [y] \wedge [y]$ are both members of the PARTS list. Additionally, because it is the non-head daughter of the NP, its EXCONT ($\boxed{2}$) is also a member of the PARTS list.

(10) a. Part of the lexical entry of *yi-ben*:

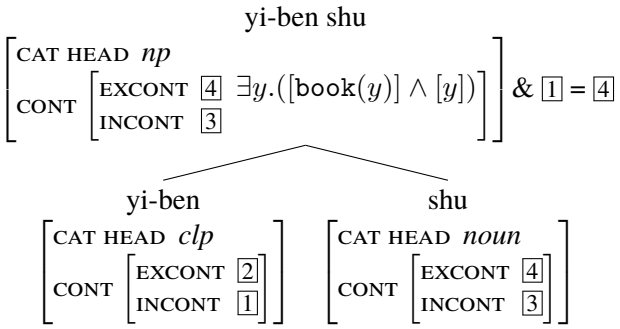
$$\left[\begin{array}{l} \textit{word} \\ \textsc{phon}\ \langle \textit{yi-ben} \rangle \\ \textsc{sl}\ \left[\begin{array}{l} \textsc{cat head}\ \textit{clp} \\ \textsc{cont}\ \left[\begin{array}{ll} \textsc{excont} & \boxed{2} \\ \textsc{incont} & \boxed{1}\ \exists y.([y] \wedge [y]) \\ \textsc{parts} & \langle y, \boxed{1}, \boxed{1a}\ [y] \wedge [y], \boxed{2} \rangle \end{array}\right] \end{array}\right] \end{array}\right] \ \&\ \boxed{1} \lhd \boxed{2}$$

b. Part of the lexical entry of *shu*:

$$\left[\begin{array}{l} \textit{word} \\ \textsc{phon}\ \langle \textit{shu} \rangle \\ \textsc{sl}\ \left[\begin{array}{l} \textsc{cat head}\ \textit{noun} \\ \textsc{cont}\ \left[\begin{array}{ll} \textsc{excont} & \boxed{4} \\ \textsc{incont} & \boxed{3}\ \texttt{book}(\mathrm{Y}) \\ \textsc{parts} & \langle \mathrm{Y}, \boxed{3}, \boxed{3a}\ \texttt{book} \rangle \end{array}\right] \end{array}\right] \end{array}\right] \ \&\ \boxed{3} \lhd \boxed{4}$$

Now, in (11) let us derive the logical form of the NP *yi-ben shu* (*a book*). The semantic composition of the mother NP is guided by several principles (Penn & Richter, 2004). The LRS Projection Principle states that the EXCONT and the INCONT of the mother are identical to their counterparts in the head daughter. Therefore, the EXCONT of the NP is $\boxed{4}$ and the INCONT is $\boxed{3}$. The Semantics Principle (SP) is the other guiding principle to determine each syntactic daughter's semantic contribution. The SP differs depending on the CAT|HEAD of the daughters. For (11), because the non-head is a quantifier and its INCONT is of the form $Qx.(\rho \circ \nu)$, the INCONT of the head ($\boxed{3}$) is a component of $\rho$. Therefore, the existentially quantified expression is now $\exists y.([\texttt{book}(y), \mathrm{Y}] \wedge [y])$. Because $y$ is a subexpression of $\texttt{book}(y)$, the expression can be simplified to $\exists y.([\texttt{book}(y)] \wedge [y])$. Then, the local selection mechanism will bind the free variable Y with the existentially quantified $y$ because that is the only possible binding option. The expression can be rewritten as $\exists y.([\texttt{book}(y)] \wedge [y])$. The SP for the NP case also states that the INCONT value of the non-head daughter ($\boxed{1}$) is identical with the EXCONT value of the head daughter ($\boxed{4}$). The analysis (12) of the other NP (*mei-ge xuesheng*, *every student*) is analogous.

(11) Deriving the logical form of the NP *yi-ben shu* (*a book*):




(12) The semantic composition of the NP *mei-ge xuesheng* (*every student*):

$$\begin{bmatrix} \textit{mei-ge xuesheng} \\ \text{CAT HEAD } \textit{np} \\ \text{CONT} \quad \begin{bmatrix} \text{EXCONT } \boxed{6}\ \forall x.([\texttt{student}(x)] \wedge [x]) \\ \text{INCONT } \boxed{5}\ \texttt{student}(x) \end{bmatrix} \end{bmatrix}$$

**Building Verbal Projections** In (13a), we give the lexical entry of the adverb *dou* and the verb *du-guo* (*read*). The analysis is very similar to the previous analysis of the NP. As we discussed in section 2.3, *dou* possesses a genuinely semantical import and it is inherently universal in (2b). We have reflected that in the lexical entry of *dou* (13a).

(13) a. Part of the lexical entry of *dou*:

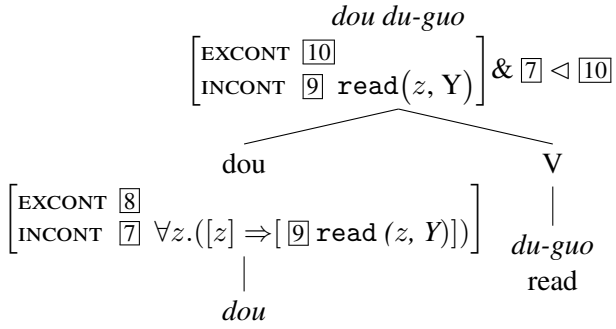
$$\begin{bmatrix} \textit{word} \\ \text{PHON } \langle \textit{dou} \rangle \\ \text{SL} \quad \begin{bmatrix} \text{CAT HEAD } \textit{adverb} \\ \text{CONT} \quad \begin{bmatrix} \text{EXCONT } \boxed{8} \\ \text{INCONT } \boxed{7}\ \forall z([z] \Rightarrow [z]) \\ \text{PARTS } \langle z, \boxed{7a}\ [z] \Rightarrow [z], \boxed{7}, \boxed{8} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \ \& \ \boxed{7} \lhd \boxed{8}$$

b. Part of the lexical entry of *du-guo*:

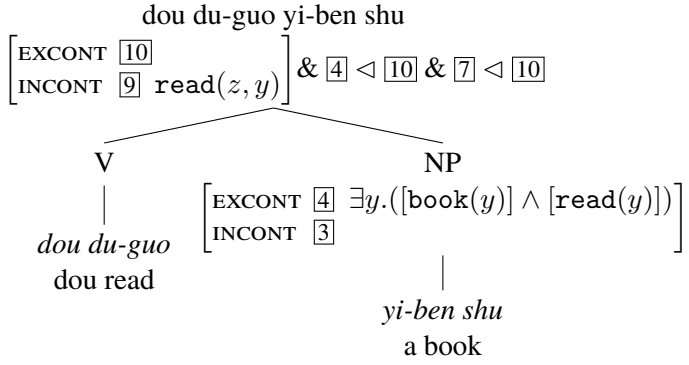
$$\begin{bmatrix} \textit{word} \\ \text{PHON } \langle \textit{du-guo} \rangle \\ \text{SL} \quad \begin{bmatrix} \text{CAT HEAD } \textit{verb} \\ \text{CONT} \quad \begin{bmatrix} \text{EXCONT } \boxed{10} \\ \text{INCONT } \boxed{9}\ \texttt{read}(\text{Z}, \text{Y}) \\ \text{PARTS } \langle Z, Y, \boxed{9}, \boxed{9a}\ \texttt{read} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \ \& \ \boxed{9} \lhd \boxed{10}$$

The composition of the VP and the S is also similar to that of the NP (14). The LRS Projection Principle specifies that the INCONT value is $\boxed{9}$ and the EXCONT value is $\boxed{10}$ for both (14a) and (14b). For (14a), the SP specifies that $\boxed{9}$ is a subterm of the implication's consequent. Also, similar to how $y$ binds to the free variable Y in (11), the universally quantified $z$ binds to Z. For (14b), the non-head is a quantified NP with the EXCONT value of the form $Qx.(\rho \circ \nu)$. Therefore, the INCONT value of the head ($\boxed{9}$) is a subexpression of the right-hand conjunct and the free variable Y is bound to $y$.

(14) a. Analysis of the adverb *dou* modifying a verb:

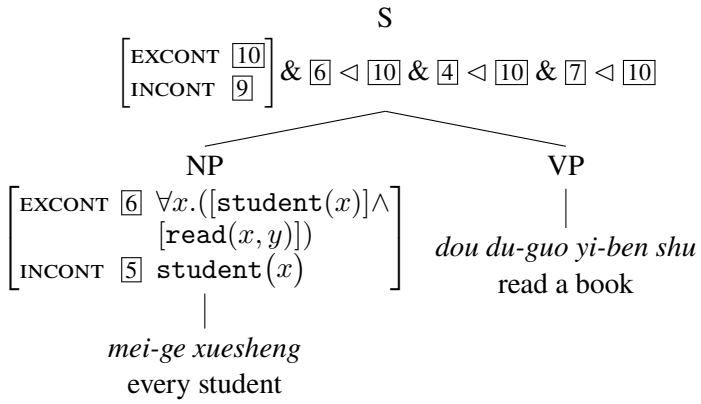



b. Analysis of the VP *dou du-guo yi-ben shu* (*dou read one book*):




Finally, the analysis of the whole sentence appears in (15). The non-head is a quantified NP with the EXCONT value of the form $Qx.(\rho \circ \nu)$. Thus, the analysis is the same as in (14).

(15) Analysis of the sentence:




## 5.1 Universal Complexity Constraint

The SP does not impose any conditions on how to resolve the relative scopes of the universal quantifier (4) contributed by the subject NP and the universal quantifier contributed by *dou* (7). There are therefore three valid combinations (16). The first

two readings differ in which universal quantifier outscopes the other: the quantifier contributed by the subject NP outscoping the quantifier contributed by *dou* (16a), or the other way around (16b).

(16) a. $\boxed{4} \lhd \boxed{7}$: the EXCONT contains two universal quantifiers.
b. $\boxed{7} \lhd \boxed{4}$: the EXCONT contains two universal quantifiers.
c. $\boxed{7} = \boxed{4}$: the EXCONT contains one universal quantifier.

(16a) will yield three possible readings:

- $\forall_1 x.(\text{student}(x) \Rightarrow \forall_2 z.(\exists y.\text{book}(y) \wedge \text{read}(x, y)))$;
- $\forall_1 x.(\text{student}(x) \Rightarrow \exists y.\text{book}(y) \wedge \forall_2 z.(\text{read}(x, y)))$;
- and $\forall_2 z.(\forall_1 x.(\text{student}(x) \Rightarrow \exists y.\text{book}(y) \wedge \text{read}(x, y)))$.

(16b) will yield similar readings with duplicated universal quantifiers. Recall the Polish example *nikt nie przyszedł* (2.3). Among the different ways to resolve the negation contributed by the n-word (*nikt*, *nobody*) and the negation contributed by *nie* (NM) is an undesirable double negation reading of the sentence. To exclude this reading, Richter & Sailer (2004) impose a language-specific constraint for Polish:

(17) The NEGATION COMPLEXITY CONSTRAINT (NCC):
For each sign, there may be at most one negation that is a component of the TOP value and has the MAIN value as its component.

Similarly, we want to impose the following language-specific constraint for Chinese:

(18) The UNIVERSAL COMPLEXITY CONSTRAINT (UCC):
*dou*'s contribution is *eclipsed* by the contributions of universally quantified QPs that occur before the verb.

The idea of eclipsed operators does exist in LRS in less general forms: in the NCC above, it appears as a cardinality constraint on the number of negations, and in later LRS publications, certain words make reference to logical operators in their semantics that they did not contribute (with the understanding that some other word must have contributed them). Here, we cannot avail ourselves of an absolute cardinality constraint because the number of pre-verbal QPs is theoretically unbounded (19):

(19) 每个 班 的 每个 学生 都 读过 一本 书
měi-gè bān dè měi-gè xuéshēng dōu dúguò yī-běn shū
every-CL class POS every-CL student DOU read-ASP one-CL book
Every student from every class read a book.

Furthermore, *dou* does contribute a universal quantifier when there are no pre-verbal QPs (20):

(20) 张三 李四 王五 都 读过 一本 书
zhāngsān lǐsì wángwǔ dōu dú-guò yī-běn shū
Zhangsan Lisi Wangwu DOU read-ASP one-CL book
Zhangsan, Lisi and Wangwu all read a book.

But *dou* does not contribute an additional universal quantifier when there are others that it could be concordant with.

The first two readings (16a, 16b) violate the UCC as the universal quantifier $\forall_1$ is contributed by a QP (*mei-ge xuesheng, every student*), and the other would-be universal quantifier $\forall_2$ is contributed by *dou*.

## 5.2 Universal Criterion

Richter & Sailer (2004) impose a second language-specific principle to enforce the co-occurrence of *nie* (NM) and n-words:

(21) The NEG CRITERION (NegC):
For every verb, if there is a negation in the TOP value of the verb that has scope over the MAIN value of the verb, then that negation must be an element of the PARTS list of the verb.

Similarly, we want to enforce the co-occurrence of *dou* and pre-verbal *mei*-NPs by imposing a UNIVERSAL CRITERION.

(22) The UNIVERSAL CRITERION ($\forall$C):
For an utterance, if there is a universal QP that appears before the verb, the first QP to the left of the verb and the verb must be universally quantified; otherwise, if there are no universal QPs in any preverbal position, the verb must not be universally quantified.

The $\forall$C accounts for our aforementioned data (2). If there is a universal QP before the verb, *dou* is mandatory. Furthermore, if there is no universal quantifier before the verb, no matter whether there are universal quantifiers postverbally, (2a) or not (23), *dou* is not required.

(23) 一个 学生 读过 一本 书
yī-gè xuéshēng dú-guò yī-běn shū
one-CL student read-ASP one-CL book

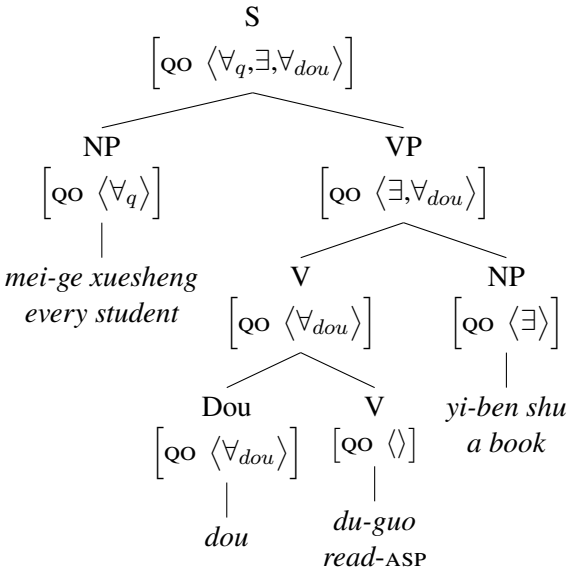
The $\forall$C can also explain the two examples in (6). For (6a), because the QP *mei-be shu* (*every book*) appears before the verb, *dou* must appear; however, because the first QP to the left of verb is an existential QP, *dou* must not appear. This contradiction explains why (6a) is ungrammatical with or without the presence of *dou*. Nevertheless, if we replace the existential QP with a non-quantifier (in (6b), a proper noun replaces the QP), the first QP to the left of the verb is now the universal quantifier, and (6b) is grammatical with a mandatory *dou*.

## 5.3 Quantifier Order List

Finally, we account for the scopal asymmetry by introducing a novel QUANTIFIER ORDER LIST. As shown in (25), the QO list records the linear order of the scopal elements — the QO list of the sentence *mei-ge xuesheng dou du-guo yi-ben shu* (*every student dou read a book*) is $\langle \forall, \exists, \forall \rangle$.

(24) The QUANTIFIER ORDER LIST (QO):
The quantifier order list (QO) records the linear order of the scopal elements, with the exception that a pre-verbal quantifier is outscoped by any quantifiers in the object NPs.

(25) QO list composition for sentence (2b) *mei-ge xuesheng dou du-guo yi-ben shu* (*every student dou read a book*):




We conjecture that the quantificational scope of a clause in Chinese is determined by this linear ordering. Although we impose the restriction through the UCC that the adverb *dou* does not contribute an additional universal quantifier, the universal quantification can be expressed by either a quantifier or the adverb *dou*, therefore causing a scopal ambiguity. Taking (25) as an example, the sentence is ambiguous because, when the quantifier expresses the universal quantification ($\forall_q$), the sentence will yield a wide universal reading; but when *dou* expresses the universal quantification, and because the quantification of *dou* ($\forall_{dou}$) follows the quantification of the object NP ($\exists$) on the QO list, the sentence will yield the wide existential reading.

(26) The QUANTIFIER ORDER CONSTRAINT (QOC):
The quantifier scope order must be a subsequence of the QO.

This constraint can also be generalised to other examples. For (27a), *dou* is not present in the sentence and the QO list can only be $\langle \exists, \forall \rangle$. Therefore, there is only a

single wide existential reading of the sentence. Unlike (27b), both (27c) and (27d) are not ambiguous despite having a mandatory *dou* in the sentence. This is because the existential quantification precedes both universal quantifications in both of the sentences.

(27) a. yi-ge xuesheng du-guo mei-ben shu
one-CL student read-ASP every-CL book
QO: $\langle \exists, \forall \rangle$ readings: $(\exists > \forall)$ $(*\forall > \exists)$

b. mei-ge xuesheng dou du-guo yi-ben shu
every-CL student DOU read-ASP one-CL book
QO: $\langle \forall, \exists, \forall \rangle$ readings: $(\forall > \exists)$ $(\exists > \forall)$

c. yi-ben shu mei-ge xuesheng dou du-guo
one-CL book every-CL student DOU read-ASP
QO: $\langle \exists, \forall, \forall \rangle$ readings: $(\exists > \forall)$ $(*\forall > \exists)$

d. yi-ge xuesheng mei-ben shu dou du-guo
one-CL student every-CL book DOU read-ASP
QO: $\langle \exists, \forall, \forall \rangle$ readings: $(\exists > \forall)$ $(*\forall > \exists)$

### 5.4 Full Analysis

The full analysis of the sentence (2b) *mei-ge xuesheng dou du-guo yi-ben shu* (*every student dou read a book*) is shown in Figure 1. For logical forms in the parse tree, the curly braces $\{\alpha\}$ contain the internal content, the caret sign $\hat{}\beta$ indicates the external content, the round brackets $()$ change the order of operation, as in arithmetic, and the square brackets again specify subterms that must be contained; $[LF_1, LF_2]$ denotes a term with both $LF_1$ and $LF_1$ as subterms.

## 6 Conclusion

Using a novel concord-based analysis of Chinese quantifier scope, we address some of the limitations of previous work, and reconcile the co-occurrence of *mei* and *dou*. Future research will hopefully use our LRS case study as a starting point to expand on the topic of Chinese quantifier scope. There are many more possible quantifiers than universal and existential. Do they also have a special scope-bearing adverb like *dou*? Is the same concord-based analysis amenable to the other quantifiers? Liu (2021) has also pointed out there are other adverbs such as *ye* (also) and *you* (again) that exhibit a similar distribution to *dou* in that they can all appear preverbally or before predicate adjectives.[2] Can we perform a similar analysis on those adverbs as well? These are all intriguing questions to be answered in relation to the present topic.

[2]Relative to quantificational *dou*, *ye* and *you* can occur either before or after, with the relative scope being determined by the chosen linear order. Relative to presuppositional *dou*, they must occur after (closer to the predicate).

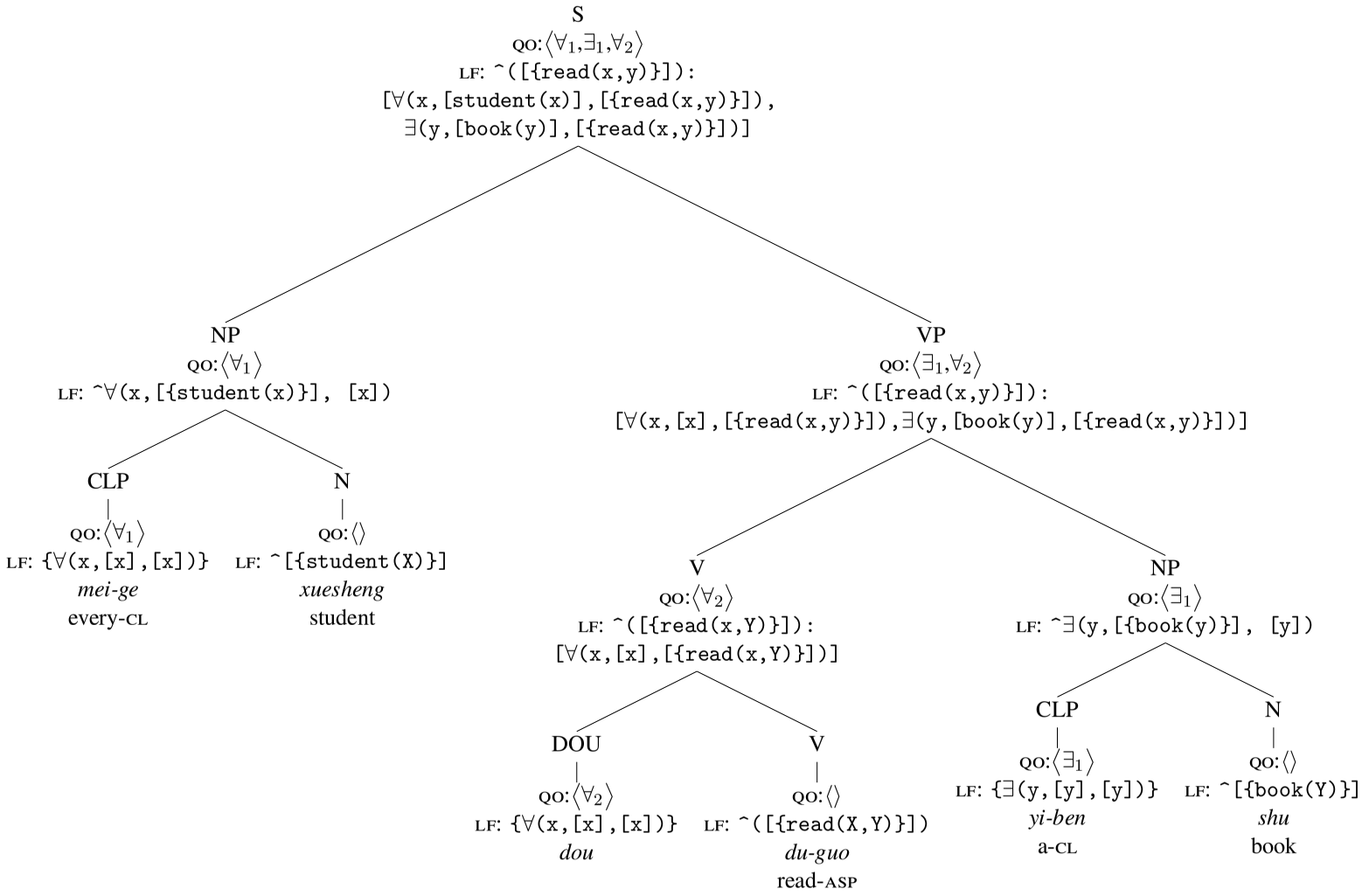



Figure 1: LRS analysis of (2b) *mei-ge xuesheng dou du-guo yi-ben shu* (*every student dou read a book*).

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# How to be a ham sandwich or an eel: The English deferred equative and the Japanese *eel* sentence

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**Abstract**

In some languages including English and Japanese, a nominal predicate construction (NPC; "$NP_1$ is $NP_2$") has a marked variety—"open-ended-relation NPCs" (ONPCs), to label it—where the referents of the subject NP and the predicate NP are understood to be in some pragmatically prominent relation other than identity or inclusion (e.g. *I'm the ham sandwich* 'I'm the customer who ordered the ham sandwich'). The Japanese ONPC has been called the "eel sentence (eel construction)", after an oft-cited example involving *unagi* 'eel' as its predicate NP. The English ONPC is discussed in good detail by Ward (2004; "Equatives and deferred reference", *Language* 80) under the rubric of the "deferred equative". The ONPCs in the two languages can naturally be used only under limited discourse configurations, with the English one being more severely constrained than the Japanese one. This work develops semantic analyses of the two ONPCs that improve on previous accounts.

# 1 Introduction

In some languages including English and Japanese, a nominal predicate construction (NPC; "$NP_1$ is $NP_2$") may receive a marked interpretation where the referents of the subject NP (SNP) and the predicate NP (PNP) are understood to be in some pragmatically prominent relation other than identity or inclusion. I refer to NPCs on this marked interpretation as "open-ended-relation NPCs" (ONPCs). The Japanese ONPC has been called the "eel sentence (eel construction)", after an oft-cited example involving *unagi* 'eel' as its PNP (Hoffer 1972; Okutsu 1978; Tokizaki 2003). The English ONPC is discussed in good detail by Ward (2004) under the rubric of the "deferred equative". The English ONPC is discourse-pragmatically more constrained than the Japanese one, as illustrated in (1)/(2).[1]

(1) (a restaurant customer to a waitperson who brought several dishes to the table)
   (E) I'm the ham sandwich.
   (J) Watashi wa hamusandoitchi desu.
      I Th ham.sandwich Cop.Plt.Prs
      '(lit.) I am (the) ham sandwich.'

(2) (in reply to: "What did you have for your lunch? I had a hamburger.")
   (E) #I'm {a/the} ham sandwich.
   (J) Watashi wa hamusandoitchi desu.
      I Th ham.sandwich Cop.Plt.Prs
      '(lit.) I am (a) ham sandwich.'

[†]This work was supported by JSPS KAKENHI Grant Number 22K00505.

[1]The abbreviations used in glosses are: Acc = accusative, Attr = attributive, Aux = auxiliary, Cop = copula, Gen = genitive, Ger = gerund, Inf = infinitive, Nom = nominative, Npfv = nonperfective, Plt = polite, Prs = present, Pst = past, Th = thematic *wa* (ground/topic-marker).

This work develops semantic analyses of the two ONPCs that make accurate predictions on their discourse-pragmatic distributions.

# 2 The English open-ended-relation NPC (the deferred equative)

## 2.1 Ward (2004) on deferred equatives

Ward (2004) argues that English NPCs like (3) and (4B) instantiate a special construction that he terms *the deferred equative*.

(3) (to a restaurant waitperson who brought several dishes to the table)
I'm the ham sandwich.

(4) A: I remember that one student each is writing an M.A. thesis on *Alien*, *Rocky*, and *Platoon*, but I cannot recall who is working on which movie.
B: Ken is *Alien*, Joe is *Rocky*, and Chris is *Platoon*.

Prima facie, it may be tempting reduce the peculiarity of English sentences like (3)/(4B) to metonymic transfer at the level of nominals (Nunberg 1995; Copestake & Briscoe 1995), which is observed in sentences like (5a,b).

(5) (uttered by a restaurant employee)
a. The ham sandwich is at Table 7.
b. That french fries is getting impatient.
(adapted from Nunberg 1995:115)

Given that in English it is customarily possible for an NP to stand for an entity (e.g. a person) metonymically associted with its referent (e.g. a dish), it may seem reasonable to treat (3)/(4B) as regular NPCs whose predicate NP happens to have undergone this kind of metonymic transfer.

Ward (2004), however, convincingly argues that NPCs like like (3)/(4B) cannot be accounted for in terms of metonymic transfer at the level of nominals ("deferred nonequatives"). One piece of evidence that the subject and predicate NPs of a deferred equative (typically) retain their literal meaning is that a predicate NP or subject NP literally denoting a non-human but equated with a human, such as *the pad thai* in (6b)/(7b), still accepts a modifier selecting a non-human-denoting modifiee.[2]

[2](6a)/(7a) are acceptable on an interpretation where the subject or predicate NP happens to have undergone metonymic transfer, as in (i):

(i) Quite a few celebrities come to our restaurant regularly. The ham sandwich at table 5 is James Gordon. The pad thai, who always leaves a big tip, is Bruce Wayne.

(6) a. #John is the pad thai, who drives a Rolls Royce.
b. John is the pad thai, which looks delicious.
c. John is talking to the pad thai, who drives a Rolls Royce.
(Ward 2004:281)

(7) a. #The pad thai, who drives a Rolls Royce, is John.
b. The pad thai, which looks delicious, is John.
c. The pad thai, who drives a Rolls Royce, is talking to John.
(Ward 2004:281)

The contrast between (8) and (9) likewise shows that the predicate NP of a deferred equative by default refers to what it literally refers to, while a complement NP (i) with a transferred sense/reference and (ii) selected by a regular verb (i.e. non-copula) does not.

(8) Let's see ... You're {what/#who}, the pad thai or the nam sod?
(adapted from Ward 2004:281)

(9) (restaurant waitpeople talking about customers)
Tell me honestly, {#what/who} do you like more, the pad thai or the nam sod?
(adapted from Ward 2004:281)

Observing the unnaturalness of utterances like (10B-b) and (11B-b), Ward (2004) proposes that the deferred equative construction (my open-ended-relation NPC) (i) presupposes the presence of a contextually salient (surjective) *pragmatic mapping* between two (non-empty/non-singleton) sets of relevant discourse referents, and (ii) asserts that on this mapping the referent of the subject corresponds to that of the predicate NP.

(10) A: How was your meal?
B: Good. I {a. had/b. #was} the pad thai.
(adapted from Ward 2004:280)

(11) A: Sorry you had to have lunch all by yourself. What did you have?
B: I {a. had/b. #was} the pad thai.
(adapted from Ward 2004:280)

He formulates pragmatic mappings in the form of an open proposition (OP), defined as "a proposition with one or more variables or underspecified elements, corresponding to that aspect of information structure that constitutes backgrounded or presupposed information". In the case of (12a), the relevant OP looks like (12b).

(12) a. (a restaurant customer to a waitperson who brought several dishes to the table)
I'm the pad thai.
b. OP: X *maps onto* Y, where X is a member of the set $\{x \mid x$ is a customer$\}$ and Y is a member of the set $\{y \mid y$ is an order$\}$.

c. FOCI: I, the pad thai

(adapted from Ward 2004:279)

One problem with Ward's formulation is that, given that a mapping is by definition a relation that is potentially many-to-one but never one-to-many, it wrongly predicts that an utterance like (13) is infelicitous, a member of $\{x \mid x \text{ is a customer}\}$ corresponding to two members of $\{y \mid y \text{ is an order}\}$.

(13) (a restaurant customer to a waitperson who brought five dishes to a table of three)
I'm the ham sandwich and fried chicken.

Note that here the speaker need not assume that the waitperson is aware that the ham sandwich and fried chicken were ordered by the same customer, so that in a way the two dishes constitute a "single order".

## 2.2 Proposal

I propose that the felicitous use of an English open-ended-relation NPC requires (i) that there be (a) a contextually prominent set of entities $P$ that contains the referent of the subject NP and at least one other member, (b) a contextually prominent set of entities $Q$ that contains the referent of the predicate NP and at least one other member, and (c) a contextually prominent binary relation $R$, and (ii) that it is common ground that $R$ is a *serial and surjective correspondence* from $P$ to $Q$ (i.e. each member of $P$ is in $R$ with at least one member of $Q$, and vice versa).

(14), repeated from (2), does not meet this condition, there being no established set of dishes each of which is known to have been eaten by somebody among the people under discussion; it is not even common ground that somebody ate a ham sandwich.

(14) (in reply to: "What did you have for your lunch? I had a hamburger.")
#I'm a ham sandwich.

(15B) does not meet this condition either (cf. (4)). Here, that somebody among the people under discussion saw *Rocky* is part of the interlocutors' shared knowledge, but the condition that each of the contextually salient movies was seen by someone (among the people under discussion) is not satisfied.

(15) (It is common ground that Ken, Joe, and Chris each saw one of *Rocky*, *Alien*, and *Platoon*, and nobody else saw any movie.)
A: Ken saw *Rocky*, right? What about Joe and Chris? Which movie did they see?
B: ??Joe and Chris are *Rocky*, too.

The English ONPC furthermore conveys what may be called *the exhaustivity implication* (cf. Velleman et al. 2012 and Büring & Križ 2013 on the cleft construc-

tion), as a non-presuppositional not-at-issue content,[3] as illustrated by (16b).

(16) (a restaurant customer to a waitperson who brought five dishes to a table of three)
   a. I'm the ham sandwich and fried chicken.
   b. I'm the ham sandwich. #I'm the fried chicken, too.
   cf. I ordered the ham sandwich. I ordered the fried chicken, too.

The exhaustivity implication is concerned only with the referent of the PNP but not with the referent of the SNP. The felicity of (17) evidences this point.

(17) (at a national press conference where a number of reporters from every major newspaper are present)
   John is the Washington Post. Mary is the Washington Post, too.
   'John is a reporter for the Washington Post. Mary is a reporter for the Washington Post, too.'
   (adapted from Ward 2004:282)

That the exhaustivity implication is not part of the at-issue content can be shown with the oddity of discourses like (18a,b):

(18) (It is common ground that three critics, including Ken, wrote reviews of five movies in total, and each critic wrote on one or two movies)
   a. Ken is not *Alien*. #He wrote a review of *Rocky*, too.
   b. Probably Ken is *Alien*. #But he may have written a review of *Rocky*, too.

That the exhaustivity implication is non-presuppositional, on the other hand, can be shown with an example like (19), which is felicitous despite it being contextually plausible (i.e. consistent with the common ground) that Ken wrote reviews of three or more movies.

(19) (It is common ground that three critics, including Ken, wrote reviews of 10 movies in total, and each critic wrote on two to five movies)
   Ken is *Alien* and *Rocky*.

The meaning of an English open-ended-relation NPC will look like (20), with the first clause of (4B) ("Ken is *Alien*") as an example. Materials between curly braces ($\{\cdot\}$) represent presupposition(al not-at-issue content)s, and ones between vertical bars ($|\cdot|$) represent non-presuppositional not-at-issue contents. $\mathbb{R}$ is a context-dependent variable ranging over relations between two entities, and $\mathbb{P}$ and

[3] Here, the term "not-at-issue content" is understood broadly and taken to subsume presupposition (= presuppositional not-at-issue content) as its subtype. "Presupposition(al not-at-issue content)s" in the current work correspond to Tonhauser et al.'s (2013) "[+SCF (Strong Contextual Felicity)] projective contents, and non-presuppositional not-at-issue contents correspond to their "[−SCF] projective contents".

$\mathbb{Q}$ are context-dependent variables ranging over sets consisting of two or more entities. "$\sqsubseteq$" stands for the (individual or material) parthood relation (Link 1998).

(20) $\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}$ & **ken** $\in \mathbb{P}$ & **alien** $\in \mathbb{Q}\}[|\forall z \in \mathbb{Q}[\mathbb{R}$(**ken**,$z) \rightarrow z \sqsubseteq$ **alien**$]|$ $[\mathbb{R}$(**ken**,**alien**$)]]$

(21) For any context c, world w, and assignment g,

a. $[\![\{\phi\}[\psi]]\!]^{c,w,g}$ is defined only if $[\![^\wedge\phi]\!]^{c,w,g} \in$ CG(c) (i.e. it is common ground in c that "$\phi$"); if defined, $[\![\{\phi\}[\psi]]\!]^{c,w,g} = [\![\psi]\!]^{c,w,g}$;

b. $[\![|\phi|[\psi]]\!]^{c,w,g}$ is defined only if $[\![\phi]\!]^{c,w,g} = 1$; if defined, $[\![|\phi|[\psi]]\!]^{c,w,g} = [\![\psi]\!]^{c,w,g}$.

(22) a. Dom($\mathbb{R}$) is relations between two entities ($\mathbb{R}$ is of type $\langle e, \langle e, t\rangle\rangle$).

b. For any context c, world w, and assignment g, $[\![\mathbb{R}]\!]^{c,w,g}$ is defined only if g($\mathbb{R}$) is a relation between two entities that is prominent in c; if defined, $[\![\mathbb{R}]\!]^{c,w,g}$ = g($\mathbb{R}$).

(23) a. Dom($\mathbb{P}$) is non-empty, non-singleton sets of entities ($\mathbb{P}$ is of type $\langle e, t\rangle$). Likewise for $\mathbb{Q}$.

b. For any context c, world w, and assignment g, $[\![\mathbb{P}]\!]^{c,w,g}$ is defined only if g($\mathbb{P}$) is a set of entities that is prominent in c; if defined, $[\![\mathbb{P}]\!]^{c,w,g}$ = g($\mathbb{P}$). Likewise for $\mathbb{Q}$.

(24) $P \leftrightarrows_R Q =_{def} \forall x_1 \in P, \forall y_1 \in Q[\exists x_2 \in P, \exists y_2 \in Q[R(x_1,y_2)$ & $R(x_2,y_1)]$

In prose, (20) amounts to saying that (i) there is some serial and surjective correspondence $R$ between two sets: {Ken, ...} and {*Alien*, ...} (presupposition), (ii) Ken stands in $R$ with *Alien* (at-issue content), and (iii) Ken does not stand in $R$ with any movie other than *Alien* (exhaustivity implication).

# 3 The Japanese open-ended-relation NPC (the eel sentence)

The Japanese ONPC (the eel sentence) is associated with a strictly weaker presupposition than the English one, but it still is more discourse-pragmatically constrained than acknowledged in the previous literature. In addition to there being a contextually prominent two-place relation $R$, the construction presupposes (i) that there is some $x$ such that $\langle$the referent of the SNP, $x\rangle \in R$ (*existence presupposition*), and (ii) that there is at least one pair of entities $\langle y, z\rangle$ such that (a) $\langle y, z\rangle \in R$ and (b) $y$ is distinct from the referent of the SNP (*multiple-pair presupposition*). Furthermore, like the English one, the Japanese ONPC conveys the exhaustivity implication (with respect to the PNP).

(25) and (26) illustrate the effect of the existence presupposition. In both exchanges, the relation '$x$ studies the life of $y$ (as a marine biologist)' is made prominent by the first utterance of interlocutor B, but while follow-up utterance (25B$_2$') is natural, (26B$_2$') is not. This contrast can be attributed to the existence

presupposition—that B's husband studies the life of some marine creature—being satisfied only in (25).

(25) A: 'I heard that you and your husband are marine biologists. Do you work on particular creatures, like whales?'
$B_1$: Watashi wa kuromaguro no seitai o kenkyuu shite
I Th bluefin.tuna Gen life Acc study do.Ger
imasu.
Npfv.Plt.Prs
'I study the life of bluefin tuna.'
$B_2$: Otto wa unagi no seitai o kenkyuu shite imasu.
husband Th eel Gen life Acc study do.Ger Npfv.Plt.Prs
'(My) husband studies the life of eel.'
$B_2$': Otto wa unagi desu.
husband Th eel Cop.Plt.Prs
(lit.) '(My) husband is eel.'

(26) (The interlocutors have just met for the first time. A does not anything about B's husband.)
A: 'So you are a marine biologist? Do you work on a particular creature, like whales?'
$B_1$: Watashi wa kuromaguro no seitai o kennkyuu shite
I Th bluefin.tuna Gen life Acc study do.Ger
imasu.
Npfv.Plt.Prs
'I study the life of bluefin tuna.'
$B_2$: (Chinamini) otto wa unagi no seitai o kenkyuu shite
incidentally husband Th eel Gen life Acc study do.Ger
imasu.
Npfv.Plt.Prs
'(Incidentally) (my) husband studies the life of eel.'
$B_2$': #{Chinamini / ∅} otto wa unagi desu.
incidentally husband Th eel Cop.Plt.Prs
(lit.) ((Incidentally) (my) husband is eel.)

(27) and (28) illustrate the effect of the multiple-pair presupposition. (28B') sounds odd, there being no contextually prominent pair of a person and a movie distinct from ⟨Ken, *Alien*⟩.

(27) (It is common ground that Mari and Ken saw a possibly different movie.)
A: 'Mari saw *Rocky*, right? What about Ken? What movie did he see?'
B: Ken wa *Alien* o mimashita. / Ken mo *Rocky* o mimashita.
K. Th *A.* Acc see.Plt.Pst K. also *R.* Acc see.Plt.Pst
'Ken saw *Alien*. / Ken saw *Rocky*, too.'

B': Ken wa *Alien* desu.
K. Th *A.* Cop.Plt.Pst
(lit.) 'Ken is *Alien*.'
B": Ken mo *Rocky* desu.
K. also *R.* Cop.Plt.Pst
(lit.) 'Ken is *Rocky*, too.'

(28) (It is common ground that Ken is the only person who saw a movie.)
A: 'What movie did Ken see?'
B: Ken wa *Alien* o mimashita.
K. Th *A.* Acc see.Plt.Pst
'Ken saw *Alien*.'
B': #Ken wa *Alien* desu.
K. Th *A.* Cop.Plt.Pst
(lit.) (Ken is *Alien*.)

(29), finally, illustrates the effect of the exhaustivity implication.

(29) (in reply to: 'What did you have for your lunch? I had a hamburger.')
a. Watashi wa hamusandoitchi o tabemashita. (Ato) furaidochikin
I Th ham.sandwich Acc eat.Plt.Pst and fried.chicken
mo tabemashita.
also eat.Plt.Prs
'I ate a ham sandwich. (And) (I) ate fried chicken, too.'
b. Watashi wa hamusandoitchi desu. #{Ato / ∅} furaidochikin
I Th ham.sandwich Cop.Plt.Prs and fried.chicken
de mo arimasu.
Cop.Inf also Aux.Plt.Prs
(lit.) 'I am a ham sandwich. (And) (I) am fried chicken, too.'
cf. Watashi wa gaka desu. (Ato) toogeika de mo
I Th painter Cop.Plt.Prs and potter Cop.Inf also
arimasu.
Aux.Plt.Prs
'I am a painter. (And) I am a potter, too.'

Taking (27B') as an example, the meaning of a Japanese open-ended-relation NPC will look like (30).

(30) Ken wa *Alien* desu. '(lit.) Ken is *Alien*.' $\mapsto$
$\{\exists y_1, x_2, y_2[\mathbb{R}(\textbf{ken},y_1)\ \&\ \mathbb{R}(x_2,y_2)\ \&\ x_2 \neq \textbf{ken}]\}[|\forall z[\mathbb{R}(\textbf{ken},z) \rightarrow z \sqsubseteq \textbf{alien}]|[\mathbb{R}(\textbf{ken},\textbf{alien})]]$

In prose, this amounts to saying that (i) Ken and at least one other person stand in some contextually prominent relation $R$ with some movie (possibly the same one) (presupposition), (ii) Ken stands in $R$ with *Alien* (at-issue-content), and (iii)

he does not stand in $R$ with any movie other than *Alien* (exhaustivity implication).

# 4 Derivation of the regular and open-ended-relation NPCs

This section discusses how an ONPC can be generated in the constraint-based framework, and how that compares with the case of the regular, unmarked NPC.

## 4.1 The regular (identity/inclusion-type) NPC

A typical NPC implies that the relation of identity holds between the referents of the subject and predicate NPs, as in (31a,b), or the relation of inclusion holds between the referent of the subject NP and the set or collection denoted by the predicate nominal, as in (32a,b).

(31) a. Cicero is Tully.
b. Hiratsuka Raicho {wa/ga} Hiratsuka Haru da.
H. R. {Th/Nom} H. H. Cop.Prs
'Hiratsuka Raicho is Hiratsuka Haru.'

(32) a. Cicero is an orator.
b. Hiratsuka Raicho {wa/ga} sakka da.
H. R. {Th/Nom} writer Cop.Prs
'Hiratsuka Raicho is a writer.'

An issue of dispute about the semantics of the NPC—which is by and large independent from the main concerns of the current work—is how the two unmarked types of relations expressible with it, identity (equation) and inclusion (attribution), are related to each other (Higgins 1979; Declerck 1988, 1990; Mikkelsen 2011).

Montague (1973) posits the meaning along the lines of (33) for the copula BE, which, with the assumption that an (indefinite or definite) common noun phrase as well as a proper name filling the slot of the predicate NP is a generalized quantifier, uniformly accounts for identification statements like (34) and inclusion statements (property-ascribing statements) like (35) ("$\rightarrow_\beta$" stands for beta-reduction).

(33) is $\mapsto \lambda X[\lambda x[X(\lambda y[x = y])]$

(34) Cicero is Tully.
a. Tully: $\lambda P[P(\textbf{tully})]$
b. is Tully:
$\lambda X[\lambda x[X(\lambda y[x = y])]](\lambda P[P(\textbf{tully})])$
$\rightarrow_\beta$ (twice)
$\lambda x[x = \textbf{tully}]$
c. Cicero: $\lambda Q[Q(\textbf{cicero})]$

d. Cicero is Tully:
$\lambda Q[Q(\textbf{cicero})](\lambda x[x = \textbf{tully}])$
$\rightarrow_\beta$ (twice)
**cicero = tully**

(35) Cicero is an orator.

a. an orator: $\lambda P[\exists z(\textbf{orator}(z) \,\&\, P(z))]$
b. is an orator:
$\lambda X[\lambda x[X(\lambda y[x = y])]](\lambda P[\exists z[\textbf{orator}(z) \,\&\, P(z))])$
$\rightarrow_\beta$ (twice)
$\lambda x[\exists z(\textbf{orator}(z) \,\&\, x = z)]$
c. Cicero: $\lambda Q[Q(\textbf{cicero})]$
d. Cicero is an orator:
$\lambda Q[Q(\textbf{cicero})](\lambda x[\exists z[\textbf{orator}(z) \,\&\, x = z]])$
$\rightarrow_\beta$ (twice)
$\exists z[\textbf{orator}(z) \,\&\, \textbf{cicero} = z]]$
$\Leftrightarrow$ **orator**(**cicero**)

I follow here Montague's (1973) uniform approach in assuming that (what may be informally referred to as) the identity-type NPC and the inclusion-type NPC encode the same logical relation between the referents of the subject and predicate NPs, specifically "$\lambda X[\lambda x[X(\lambda y[x = y])]$". I depart from Montague, on the other hand, in not attributing this semantic component to the copula, but instead positing a phrase-modificational rule (in the spirit of Copestake & Briscoe's (1995) lexical rules[4]) applied to an NP and yields a homophonous NP (i) that has an extended, "predicative" meaning and (ii) selects a subject.

(36) **The Identity/Inclusion Predicatization Rule**

$$\left[\begin{array}{ll}
\text{INPUT} & \left[\begin{array}{ll}
\textit{expression} & \\
\text{PHONOLOGY} & \boxed{1} \\
\text{SYNTAX} & \boxed{2}\left[\begin{array}{ll}\text{CATEGORY} & \textit{noun} \\ \text{VALENCE} & !\ \textit{empty-list}\end{array}\right] \\
\text{SEMANTICS} & \alpha\text{'}
\end{array}\right] \\
\text{OUTPUT} & \left[\begin{array}{ll}
\textit{expression} & \\
\text{PHONOLOGY} & \boxed{1} \\
\text{SYNTAX} & \boxed{2}\left[\text{VALENCE} \quad \langle \text{NP} \rangle\right] \\
\text{SEMANTICS} & \lambda X[\lambda x[X(\lambda y[x = y])](\alpha\text{'})
\end{array}\right]
\end{array}\right]$$

[4]Despite what their name suggests, Copestake & Briscoe's (1995) lexical rules can have phrases as well as lexemes/words as their input/output.

## 4.2 The English open-ended-relation NPC

The following rule generates (the PNP of) an English ONPC:

(37) **The Open-Ended-Relation Predicatization Rule (English)**

$$\left[\begin{array}{ll}
\text{INPUT} & \left[\begin{array}{ll}
\textit{expression} & \\
\text{PHON} & \boxed{1} \\
\text{SYN} & \boxed{2}\left[\begin{array}{ll}\text{CATEGORY} & \textit{noun} \\ \text{VALENCE} & !\ \textit{empty-list}\end{array}\right] \\
\text{SEM} & \alpha\text{'}
\end{array}\right] \\
\text{OUTPUT} & \left[\begin{array}{ll}
\textit{expression} & \\
\text{PHON} & \boxed{1} \\
\text{SYN} & \boxed{2}\left[\text{VALENCE} \quad \langle \text{NP} \rangle\right] \\
\text{SEM} & \lambda X[\lambda x[X(\lambda y[\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}\ \&\ x \in \mathbb{P}\ \&\ y \in \mathbb{Q}\} \\ & [|\forall z \in \mathbb{Q}[\mathbb{R}(x,z) \rightarrow z \sqsubseteq y]|[\mathbb{R}(x,y)]]])]](\alpha\text{'})
\end{array}\right]
\end{array}\right]$$

(38) illustrates the composition of the English ONPC *Ken is* Alien.

(38) Ken is *Alien*.

a. $\textit{Alien} \mapsto \lambda P[P(\textbf{alien})]$

b. (is) *Alien* [predicatized with rule (37)] $\mapsto$
$\lambda X[\lambda x[X(\lambda y[\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}\ \&\ x \in \mathbb{P}\ \&\ y \in \mathbb{Q}\}[|\forall z \in \mathbb{Q}[\mathbb{R}(x,z) \rightarrow z \sqsubseteq y]|[\mathbb{R}(x,y)]]])]](\lambda P[P(\textbf{alien})])$
$\rightarrow_\beta$
$\lambda x[\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}\ \&\ x \in \mathbb{P}\ \&\ \textbf{alien} \in \mathbb{Q}\}[|\forall z \in \mathbb{Q}[\mathbb{R}(x,z) \rightarrow z \sqsubseteq \textbf{alien}]|[\mathbb{R}(x,\textbf{alien})]]]$

c. Ken $\mapsto \lambda Q[Q(\textbf{ken})]$

d. Ken is *Alien* $\mapsto \lambda Q[Q(\textbf{ken})](\lambda x[\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}\ \&\ x \in \mathbb{P}\ \&\ \textbf{alien} \in \mathbb{Q}\}[|\forall z \in \mathbb{Q}[\mathbb{R}(x,z) \rightarrow z \sqsubseteq \textbf{alien}]|[\mathbb{R}(x,\textbf{alien})]]])$
$\rightarrow_\beta$
$\{\mathbb{P} \leftrightarrows_{\mathbb{R}} \mathbb{Q}\ \&\ \textbf{ken} \in \mathbb{P}\ \&\ \textbf{alien} \in \mathbb{Q}\}[|\forall z \in \mathbb{Q}[\mathbb{R}(x,z) \rightarrow z \sqsubseteq \textbf{alien}]|[\mathbb{R}(\textbf{ken},\textbf{alien})]]$

## 4.3 The Japanese open-ended-relation NPC

The following rule, minimally contrasting with (37), generates (the PNP of) a Japanese ONPC:

(39) **the open-ended-relation predicatization rule (Japanese)**

$$\begin{bmatrix} \text{INPUT} & \begin{bmatrix} \textit{expression} & \\ \text{PHON} & \boxed{1} \\ \text{SYN} & \boxed{2}\begin{bmatrix} \text{CATEGORY} & \textit{noun} \\ \text{VALENCE} & !\ \textit{empty-list} \end{bmatrix} \\ \text{SEM} & \alpha\text{'} \end{bmatrix} \\ \text{OUTPUT} & \begin{bmatrix} \textit{expression} & \\ \text{PHON} & \boxed{1} \\ \text{SYN} & \boxed{2}\begin{bmatrix} \text{VALENCE} & \langle \text{NP} \rangle \end{bmatrix} \\ \text{SEM} & \lambda X[\lambda x[X(\lambda y[\{\exists y_1, x_2, y_2[\mathbb{R}(x,y_1)\ \&\ \mathbb{R}(x_2,y_2)\ \&\ x_2 \neq x]\}[|\forall z[\mathbb{R}(x,z) \rightarrow z \sqsubseteq y]| \\ & [\mathbb{R}(x,y)]]])]](\alpha\text{'}) \end{bmatrix} \end{bmatrix}$$

(40) illustrates the composition of the Japanese ONPC *Ken wa* Alien *desu*.

(40) Ken wa *Alien* desu. 'Ken is *Alien*.'

a. *Alien* $\mapsto \lambda P[P(\textbf{alien})]$

b. *Alien* (desu) [predicatized with rule (39)] $\mapsto$
$\lambda X[\lambda x[X(\lambda y[\{\exists y_1, x_2, y_2[\mathbb{R}(x,y_1)\ \&\ \mathbb{R}(x_2,y_2)\ \&\ x_2 \neq x]\}$
$[|\forall z[\mathbb{R}(x,z) \rightarrow z \sqsubseteq y]|[\mathbb{R}(x,y)]]])]](\lambda P[P(\textbf{alien})])$
$\rightarrow_\beta$
$\lambda x[\{\exists y_1, x_2, y_2[\mathbb{R}(x,y_1)\ \&\ \mathbb{R}(x_2,y_2)\ \&\ x_2 \neq x]\}[|\forall z[\mathbb{R}(x,z) \rightarrow$
$z \sqsubseteq \textbf{alien}]|[\mathbb{R}(x,\textbf{alien})]]]$

c. Ken (wa) $\mapsto \lambda Q[Q(\textbf{ken})]$

d. Ken wa *Alien* desu $\mapsto \lambda Q[Q(\textbf{ken})](\lambda x[\{\exists y_1, x_2, y_2[\mathbb{R}(x,y_1)\ \&$
$\mathbb{R}(x_2,y_2)\ \&\ x_2 \neq x]\}[|\forall z[\mathbb{R}(x,z) \rightarrow z \sqsubseteq \textbf{alien}]|[\mathbb{R}(x,\textbf{alien})]]])$
$\rightarrow_\beta$
$\{\exists y_1, x_2, y_2[\mathbb{R}(x,y_1)\ \&\ \mathbb{R}(x_2,y_2)\ \&\ x_2 \neq \textbf{ken}]\}[|\forall z[\mathbb{R}(\textbf{ken},z) \rightarrow$
$z \sqsubseteq \textbf{alien}]|[\mathbb{R}(\textbf{ken},\textbf{alien})]]$

# 5 Conclusion

This work put forth semantic analyses of the English open-ended-relation NPC (Ward's (2004) "deferred equative") and the Japanese open-ended-relation NPC (commonly referred to as the "eel sentence" in the literature) that improve on existing accounts, and proposed positing phrasal rules to derive the two ONPCs utilizing the apparatus of constraint-based syntax. The findings hopefully contribute to the future discussion of how open-ended-relation NPCs across languages might contrast with each other, being subject to different sets of discourse-pragmatic constraints.

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# *Respectively* interpretation and Binding Conditions A and B

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**Abstract**

The theory of *respectively* interpretation proposed in Yatabe & Tam (2021) entails that Binding Conditions A and B need to be formulated as constraints on the form of semantic representations. It is possible to formulate the two binding conditions as such constraints if anaphoric relations are encoded in semantic representations in a way analogous to the way they are encoded in Discourse Representation Theory.

# 1 Introduction

In this paper, I am going to examine the interaction between *respectively* interpretation and binding conditions. I will first describe the theory of *respectively* interpretation that is presented in Yatabe & Tam (2021), and argue that it is the best theory of *respectively* interpretation currently available. Then I am going to show what consequences that theory has about binding theory.

# 2 Yatabe and Tam (2021)

In Appendix D of Yatabe & Tam (2021), we present a theory of *respectively* interpretation that is capable of assigning appropriate truth conditions not only to a sentence like (1) but also to sentences that involve non-constituent coordination, such as (2) and (3).

(1) Chris and Pat read Austen and Beckett respectively.

(2) John loves and Mary hates oysters and clams respectively. (from Postal (1998, p. 134))

(3) Chris bought, and Pat sold, a car on Thursday and a bike on Friday, respectively.

According to the theory, each such sentence is initially associated with a semantic representation that expresses a reading different from the *respectively* reading, and that semantic representation is later rewritten to become a representation expressing the *respectively* reading. For instance, in the case of the sentence in (1), the proposed grammar initially creates a semantic representation that expresses the proposition that both Chris and Pat read both Austen and Beckett, and that representation is subsequently rewritten to become a representation that expresses the proposition that Chris read Austen and Pat read Beckett. The presence of the word *respectively* in a sentence is taken to merely signify the need to invoke this rewriting mechanism, and is disregarded in associating an initial semantic representation to the sentence.

[†]I thank the three anonymous reviewers who commented on the extended abstract, the audience at the HPSG 2022 conference, and the audience at UT Austin.

Let me introduce a useful term, *single-conjunct extract*, and then use that term to describe the way the rewriting mechanism works. What I will call a *single-conjunct extract* of a semantic representation is what is obtained by retaining only one conjunct[1] of each coordinate structure in the semantic representation. For instance, the single-conjunct extracts of the initial semantic representation of sentence (1) are four semantic representations that respectively express "Chris read Austen", "Chris read Beckett", "Pat read Austen", and "Pat read Beckett". Now, suppose you consistently choose the first conjunct in obtaining a single-conjunct extract of the initial semantic representation of sentence (1). You get a representation expressing the proposition that Chris read Austen. Likewise, if you consistently choose the second conjunct in obtaining a single-conjunct extract of that semantic representation, you get a representation expressing the proposition that Pat read Beckett. It is by conjoining these two single-conjunct extracts that the rewriting mechanism produces the final semantic representation that expresses the *respectively* reading.

This theory is designed to be able to deal with examples like (4) in which disjunction gives rise to *respectively* interpretation.

(4) Sentence A and sentence B will be true just in case the set of sneezers contains every man or most babies, respectively.

The fact that not all instances of conjunction and disjunction can give rise to *respectively* interpretation is captured by the following constraint.

(5) When the rewriting mechanism transforms a formula $X$ into another formula $Y$ that represents a *respectively* reading, there must exist a paraphrase of $X$ that satisfies the following three conditions.
- The paraphrase is truth-conditionally equivalent to $X$, given an appropriate context.
- The paraphrase can be obtained by combining the single-conjunct extracts of $X$ using conjunction and disjunction.
- Deletion of some of the single-conjunct extracts in the paraphrase yields $Y$.

I will illustrate the workings of this constraint using concrete examples. The first example is sentence (1). As I already noted, this sentence is initially associated with a semantic representation expressing the proposition that both Chris and Pat read both Austen and Beckett. This proposition can be paraphrased as "Chris read Austen, Chris read Beckett, Pat read Austen, and Pat read Beckett". And if you delete two of the four single-conjunct extracts in this paraphrase, you obtain the *respectively* reading, "Chris read Austen and Pat read Beckett". Therefore this *respectively* reading is licensed by the constraint in question.

[1] Things that are coordinated with each other in a syntactic or semantic coordinate structure will all be referred to as conjuncts in this paper, irrespective of whether the coordinator involved expresses conjunction or disjunction.

The second example we consider is sentence (4).[2] Suppose that the coordinate DP *sentence A and sentence B* and the disjunction in *every man or most babies* are both interpreted outside the scope of the biconditional.[3] Then the proposition expressed by the initial semantic representation for the sentence will be something like (6).

(6) For each $x$ in the group consisting of sentence A and sentence B, either $x$ is true iff the set of sneezers contains every man or $x$ is true iff the set of sneezers contains most babies.

This can be paraphrased using single-conjunct extracts as in (7), where $P$ stands for "the set of sneezers contains every man" and $Q$ stands for "the set of sneezers contains most babies".

(7) [[For each $x$ in the group consisting of sentence A, $x$ is true iff $P$] or
[for each $x$ in the group consisting of sentence A, $x$ is true iff $Q$]] and
[[for each $x$ in the group consisting of sentence B, $x$ is true iff $P$] or
[for each $x$ in the group consisting of sentence B, $x$ is true iff $Q$]].

By deleting the second and the third single-conjunct extract in this paraphrase, we get the *respectively* reading, "Sentence A is true iff $P$, and sentence B is true iff $Q$". Therefore this *respectively* reading is also licensed.

The third example, given in (8), is a case where *respectively* interpretation fails to materialize.

(8) *Sue or Karen jogs or drives respectively. (from Eggert (2000))

The semantic representation initially associated with the sentence can be paraphrased as "Sue jogs or Sue drives or Karen jogs or Karen drives", using the four single-conjunct extracts of that initial representation. However, no matter which single-conjunct extracts you delete in that paraphrase, you cannot arrive at the *respectively* reading of the sentence, "Sue jogs *and* Karen drives", which is constructed by *conjoining* a single-conjunct extract that is obtained by consistently choosing the first conjunct and a single-conjunct extract that is obtained by consistently choosing the second conjunct. Therefore this *respectively* reading fails to be licensed.

## 3 Two other theories of *respectively* interpretation

Now, there are two other theories of *respectively* interpretation that can deal with cases involving non-constituent coordination. I will compare our theory with those

[2] I thank Hans Kamp for pointing out the potential problem that an example like this containing a biconditional could pose for our account.

[3] One way to give the disjunction wide scope over the biconditional is to analyze the sentence as involving left-node raising of the string *will be true just in case the set of sneezers contains* out of a VP of the form *will be true just in case the set of sneezers contains every man or will be true just in case the set of sneezers contains most babies*.

two theories in this section.

The first theory to review is what is proposed in Goodall (1987). According to this theory, the syntactic representation of a sentence that receives *respectively* interpretation consists of multiple clauses that are conjoined with each other. In this theory, coordination in general is represented as a union of phrase markers, that is, a "pasting together," one on top of the other, of two or more trees, with any identical nodes merging together. Thus, the sentence *John and Mary saw himself and herself (respectively)* is assumed to involve union of the phrase marker for *John saw himself* and the phrase marker for *Mary saw herself*.

There are two good reasons to be skeptical of this theory. First, as discussed in detail in Dalrymple & Kehler (1995), a theory like Goodall's cannot be applied to an example like (9), which is acceptable as a response to a query such as *Where do John and Bill live?*.

(9) They live in New York and Chicago respectively.

Now, Bošković (to appear) argues that *respectively* interpretation induced by a plural DP should be regarded as an entirely different phenomenon from *respectively* interpretation induced by coordinate structures, citing the contrast between sentence (10) and the second sentence in (11).

(10) Bill and Sue hired himself and nominated herself respectively.

(11) I finally met Lyn and Bill yesterday. *These two students hired herself and nominated himself respectively.

If this view is on the right track, then a sentence like (9) becomes irrelevant in evaluating the validity of Goodall's theory. However, the contrast that Bošković notes does not necessarily show what he says it does. The second sentence in (11) may be degraded not because it has syntactic structure fundamentally different from that of sentence (10) but rather merely because the anaphors in the sentence lack antecedents that agree with them in gender, number, and person. I will come back to this issue in Section 7.

The second problem with Goodall's theory is that it is incapable of dealing with cases involving disjunction. There is nothing in Goodall's theory that accounts for the fact that both conjunction and disjunction can yield *respectively* interpretation under some circumstances but not under other circumstances.

The second theory that I would like to compare our theory to is the one proposed in Kubota & Levine (2016). This theory is an extension of the theory presented in Gawron & Kehler (2004) using Categorial Grammar mechanisms. Unlike Goodall's theory, it has no problem dealing with sentences in which a plural DP like *they* gives rise to *respectively* interpretation. However, just like Goodall's theory, their theory cannot deal with cases where disjunction is responsible for *respectively* interpretation. Kubota & Levine (2018) and Kubota & Levine (2020) discuss the possibility of adding a special mechanism to their theory that deals specifically with *respectively* readings induced by disjunction, but do not present a concrete theory.

Incidentally, in Yatabe & Tam (2021), we note the existence of examples like (9), but do not go on to present a concrete analysis of such examples. This shortcoming, however, is easy to fix. As shown in detail in the Appendix of the present paper, all that needs to be done is to add to the theory the assumption that the INDEX value of a plural DP can be of the form $x_1 + \cdots + x_n$.

## 4 Binding facts and *respectively* interpretation

Our theory of *respectively* interpretation has some immediate consequences for binding theory. Consider first the following two sentences, both discussed in Goodall (1987).

(12) John and Mary saw him and a cow respectively.

(13) John and Mary love his pet goldfish and him respectively.

Coreference between *John* and *him* is disallowed in sentence (12) but possible in sentence (13). Assuming that our almost purely semantic account of *respectively* interpretation is on the right track, there is arguably no reasonable way to account for these observations in syntactic terms, and we are led to conclude that Binding Condition B is a constraint on the form of semantic representations.

Next, consider the following examples.

(14) Which man and which woman did respectively the doctor talk to about himself, and the lawyer talk to about herself? (from Postal (1998, p. 161))

(15) John and Mary hired himself and nominated herself respectively. (from Bošković (2022))

Assuming, again, that Yatabe and Tam's theory is on the right track, it seems difficult to escape the conclusion that Binding Condition A is also a constraint on the form of semantic representations.

## 5 Reformulating Binding Condition A

In what follows, I will show that it is actually possible to reformulate Binding Conditions A and B as constraints on the form of semantic representations if we make certain assumptions about the way anaphoric relations are encoded in semantic representations. First, I assume that a pronominal like *her* contributes to the semantic representation an elementary predication like (16) and that a reflexive pronoun like *yourself* contributes an elementary predication like (17). These elementary predications indicate which variable in the semantic representation is to serve as the antecedent of each pronoun.

(16)
$$\begin{bmatrix} \text{RELATION} & \text{anaphora} \\ \text{PRONOMINAL} & i \\ \text{ANTECEDENT} & j \end{bmatrix}$$

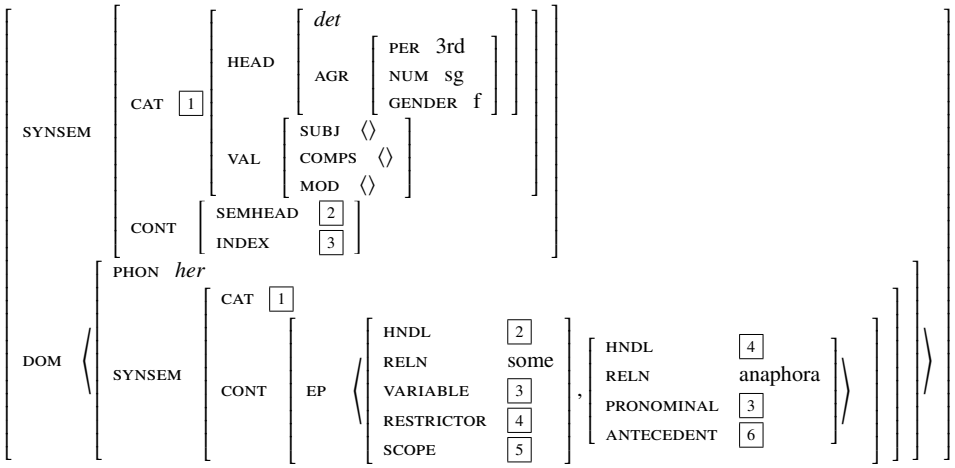


Figure 1: Part of the lexical entry for *her*

$$(17)\quad \begin{bmatrix} \textsc{relation} & \text{anaphora} \\ \textsc{reflexive} & i \\ \textsc{antecedent} & j \end{bmatrix}$$

I also assume that no two DPs in the same sentence are allowed to have the same index and that what is captured by coindexing in most other theories is instead captured by elementary predications like (16) and (17).

To be more concrete, I propose that a pronominal like *her* and a reflexive pronoun like *yourself* be associated with lexical entries like those shown in Fig. 1 and Fig. 2 respectively. Notice that, in each of these lexical entries, the EP value inside the DOM value[4] contains an elementary predication expressing an existential quantifier in addition to an elementary predication stating which variable is to be the antecedent of the variable contributed by the pronoun. The existential quantifier provides existential closure for the variable provided by the pronoun, creating semantic representations that bear some similarity to the semantic representations postulated in Discourse Representation Theory (see Kamp & Reyle (1993)).

I will further assume that elementary predications contributed by predicates indicate which variable has come from which grammatical function. For instance, an elementary predication contributed by an active verb *see* and an elementary predication contributed by a passive verb *seen* will be like the ones shown in (18) and (19) respectively.

$$(18)\quad \begin{bmatrix} \textsc{relation} & \text{see} \\ \textsc{subject} & i \\ \textsc{object} & j \end{bmatrix}$$

[4]See Yatabe & Tam (2021) for an explanation as to why elementary predications expressing the meaning of expressions need to be placed inside DOM values.

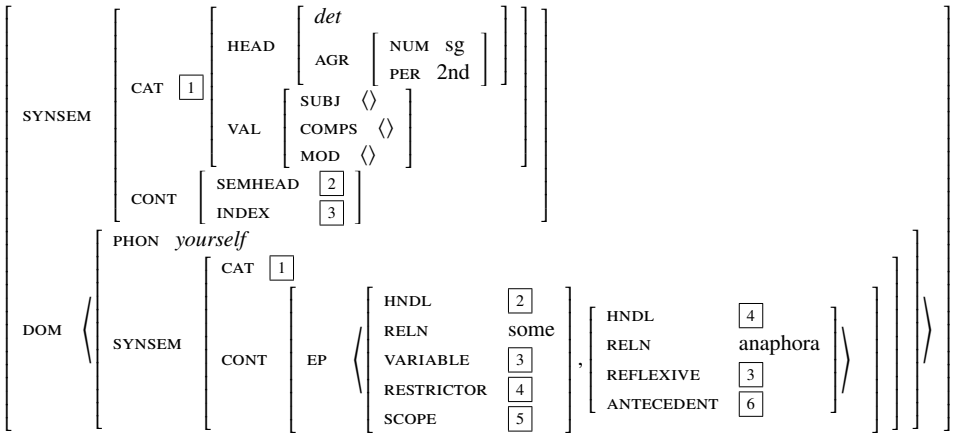


Figure 2: Part of the lexical entry for *yourself*

(19)
$$\begin{bmatrix} \text{RELATION} & \text{be\_seen} \\ \text{SUBJECT} & i \\ \text{OBLIQUE} & j \end{bmatrix}$$

Given these assumptions, Binding Condition A can now be stated as in (22). The term *outrank*, used in (22), is defined in (20). The term *exempt anaphor*, also used in (22), is defined in (21). What is called the *initial semantic representation* of a sentence here is the MRS representation that the grammar initially associates with the sentence. What is called the *final semantic representation*, on the other hand, is the semantic representation which is produced by the rewriting mechanism responsible for *respectively* interpretation and which expresses the correct truth conditions of the sentence.

(20) Let $E$ be an elementary predication and let $X$ and $Y$ be variables contained in $E$. We say that $X$ *outranks* $Y$ in $E$ if and only if (i) $X$ is the SUBJECT value of $E$ and $Y$ is not, or (ii) $X$ is the OBJECT value of $E$ and $Y$ is neither the SUBJECT value nor the OBJECT value of $E$, or (iii) $X$ is the SECONDARY-OBJECT value of $E$ and $Y$ is not the SUBJECT value, the OBJECT value, or the SECONDARY-OBJECT value of $E$.

(21) An elementary predication $E$ of the form shown in (17) is an *exempt anaphor* in a semantic representation $M$ if $M$ does not contain an elementary predication in which the REFLEXIVE value of $E$ is outranked by some other variable.

(22) Binding Condition A:
Let $M'$ be a final semantic representation that has been derived by applying (possibly vacuously) to an initial semantic representation $M$ the rewriting mechanism responsible for *respectively* interpretation. Let $E'$ be an elementary predication of the form shown in (17) that is contained in $M'$, and $E$ be the source of $E'$ contained in $M$, which means that $E$ is either

identical to $E'$ or an alphabetic variant of $E'$. Suppose that $E$ is not an exempt anaphor in $M$. Then $M'$ must contain an elementary predication in which the REFLEXIVE value of $E'$ is outranked by the ANTECEDENT value of $E'$.

Let me illustrate how this condition applies to some concrete examples, starting with the simple sentence in (23).

(23) Chris likes herself.

The EP value associated with the sentence as a whole is shown in (24). Note that the meaning of a quantifier such as *some* is assumed to be a three-place predicate whose arguments are (i) the variable it binds, (ii) the restrictor, and (iii) the (nuclear) scope. Note also that it is assumed that the handle of an elementary predication contributed by a proper noun is obligatorily equated with *gtop*, the global top handle (see Yatabe & Tam (2021, p. 31)).

(24)
$$\left\langle \begin{bmatrix} \text{HNDL} & gtop \\ \text{RELN} & \text{identical} \\ \text{ARG1} & i \\ \text{ARG2} & \text{Chris} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h2 \\ \text{RELN} & \text{like} \\ \text{SUBJECT} & i \\ \text{OBJECT} & j \end{bmatrix}, \begin{bmatrix} \text{HNDL} & gtop \\ \text{RELN} & \text{some} \\ \text{VARIABLE} & j \\ \text{RESTRICTOR} & h1 \\ \text{SCOPE} & h2 \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h1 \\ \text{RELATION} & \text{anaphora} \\ \text{REFLEXIVE} & j \\ \text{ANTECEDENT} & i \end{bmatrix} \right\rangle$$

The list of elementary predications given in (24) is equivalent to the following formula, where "$j \rightarrow i$" corresponds to the last elementary predication and is assumed to be true if and only if the denotation of $j$ and the denotation of $i$ are identical.

(25) $i = \text{Chris} \wedge \text{some}(j, j \rightarrow i, \text{like}(i, j))$

What is shown in (24) is both the initial semantic representation and the final semantic representation for the sentence in (23). The fourth elementary predication in (24) is not an exempt anaphor according to (21), because this EP list contains an elementary predication in which the REFLEXIVE value of that elementary predication (namely $j$) is outranked by some other variable (namely the second elementary predication). Thus Binding Condition A needs to be satisfied, and it *is* satisfied because (24) contains an elementary predication whose RELN value is *like* in which the REFLEXIVE value of the fourth elementary predication (namely $j$) is outranked by its ANTECEDENT value (namely $i$).

Next, let us consider the sentence in (15) above, which involves *respectively* interpretation. Since the subject *John and Mary* in this sentence needs to be given distributive interpretation, it is necessary to state here how distributive interpretation is handled by the grammar. I will use the sentence in (26a) as an example.

(26) a. Three students sang.

b. [$_{S}$ Three students [$_{VP}$ DIST1 [$_{VP}$ sang]]]

c. some($X$, $|X| = 3 \wedge$ students($X$), every($z$, member_of($z$, $X$), sang($z$)))

In Yatabe (2021), I propose an analysis of sentence (26a) in which it is given a syntactic structure like (26b), where the unpronounced lexical item DIST1 functions like the floated quantifier *each*. Like many previous analyses such as those presented in Heim et al. (1991) and Kamp & Reyle (1993), this analysis ultimately assigns to the sentence a semantic interpretation like (26c), where a formula of the form "member_of($a$, $b$)" is assumed to be true if and only if the denotation of the first argument is a member of the group consisting of the denotation of the second argument.

Assuming this analysis of distributive interpretation, the initial semantic representation for sentence (15) is constructed as in (27), disregarding the presence of the word *respectively*. The semantic coordinators that are to be given *respectively* interpretation are assigned a subscript here, in accordance with the theory of Yatabe & Tam (2021).

(27)
$$\left\langle \begin{bmatrix} \text{HNDL} & gtop \\ \text{RELN} & \text{some} \\ \text{VARIABLE} & z \\ \text{RESTRICTOR} & h1 \\ \text{SCOPE} & h2 \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h1 \\ \text{RELN} & \text{identical} \\ \text{ARG1} & z \\ \text{ARG2} & x +_i y \end{bmatrix}, \begin{bmatrix} \text{HNDL} & gtop \\ \text{RELN} & \text{identical} \\ \text{ARG1} & x \\ \text{ARG2} & \text{John} \end{bmatrix}, \right.$$
$$\begin{bmatrix} \text{HNDL} & gtop \\ \text{RELN} & \text{identical} \\ \text{ARG1} & y \\ \text{ARG2} & \text{Mary} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h2 \\ \text{RELN} & \text{every} \\ \text{VARIABLE} & w \\ \text{RESTRICTOR} & h3 \\ \text{SCOPE} & h4 \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h3 \\ \text{RELN} & \text{member\_of} \\ \text{ARG1} & w \\ \text{ARG2} & z \end{bmatrix},$$
$$\begin{bmatrix} \text{HNDL} & h4 \\ \text{RELN} & \text{and}_i \\ \text{CONJUNCTS} & \langle h5, h6 \rangle \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h8 \\ \text{RELN} & \text{hired} \\ \text{SUBJECT} & w \\ \text{OBJECT} & u \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h5 \\ \text{RELN} & \text{some} \\ \text{VARIABLE} & u \\ \text{RESTRICTOR} & h7 \\ \text{SCOPE} & h8 \end{bmatrix},$$
$$\begin{bmatrix} \text{HNDL} & h7 \\ \text{RELN} & \text{anaphora} \\ \text{REFLEXIVE} & u \\ \text{ANTECEDENT} & w \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h10 \\ \text{RELN} & \text{nominated} \\ \text{SUBJECT} & w \\ \text{OBJECT} & v \end{bmatrix},$$
$$\left. \begin{bmatrix} \text{HNDL} & h6 \\ \text{RELN} & \text{some} \\ \text{VARIABLE} & v \\ \text{RESTRICTOR} & h9 \\ \text{SCOPE} & h10 \end{bmatrix}, \begin{bmatrix} \text{HNDL} & h9 \\ \text{RELATION} & \text{anaphora} \\ \text{REFLEXIVE} & v \\ \text{ANTECEDENT} & w \end{bmatrix} \right\rangle$$

The representation in (27) is equivalent to (28), where *and*($X$, $Y$) is meant to be equivalent to $X \wedge Y$.

(28) $x = \text{John} \wedge y = \text{Mary}$
$\wedge \text{some}(z, z = x +_i y,$
$\quad \text{every}(w, \text{member\_of}(w, z),$
$\quad\quad \text{and}_i(\text{some}(u, u \rightarrow w, \text{hired}(w, u)),$
$\quad\quad\quad \text{some}(v, v \rightarrow w, \text{nominated}(w, v)))))$
("$x$ is John, $y$ is Mary, and for every member $w$ of an entity $z$ that is a group made up of $x$ and $y$, it can be said that $w$ hired $u$ that is identical to $w$ and that $w$ nominated $v$ that is identical to $w$.")

By assumption, the rewriting mechanism can target any constituent of a semantic representation that contains all the semantic coordinators with a given subscript such as $i$, so it can target the portion that starts with the first occurrence of *some*, i.e. what is shown in (29), in the present case. The single-conjunct extract of that portion of the semantic representation that we get by consistently choosing the first conjunct of each coordinator with subscript $i$ is (30), and the single-conjunct extract we get by consistently choosing the second conjunct is (31).

(29) $\text{some}(z, z = x +_i y,$
$\quad \text{every}(w, \text{member\_of}(w, z),$
$\quad\quad \text{and}_i(\text{some}(u, u \rightarrow w, \text{hired}(w, u)),$
$\quad\quad\quad \text{some}(v, v \rightarrow w, \text{nominated}(w, v)))))$

(30) $\text{some}(z, z = x,$
$\quad \text{every}(w, \text{member\_of}(w, z),$
$\quad\quad \text{some}(u, u \rightarrow w, \text{hired}(w, u))))$

(31) $\text{some}(z, z = y,$
$\quad \text{every}(w, \text{member\_of}(w, z),$
$\quad\quad \text{some}(v, v \rightarrow w, \text{nominated}(w, v))))$

By replacing (29) with the conjunction of (30) and (31) in (28), the rewriting mechanism arrives at the final semantic representation, which is shown in (32). In (32), two of the bound variables in (31), namely $w$ and $z$, have been replaced by $w'$ and $z'$ respectively in order to satisfy the variable-binding condition, which prohibits a variable bound by a quantifier from being reused as a free variable or as a variable bound by another quantifier.[5]

(32) $x = \text{John} \wedge y = \text{Mary}$
$\wedge \text{and}(\text{some}(z, z = x,$
$\quad\quad \text{every}(w, \text{member\_of}(w, z),$
$\quad\quad\quad \text{some}(u, u \rightarrow w, \text{hired}(w, u)))),$
$\quad \text{some}(z', z' = y,$
$\quad\quad \text{every}(w', \text{member\_of}(w', z'),$
$\quad\quad\quad \text{some}(v, v \rightarrow w', \text{nominated}(w', v)))))$

[5] In Yatabe & Tam (2021), it was assumed that final semantic representations do not have to satisfy the variable-binding condition. Here I drop that assumption because it is incompatible with the theory formulated in the present paper.

This is an adequate if long-winded semantic representation that expresses the *respectively* reading of sentence (15).

Binding Condition A is satisfied by sentence (15) when its initial semantic representation is (27) and its final semantic representation is (32). The official MRS version of the final representation, which I do not show here, contains two elementary predications of the form shown in (17), corresponding to "$u \rightarrow w$" and "$v \rightarrow w'$" in (32), both of which come from a counterpart in the initial semantic representation that was not an exempt anaphor there. The elementary predication corresponding to "$u \rightarrow w$" satisfies Binding Condition A because its REFLEXIVE value (namely $u$) is outranked by its ANTECEDENT value (namely $w$) in the elementary predication corresponding to "hired($w, u$)". The elementary predication corresponding to "$v \rightarrow w'$" likewise satisfies Binding Condition A because its REFLEXIVE value (namely $v$) is outranked by its ANTECEDENT value (namely $w'$) in the elementary predication corresponding to "nominated($w', v$)".

Note that (22) states that an anaphor is exempted from Binding Condition A if it is an exempt anaphor in the *initial* semantic representation. The reason the exempt status of an anaphor needs to be determined according to the configuration of the initial semantic representation is that a sentence like (33) is acceptable.

(33) The artist$_i$ says that the characters in her comics are based on her favorite colors, purple and grey, and represent herself$_i$ and her boyfriend respectively.
https://www.demilked.com/adorable-relationship-comics-the-avr-method/

The reflexive pronoun *herself* in this example would be incorrectly predicted not to be exempt from Binding Condition A if the exempt status of an anaphor were to be determined according to the configuration of the final semantic representation.

# 6 Raising predicates

The theory proposed in Section 5 is incompatible with some standard assumptions about the semantics of raising predicates, since a sentence like (34) is possible.

(34) The students seemed to themselves to be tired.

If the verb *seemed* in this sentence is semantically a two-place predicate as it is standardly assumed to be, then the variable contributed by the reflexive *themselves* is not outranked by any other variable in any of the elementary predications, in violation of the version of Binding Condition A formulated above. Reinhart & Reuland (1993) and Müller (2021) state that an observation like this constitutes evidence that Binding Condition A needs to make reference to syntactic representations as opposed to semantic representations.

In fact, however, a sentence like (34) does not necessarily show that Binding Condition A needs to make reference to syntactic structure. It is possible to maintain the version of Binding Condition A stated in (22) if we assume that raising predicates

such as *seem* are syntactically ambiguous and that they each have a homophonous control-predicate counterpart. Given that assumption, a sentence like (34) is no longer a problem for the proposed account because the verb *seemed* here can then be semantically a three-place predicate whose second argument, which is in this case a variable contributed by a reflexive, is anteceded by its first argument.

## 7 The necessity of syntactic antecedents

Let us now come back to the issue posed by the contrast between (10) and the second sentence in (11). Bošković (to appear) interprets this contrast as indicating that the two sentences have fundamentally different syntactic structures. As noted above, however, the contrast can also be interpreted as showing that each reflexive pronoun must have a syntactic antecedent, that is, a syntactic entity that can be regarded as the antecedent of the reflexive pronoun. The reflexives in (10) have syntactic antecedents, namely *Bill* and *Sue*, whereas the reflexives in (11) do not have syntactic antecedents.

There are three slight complications that we need to consider before we attempt to formulate the constraint in question. First, if we are to maintain the standard HPSG view that the grammatical subject position of an infinitival clause like *to defend themselves* can be truly missing rather than filled by an unpronounced pronominal element, we need to say that not only an overt DP but also an unsaturated DP argument slot can serve as the syntactic antecedent of a pronoun.

The second complication comes from cases where the antecedent of a pronoun is a plural DP that receives distributive interpretation. Consider sentence (26a) again. Notice that, in order for this sentence to be associated with the semantic representation shown in (26c), the INDEX value of the subject DP must be the variable $X$, a variable different from the SUBJECT value of the elementary predication contributed by the verb *sang*, which has to be something like (35).

(35)
$$\begin{bmatrix} \text{HNDL} & h1 \\ \text{RELN} & \text{sang} \\ \text{SUBJECT} & z \end{bmatrix}$$

When the same analysis of distributive interpretation is applied to a sentence like (36a), as in (36b) and (36c), Binding Condition A requires the ANTECEDENT value of the elementary predication contributed by the reflexive pronoun to be $z$, a variable different from the INDEX value of the subject DP, i.e. $X$.

(36) a. Three scholars cited themselves.

b. [$_{\text{S}}$ Three scholars [$_{\text{VP}}$ DIST1 [$_{\text{VP}}$ cited themselves]]]

c. $\text{some}(X, |X| = 3 \wedge \text{scholars}(X),$
$\quad \text{every}(z, \text{member\_of}(z, X), \text{some}(y, y \rightarrow z, \text{cited}(z, y))))$

This means that the DP that we would like to identify as the syntactic antecedent of a reflexive pronoun may have an INDEX value that is different from the ANTECEDENT

value of the elementary predication contributed by the reflexive pronoun as well as from the INDEX value of the reflexive pronoun.

And the third complication, which is analogous to the second one, comes from sentences like (10). In the semantic representation of (10) shown in (32), the variable *w*, which outranks the variable *u* contributed by the reflexive *himself* in the elementary predication contributed by the verb *hired*, is the only possible ANTECEDENT value of the elementary predication contributed by the reflexive, but the INDEX value of the DP *John*, which we would like to say is the syntactic antecedent of the reflexive, is not *w* but *x*.

In light of these considerations, I hypothesize that the grammar of English contains the constraint stated in (37).[6] The term *syntactic antecedent*, used in (37), is defined in (38), and the term *source variable*, used in (38), is defined in (39).

(37) For each elementary predication that has the REFLEXIVE feature, the following two conditions must be satisfied.
First, there must be either a DP or an unsaturated DP argument slot which is a syntactic antecedent of that elementary predication.
And second, the pronoun that contributed that elementary predication to the semantic representation and the syntactic antecedent of the elementary predication must agree in gender, number, and person.

(38) Definition of *syntactic antecedent*:
Let *E* be an elementary predication whose ANTECEDENT value is a variable *j*. Then a DP or a DP argument slot whose INDEX value is a variable *i* is a *syntactic antecedent* of *E* if and only if *i* is a source variable of *j*.

(39) Definition of *source variable*:
A variable *x* is a *source variable* of a variable *y* if and only if (i) *x* and *y* are the same variable, or (ii) *y* is a variable bound by a quantifier whose restrictor is of the form "member_of(*y*, *x*)", or (iii) *y* is a variable bound by a quantifier whose restrictor is of the form "*y* = *x*", or (iv) *x* is a source variable of a variable that is a source variable of *y*.

This way of formulating the constraint allows us to circumvent the three potential problems noted above.

# 8 Reformulating Binding Condition B

Finally, let us consider how Binding Condition B can be reformulated as a constraint on semantic representations. The view that Binding Condition B is a constraint on semantic representations has a precedent in Reinhart & Reuland (1993), so let us examine what is proposed in that article first. The version of Binding Condition B that Reinhart and Reuland propose is (41), and the terms that are used in that

[6] A constraint like (37) needs to be postulated even if the second sentence in (11) is only slightly less acceptable than (10), as long as there is any systematic difference in acceptability.

statement are defined as in (40). The verbiage following "i.e." has been added by me to clarify the meaning.

(40) Definitions
   a. The *semantic predicate* formed of P is P and all its arguments at the relevant semantic level.
   b. A predicate is *reflexive* iff two of its arguments are coindexed (i.e. are the same variable).
   c. A predicate (formed of P) is *reflexive-marked* iff either P is lexically reflexive or one of P's arguments is a SELF anaphor (i.e. a variable contributed by a reflexive pronoun).

(41) Condition B proposed in Reinhart & Reuland (1993)
A reflexive semantic predicate is reflexive-marked.

Reinhart and Reuland claim that this condition accounts for the low acceptability of an example like (42).

(42) *Felix and Lucie$_i$ praised her$_i$.

In their view, (42) is ruled out by Binding Condition B because the sentence is associated with a semantic representation like (43).

(43) Felix ($\lambda x$($x$ praised her)) & Lucie ($\lambda x$($x$ praised $x$))

The representation in (43) is ruled out by the condition because the semantic predicate "$x$ praised $x$" contained in it is reflexive but not reflexive-marked.

It is reasonably clear what kind of theory Reinhart and Reuland are proposing, but it is not necessarily clear what prediction their theory makes for each specific example, because they do not state the rules according to which each sentence is given a specific semantic representation. For instance, it is not clear what ensures that sentence (42) is associated with the representation in (43) and not with a semantic representation like (44), which is not ruled out by their Binding Condition B.

(44) $\forall x[x \in \{\text{Felix}, \text{Lucie}\} \rightarrow x \text{ praised her}]$

Here, I will formulate a version of Binding Condition B that does what Reinhart and Reuland's condition is supposed to do, presupposing that sentences are given the kinds of semantic representations that I have been assuming that they are given. The condition stated in (45) is the version of Binding Condition B that I propose. The expression *illicit-antecedent set*, used in the statement, is defined in (46), and the expression *referential equivalent*, used in (46), is defined in (47).

(45) Binding Condition B:
Let $E$ be an elementary predication of the form shown in (16) which is contained in a final semantic representation $M$. Suppose that the ANTECEDENT

value and the PRONOMINAL value of $E$ are $a$ and $p$ respectively. Then $a$ must not be an element of the illicit-antecedent set of $p$ in $M$.

(46) Definition of *illicit-antecedent set*:
The *illicit-antecedent set* of a variable $x$ in a semantic representation $M$ is the minimal set $A$ such that
(a) for any variable $y$ that outranks $x$ in an elementary predication contained in $M$, $y \in A$,
(b) for any variable $y \in A$, $\{z\colon z \text{ is a referential equivalent of } y\} \subseteq A$, and
(c) for any variable $y \in A$, if (i) a referential equivalent of $y$ is bound in $M$ by a quantifier whose restrictor is of the form "member_of$(y, z)$" and (ii) there is a referential equivalent of $z$ that is of the form "$w_1 + \cdots + w_n$" $(n \geq 1)$, then $\{w_1, \ldots, w_n\} \subseteq A$.

(47) Definition of *referential equivalent*:
A variable $x$ is a *referential equivalent* of a variable $y$ if and only if (i) $x$ and $y$ are the same variable, or (ii) $x$ is bound by a quantifier whose restrictor is of the form "$x \rightarrow y$" or of the form "$x = y$", or (iii) $y$ is bound by a quantifier whose restrictor is of the form "$y \rightarrow x$" or of the form "$y = x$", or (iv) $x$ is a referential equivalent of some variable that is a referential equivalent of $y$.

Let us see how the proposed Binding Condition B applies to a few concrete examples. The first example that I consider is (48), an example discussed in Berman & Hestvik (1994). This sentence is acceptable when the pronoun *them* refers to John and his mother.

(48) John's mother protected them from the robbers.

Assuming that the pronoun *them* is not given distributive interpretation, this example is associated with a semantic representation like (49).

(49) $j = \text{John} \wedge \text{the}(x, \text{mother}(x, j),$
$\quad \text{some}(y, y \rightarrow j + x,$
$\quad\quad \text{the}(z, \text{robbers}(z),$
$\quad\quad\quad \text{protected}(x, y, z))))$

Binding Condition B requires that $j + x$ should not be an element of the illicit-antecedent set of $y$ here. Since the illicit-antecedent set of $y$ here is $\{x\}$ and does not contain $j + x$, Binding Condition B is satisfied, and the sentence is correctly predicted to be acceptable.

Next, let us see how sentence (12), repeated here as (50), is analyzed in the proposed account.

(50) John and Mary saw him and a cow respectively.

Suppose that the subject *John and Mary* receives distributive interpretation. Suppose also that this sentence involves conjunction of two VPs out of which the verb

*saw* is left-node-raised, because I wish to avoid having to discuss here the issue of how best to deal with coordination of quantifiers within Minimal Recursion Semantics. Then the sentence can be associated with the following initial semantic representation.

(51) $j = \text{John} \wedge m = \text{Mary}$
$\wedge\, \text{some}(x, x = j +_i m,$
$\quad \text{every}(w, \text{member\_of}(w, x),$
$\quad\quad \text{and}_i(\text{some}(y, y \rightarrow j, \text{saw}(w, y)),$
$\quad\quad\quad \text{a}(z, \text{cow}(z), \text{saw}(w, z)))))$

The rewriting mechanism responsible for *respectively* interpretation can target the portion that starts with the first occurrence of *some*. The single-conjunct extract that we get by consistently choosing the first conjunct is (52), and the single-conjunct extract that we get by consistently choosing the second conjunct is (53).

(52) $\text{some}(x, x = j,$
$\quad \text{every}(w, \text{member\_of}(w, x),$
$\quad\quad \text{some}(y, y \rightarrow j, \text{saw}(w, y))))$

(53) $\text{some}(x, x = m,$
$\quad \text{every}(w, \text{member\_of}(w, x),$
$\quad\quad \text{a}(z, \text{cow}(z), \text{saw}(w, z))))$

Conjoining the two single-conjunct extracts after renaming two of the bound variables in (53), and then putting the result back into (51), we get the following final semantic representation.

(54) $j = \text{John} \wedge m = \text{Mary}$
$\wedge\, \text{and}(\text{some}(x, x = j,$
$\quad\quad \text{every}(w, \text{member\_of}(w, x),$
$\quad\quad\quad \text{some}(y, y \rightarrow j, \text{saw}(w, y)))),$
$\quad \text{some}(x', x' = m,$
$\quad\quad \text{every}(w', \text{member\_of}(w', x'),$
$\quad\quad\quad \text{a}(z, \text{cow}(z), \text{saw}(w', z)))))$

In (54), Binding Condition B requires that $j$ should not be an element of the illicit-antecedent set of $y$. Since the illicit-antecedent set of $y$ is $\{w, j, x\}$ and contains $j$, the sentence fails to be licensed.

Like the version of the condition proposed in Reinhart & Reuland (1993), the Binding Condition B proposed in this section does not rule out sentences like (55) and (56), and hence has to be augmented with a separate condition.

(55) *Mary$_i$ expects her$_i$ to win.

(56) *John$_i$ would like very much for him$_i$ to win.

What is needed is a constraint like (57).

(57) Suppose that the SUBJECT value $x$ of an elementary predication $E$ whose RELN value is an infinitive verb meaning (such as *to_win* in (58) below) is bound by a quantifier whose restrictor consists of an elementary predication whose PRONOMINAL value is $x$ and whose ANTECEDENT value is $y$. Then the HNDL value of $E$ must not be outscoped by the HNDL value of an elementary predication $F$ such that (i) the SUBJECT value or the OBJECT value of $F$ is a referential equivalent of $y$, and (ii) there is no elementary predication which has the SUBJECT feature and whose HNDL value is outscoped by that of $F$ and outscopes that of $E$.

This condition correctly rules out sentence (55), which is associated with a semantic representation like (58), as well as sentence (56).

(58) $m = \text{Mary} \wedge \text{expects}(m, \text{some}(x, x \rightarrow m, \text{to\_win}(x)))$

# 9 Summary

In this paper, I have argued (i) that Yatabe and Tam's theory of *respectively* interpretation entails that Binding Conditions A and B need to be formulated as constraints on the form of semantic representations and (ii) that it is possible to formulate the two binding conditions as such constraints if anaphoric relations are encoded in semantic representations in a way analogous to the way they are encoded in Discourse Representation Theory, although a separate, purely syntactic constraint needs to be postulated that requires each reflexive pronoun to have a syntactic antecedent.

# Appendix

In this Appendix, I will show that examples like *They live in New York and Chicago respectively* can be properly dealt with in the theory of *respectively* interpretation proposed in Yatabe & Tam (2021) if we add to the theory the assumption that the index value of a plural DP can be of the form $x_1 + \cdots + x_n$. A composite variable of the form $x_1 + \cdots + x_n$ is already used in Yatabe & Tam (2021) as a variable whose denotation is the sum of the denotations of the variables $x_1, \ldots, x_n$, but no statement was made in that article regarding under what circumstances a composite variable is allowed to occur.

In order to show that addition of this assumption to the theory is indeed sufficient to solve the problem, I will show how the second sentence in (59) can be analyzed in the revised theory.

(59) John, Bill, and Pete were invited to the party. I like, dislike, and like these three men respectively. (from Dalrymple & Kehler (1995))

According to the theory of distributive interpretation described in Yatabe (2021, Sect. 3.1), the second sentence in (59) can contain an unpronounced distributive operator adjoined to the object DP, as shown in (60), where DIST2 is the silent distributive operator. The lexical entry for this silent distributive operator is given in Yatabe (2021, Sect. 3.1).

(60) I like, dislike, and like [$_{DP}$ [$_{DP}$ these three men] DIST2] respectively.

What is shown in (61) can be assigned to the structure in (60) as its initial semantic representation. Recall that an elementary predication of the form "member_of($a$, $b$)", which comes from the silent distributive operator and occurs in the fifth line of (61), is true if and only if the denotation of the first argument is a member of the group consisting of the denotation of the second argument.

(61) $s$ = Speaker
$\wedge$ some($x_1 + x_2 + x_3$,
these($x_1 + x_2 + x_3$) $\wedge$ three($x_1 + x_2 + x_3$) $\wedge$ men($x_1 + x_2 + x_3$),
every($y$,
member_of($y$, $x_1 +_i x_2 +_i x_3$),
and$_i$(like($s$, $y$),
dislike($s$, $y$),
like($s$, $y$))))

As has been noted in the main portion of the present paper, in the theory proposed in Yatabe & Tam (2021), semantic coordinators like + and *and* can optionally come with a subscript like $i$, and semantic coordinators with the same subscript are given *respectively* interpretation together. Thus, while the variable $x_1 +_i x_2 +_i x_3$ itself is to be given the same denotation that the variable $x_1 + x_2 + x_3$ is given, the subscript $i$ contained in it indicates that the conjunction expressed by the semantic coordinator + here is to be given *respectively* interpretation. The subscript $i$ on the predicate symbol *and* likewise means that the conjunction expressed by this semantic coordinator is also to be given *respectively* interpretation.

The rewriting mechanism responsible for *respectively* interpretation can target any constituent of a semantic representation as long as the constituent contains all occurrences of a given subscript. In the case at hand, the mechanism can target the constituent that starts with the predicate *every*. When we construct a single-conjunct extract of that constituent choosing the first semantic conjunct consistently, we get (62). When we construct a single-conjunct extract choosing the second semantic conjunct consistently, we get (63). And when we construct a single-conjunct extract choosing the third semantic conjunct consistently, we get (64).

(62) every($y$, member_of($y$, $x_1$), like($s$, $y$))

(63) every($y$, member_of($y$, $x_2$), dislike($s$, $y$))

(64) every($y$, member_of($y$, $x_3$), like($s$, $y$))

Conjoining these three and substituting the result for the constituent that starts with *every* in (61), we arrive at the representation in (65).

(65) $s$ = Speaker
$\wedge$ some($x_1 + x_2 + x_3$,
these($x_1 + x_2 + x_3$) $\wedge$ three($x_1 + x_2 + x_3$) $\wedge$ men($x_1 + x_2 + x_3$),
and(every($y$, member_of($y$, $x_1$), like($s$, $y$)),
every($y'$, member_of($y'$, $x_2$), dislike($s$, $y'$)),
every($y''$, member_of($y''$, $x_3$), like($s$, $y''$))))

This representation means "There are these three men, $x_1$, $x_2$, and $x_3$, such that the speaker likes every entity that is a member of the group consisting only of $x_1$, dislikes every entity that is a member of the group consisting only of $x_2$, and likes every entity that is a member of the group consisting only of $x_3$", which is precisely the *respectively* reading of the second sentence in (59).

Incidentally, if the object DP in the second sentence in (59) does not have a silent distributive operator adjoined to it, the grammar cannot assign a *respectively* reading to the sentence. It might seem that the grammar could assign to the sentence an initial semantic representation like (66) and later turn that initial representation into a representation expressing the *respectively* reading.

(66) $s$ = Speaker
$\wedge$ some($x_1 + x_2 + x_3$,
these($x_1 + x_2 + x_3$) $\wedge$ three($x_1 + x_2 + x_3$) $\wedge$ men($x_1 + x_2 + x_3$),
and$_i$(like($s$, $x_1 +_i x_2 +_i x_3$),
dislike($s$, $x_1 +_i x_2 +_i x_3$),
like($s$, $x_1 +_i x_2 +_i x_3$)))

A representation like (66), however, cannot actually be produced by the grammar because of what is called the *i*-within-*i* constraint on *respectively* interpretation in Yatabe & Tam (2021). The constraint prohibits the EP values of prosodic constituents coordinated by a semantic coordinator bearing a subscript *i* from containing a semantic coordinator bearing the same subscript *i*. In order for the grammar to create a representation like (66), the EP values of the prosodic constituents that are coordinated by "and$_i$" (namely the three prosodic constituents that are pronounced *like*, *dislike*, and *and like* respectively) have to contain the variable $x_1 +_i x_2 +_i x_3$, violating the constraint.

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## Part II
# Contributions to the Workshop

# Grammatical error detection using HPSG grammars: Diagnosing common Mandarin Chinese grammatical errors

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**Abstract**

Computational Grammars can be adapted to detect ungrammatical sentences, effectively transforming them into error detection (or correction) systems. In this paper we provide a theoretical account of how to adapt implemented HPSG grammars for grammatical error detection. We discuss how a single ungrammatical input can be reconstructed in multiple ways and, in turn, be used to provide specific, high-quality feedback to language learners. We then move on to exemplify this with a few of the most common error classes made by learners of Mandarin Chinese. We conclude with some notes concerning the adaptation and implementation of the methods described here in ZHONG, an open-source HPSG grammar for Mandarin Chinese.

# 1 Introduction

In recent years, the fields of automated Grammar Error Detection (GED) and Correction (GEC) have gained popularity. English has, no doubt, attracted the most attention. This is shown by the number of shared-tasks made available in the recent years (Dale & Kilgarriff, 2011; Dale et al., 2012; Ng et al., 2013, 2014; Daudaravicius et al., 2016; Bryant et al., 2019).

Similar efforts have started for Mandarin Chinese Grammar Error Detection (CGED) and Correction (CGEC). Most of such efforts revolve around the shared-task organized by the NLP-TEA held from 2014–2018 (Yu et al., 2014; Lee et al., 2015, 2016; Gaoqi et al., 2017; Rao et al., 2018). Rao & Lee (2018) provide an overview of all previous CGED tasks, drawing attention to the intrinsic difficulty of this task, and the long road ahead.

Constraint-based grammars are ideal for GED/GEC because they model grammaticality directly. In this paper we will first introduce the concepts of *mal-rules* (Schneider & McCoy, 1998), and show how multiple different meanings can be reconstructed from a single ungrammatical input using *mal-rules* modeled using Head Driven Phrase Structure Grammars (Pollard & Sag, 1994; Sag et al., 1999, HPSG). We will then introduce work on *mal-rules* applied to Mandarin Chinese Grammatical Error Detection based on first-hand data collected from learners of Mandarin Chinese. Finally, we will end with some notes on the actual implementation of mal-rules in ZHONG (Fan et al., 2015) – an open source Mandarin Chinese HPSG grammar, currently being transformed into a GED system.

To the best of our knowledge, even though there is previous work dealing with mal-rules in HPSG, there have been no papers attempting to discuss *mal-rules* from a more theoretical perspective – providing full examples of different ways to correct similar errors or discussing how it is possible and often important to ambiguate an ungrammatical input into multiple possible corrections. In addition, there are no previous reports of *mal-rule* enhanced HPSG grammars for Mandarin Chinese. This paper will address these gaps.

The rest of this paper is structured as follows: Section 2 introduces the concept of *mal-rules*, and provides examples of how they are implemented in HPSG. Some

examples of *mal-rules* targeting common errors among learners of Mandarin Chinese are shown in Section 3, followed by a few notes on their implementation in a working parser in Section 4. Finally, we conclude.

## 2 Mal-Rules in HPSG

In constraint-based linguistic language models, such as HPSG grammars, robustness is an early and ever present concern. When compared with shallow parsing methods, the explicit nature of constraint-based models makes them less robust. Forms of input that were not explicitly accounted for in grammar are simply rejected. This is by design: constraint-based models make an explicit grammaticality judgment when they parse or reject an input – which is usually not true for statistical-based parsers. This rigidity (i.e., the lack of robustness for ill-formed or unknown input) that could be considered a problem for some NLP applications, becomes a valuable trait when we need to deal with problems concerning grammaticality.

*Mal-rules* (Schneider & McCoy, 1998) extend computational grammars in order to analyze ungrammatical phenomena. *Mal-rules* can be used to identify and correct specific grammatical errors, and to trigger corrective feedback messages to help language learners. Depending on the type of parser they are implemented in, *mal-rules* can be designed to reconstruct the semantics of ungrammatical sentences, and can be selectively available for parsing but not for generation (Bender et al., 2004). Consider (1), below:

(1) * *This students sleep.*

Any English grammar should reject (1) as a proper sentence. This is enough to identify something is wrong with the sentence. However, if the intention were to diagnose what is wrong with it, then the problem gains a new layer of complexity. We would argue that, without context, it would be impossible to choose a single correction to (1). Two possible corrections are shown in (2) and (3), but a few more most certainly exist.

(2) *These students sleep.*

(3) *This student sleeps.*

In order to correct (1), we first need to guess what was the intended meaning behind the ungrammatical sentence. And to make this decision, need to be able to generate a set of candidate intended meanings.

*Mal-rules* are able to do exactly this. *Mal-rules* reconstruct ungrammatical input in meaningful ways – enabling both error detection and correction. There are, potentially, two sources of ungrammaticality in (1): the first is concerned with the problem of agreement between the determiner *this* and the noun *students*; and the second is concerned with the problem of subject-verb agreement, but is dependent on how the first is corrected. Different sets of mal-rules are needed to allow reconstructing the meaning of (2) and of (3). This will be discussed in great detail, step-by-step, in Section 2.1.

Adding *mal-rules* to a grammar is sufficient not only to detect multiple possible corrections of a sentence like (1), but would also be sufficient to explain how the sentence needed to change (i.e. in linguistic terms). This makes *mal-rules* specially interesting in the field of education. *Mal-rules* can be used to trigger corrective feedback messages to help language learners understand why a sentence is ungrammatical.

## 2.1 Mal-Rules in HPSG

Using *Mal-Rules* in HPSG grammars has a long history. There have been efforts for English (Bender et al., 2004; Flickinger & Yu, 2013), Norwegian (Hellan et al., 2013), German (Heift, 1998), Spanish (Costa et al., 2006) and French (Hagen, 1994). From these, only English and Norwegian are still in active development.

As discussed in Bender et al. (2004), the implementation of *mal-rules* in HPSG grammars can be done through three major classes of linguistic objects: syntactic rules, lexical rules, and lexical items. And even though each method has some degree of specificity, making them useful in detecting different kinds of errors, there is also overlap in their explanative power (i.e. similar errors could be captured in more than one way). These degrees of specificity, and how they interact, have not been fully discussed prior to this paper. In this paper, we will explore these different levels of specificity, as well as how multiple mal-rules can be used together to predict multiple plausible corrections for a single ungrammatical sentence.

### 2.1.1 Syntactic Mal-Rules in HPSG

The use of syntactic *mal-rules* in HPSG is both powerful and flexible. Consider the ungrammatical noun phrase (NP) *this students*. Under normal circumstances, this phrase is not grammatical. In HPSG, this is ensured by the Specifier Head Agreement Constraint (SHAC) present in the Head-Specifier Rule (4), as proposed in Sag et al. (1999). According to the SHAC, phrases taking a specifier are required to unify their agreement features with those of their specifier – this is shown by $\boxed{2}$ in (4). The specifier of a NP is its determiner, so this is what establishes the required agreement between the noun and the determiner.

(4)
$$\begin{bmatrix} \textit{head-specifier-rule} \\ \textsc{syn} \begin{bmatrix} \textsc{val} \begin{bmatrix} \textsc{spr} \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \rightarrow \boxed{1} \quad \mathbf{H} \begin{bmatrix} \textsc{syn} \begin{bmatrix} \textsc{head} \begin{bmatrix} \textsc{agr} \boxed{2} \end{bmatrix} \\ \textsc{val} \begin{bmatrix} \textsc{spr} \left\langle \boxed{1} \begin{bmatrix} \textsc{agr} \boxed{2} \end{bmatrix} \right\rangle \\ \textsc{comps} \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

(5)

$$\begin{bmatrix} \textit{mal-head-specifier-rule} \\ \text{SYN} \begin{bmatrix} \text{VAL} \begin{bmatrix} \text{SPR} \ \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \longrightarrow \boxed{1} \ \mathbf{H} \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \text{AGR} \ X \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SPR} \left\langle \boxed{1} \begin{bmatrix} \text{AGR} \ Y \end{bmatrix} \right\rangle \\ \text{COMPS} \ \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

One possible way to build the NP *this students* would be to relax the constraint imposed by the SHAC. Creating a new rule where this constraint is not enforced would qualify it as a *mal-rule* – since such rule would allow ungrammatical phrases to be licensed by the grammar. This *mal-rule* can be found in (5). Note that where $\boxed{2}$ in (4) made sure both the head-daughter (i.e. noun) and its specifier (i.e. determiner) agreed, in (5) this is not true. (5) would allow the grammar to build *this students* as a valid NP.

The Head-Specifier Rule as described in Sag et al. (1999), is used to build many kinds of phrases, including full sentences (i.e. linking NP subjects and their VP predicates). This means that the *mal-rule* shown in (5) would also license sentences such as '*Students sleeps.*' or '*I sleeps.*' – where the subject does not agree with the main verb. This accounts for the flexible power of syntactic *mal-rules*, but also shows that even though (5) could be used to detect ungrammatical sentences, it has a fairly low precision with regard to what kind of error it licences – i.e., an unspecified problem in agreement.

## 2.2 Lexical Mal-Rules in HPSG

HPSG grammars often have a rich hierarchy of lexical rules. An alternative way to build the NP *this students* would be through lexical *mal-rules*. This could be done with a lexical rule that allows, for example, a plural noun to be used as a singular noun. An example of this rule is shown in (6).

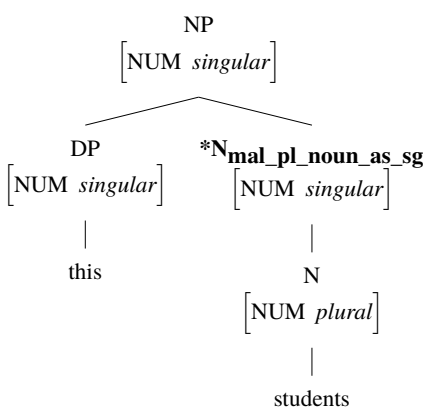
(6)

$$\begin{bmatrix} \textit{mal\_pl\_noun\_as\_sg\_lrule} \\ \text{INPUT} \left\langle \boxed{1}, \begin{bmatrix} \textit{word} \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{noun} \\ \text{AGR} \begin{bmatrix} \text{NUM} \ \textbf{\textit{pl}} \end{bmatrix} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SPR} \left\langle \boxed{2} \text{DP} \right\rangle \\ \text{COMPS} \left\langle (\boxed{3} \ldots \boxed{n}) \right\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{OUTPUT} \left\langle \boxed{1}, \begin{bmatrix} \textbf{\textit{mal\_pl\_noun\_as\_sg}} \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{noun} \\ \text{AGR} \begin{bmatrix} \text{NUM} \ \textbf{\textit{sg}} \end{bmatrix} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SPR} \left\langle \boxed{2} \right\rangle \\ \text{COMPS} \left\langle (\boxed{3} \ldots \boxed{n}) \right\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

This lexical *mal-rule* can only be applied to plural nouns, and produces a copy of the input noun, changing only the number feature (i.e. from *plural* to *singular*).

Using the lexical *mal-rule* shown in (6), our English grammar would be able to build the NP *this students* by first changing the number feature of the word *students* to singular, and then using the normal rule that joins nouns and determiners – as is shown in (7).

(7)




## 2.3 Mal Lexical Entries in HPSG

Finally, a third way to build the NP *this students* is to use a *mal* lexical entry. This is similar, in spirit, to lexical *mal-rules*, but instead of generalizing across word classes, it provides an alternative *mal* lexical entry for specific words that are known to be source of errors. One such example would be the correct and *mal* lexical entries for *this*, shown as (8) and (9), respectively.

Entries (8) and (9) differ only slightly. The first of these differences is the value for the number feature. For the *mal* lexical entry, shown in (9), it is set to *plural*. Additionally, the semantic relation it introduces is similar to what would be expected of an entry for the determiner *these*. In short, (9) behaves like the word *these* but carries the form *this*. This *mal* lexical entry would license the NP *this students* following the tree shown in (10).

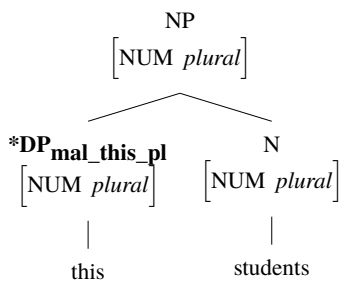
(8)

$$\left\langle this, \begin{bmatrix} determiner & \\ \textsc{syn} & \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{det} \\ \textsc{agr}|\textsc{num} & \textbf{\textit{singular}} \end{bmatrix} \end{bmatrix} \\ \textsc{sem} & \begin{bmatrix} \textsc{index} & i \\ \textsc{restr} & \left\langle \begin{bmatrix} \textsc{reln} & \textbf{\textit{this}} \\ \textsc{bv} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

(9)

$$\left\langle this, \begin{bmatrix} mal\_this\_pl & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{DET} & \\ \text{AGR|NUM} & \textbf{\textit{plural}} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & i \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \textbf{\textit{these}} \\ \text{BV} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

(10)




## 2.4 Combining Approaches

Although they might seem to provide similar results, the trees shown in (7) and (10) differ in one key aspect – the value for the number feature of the produced NP. In HPSG, the syntactic number of a phrase is determined by the head of that phrase – in a NP, this would be the noun. This is a good example of how *mal-rules* can be used to reconstruct different possible meanings from a single ungrammatical input.

To be able to evaluate the full reach of meaning reconstruction, let us consider a variation of the *mal-rule* introduced in (5). The rule shown in (11) changes the general Head-Specifier rule into a Head-Subject rule (by selecting verb has the head type for the daughter), but agreement is not enforced. In short, (11) selectively allows sentences where the subject and the main verb of a sentence do not agree.

(11)

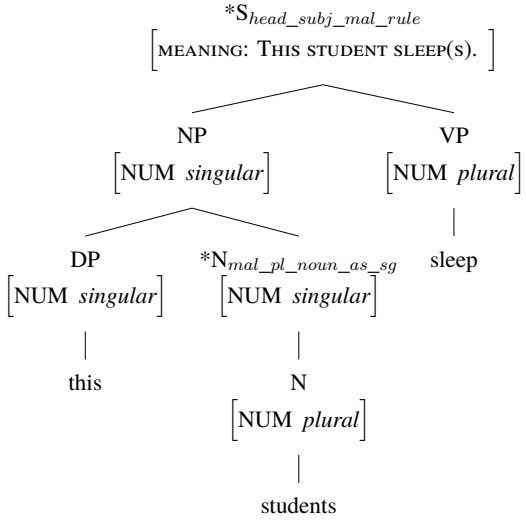
$$\begin{bmatrix} \textit{head-subj-mal-rule} & \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \longrightarrow \boxed{1}\ \mathbf{H} \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textbf{VERB} & \\ \text{AGR} & \boldsymbol{X} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \left\langle \boxed{1} \begin{bmatrix} \text{AGR} & \boldsymbol{Y} \end{bmatrix} \right\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Using only the three *mal-rules* shown in (6), (9) and (11), we can get the the two reconstructions discussed for the ungrammatical sentence in (1). These reconstructions were introduced as (2) and (3), above, and are shown in (12) and (13) in the form of syntactic trees. The main difference between these two trees is the reconstructed meaning. In (12), the grammar reconstructed a sentence where only a single student is sleeping. And in (13), the reconstructed meaning assumes more than one student is sleeping.

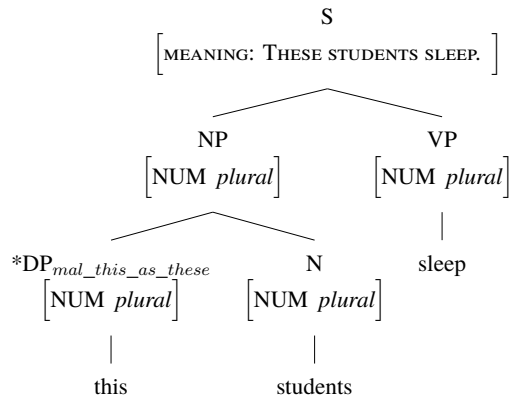
For systems where the goal is simply grammatical error detection (i.e. without correction), traversing the parsing tree and looking for nodes where *mal-rules*

were used is enough to diagnose the ways in which a sentence is ungrammatical. However, if a grammar has generation capabilities, reconstructing different meanings also allows the generation of the corrected counterparts. For this reason, most implemented HPSG grammars can be used to produce fully capable error detection and correction systems.

(12)




(13)




# 3 Detection of Common Mandarin Chinese Errors

In this section we focus on the design of rules that detect common errors among learners of Mandarin Chinese as a second language.

## 3.1 A New Mandarin Learner Corpus

GED is usually done against labeled learner data, known as Learner Corpora. Before one can hope to design GED or GEC systems, it is first necessary to know what errors learners of a given language actually make (Granger, 2003). These kind of

corpora are also useful to measure the performance of error detection or correction systems (Schulze, 2008). And when semantically annotated, Learner Corpora are useful resources to help predict the intended meaning behind students' input (Hellan et al., 2013).

Since building learner corpora is extremely time consuming, there are few freely available learner corpora. There are some resources for English, but there are no freely available learner corpora made from learners of Mandarin Chinese that focus on written language. The Jinan Learner Corpus (Wang et al., 2015) seems to no longer be accessible online, and the iCALL Corpus (Chen et al., 2015) is a speech corpus mostly concerned with errors in pronunciation.

The TOCFL Learner Corpus (Lee et al., 2018) and the Lang-8 corpus (Mizumoto et al., 2011) are the only known learner corpora with a focus on written Mandarin Chinese. Unfortunately, both of them are released under restrictive non-comercial non-redistribution licenses. In addition, both corpora have been created with specific tasks in mind. The TOCFL, for example, includes only four very broad error types: 'redundant words', 'missing words', 'word selection errors', and 'word ordering errors'. And the Lang-8 corpus is an automatically collected corpus providing only pairs of sentences and their respective corrections. While both data sources would be extremely valuable if open, the restrictive licenses constrain their use.

Therefore we decided to collect our own data. This data comes from Mandarin Chinese learners at Nanyang Technological University, Singapore. We collected 5,513 sentences from student exams, which, after removing duplicates, corresponded to 2,300 unique sentences. After a thorough annotation process, we identified 544 errors divided among 490 problematic sentences (i.e., around 21.3% of the sentences had at least one error tag assigned to them). A summary of results is shown in Table 1.

A full description of this corpus is beyond the scope of this paper. Nevertheless, we will be using four of the most frequent classes of errors to further explore *malrules* and see how these can be used to catch (and correct) common errors made by Mandarin Chinese learners. Each of the four classes of errors will be discussed separately.

### 3.2 Question Particle Redundancy (ID-1)

The most frequent grammatical error in our corpus is the misuse of the question particle 吗 *ma*. The proper use of 吗 *ma* transforms propositions into polar (i.e. yes-no) questions. This particle often confuses learners into assuming that it is similar to a question mark (i.e. simply marking the existence of a question: which is the behaviour of the the Japanese question marker か *ka*). However, as can be seen in (15) and (17), this is not the case in Chinese. In sentences where other interrogative words or structures are used, such as (14), the question particle 吗 *ma* should not be added. In (16), the usage of a special syntactic construction (Verb-NOT-Verb) already implies a polar question. It is then ungrammatical to redundantly add *ma*,

| ID | Description | Total |
|---|---|---|
| 1 | 吗 (*ma*, question particle) redundancy | 26 |
| 2 | Usage of 和 (*hé*, and) vs. 也 (*yě*, also) | 25 |
| 3 | Position of adverbial clauses | 25 |
| 4 | Usage of 是 (*shì*, to be) with adjectival predicates | 23 |
| 5 | Usage of 中国 (*zhōngguó*, China) vs. 中文 (*zhōngwén*, Chinese language) | 18 |
| 6 | Position of 也 (*yě*, also) | 14 |
| 7 | Usage of 有点儿 (*yǒudiǎnr*, somewhat) vs. 一点儿 (*yīdiǎnr*, a bit) | 14 |
| 8 | Bare adjectival predicates | 9 |
| 9 | Usage of 是... 的 (*shì...de*, focus cleft) constructions | 8 |
| 10 | Usage of 不 (*bù*, no) with specified adjectival predicates | 6 |
| 11 | Incorrect measure word | 6 |
| 12 | Missing measure word | 5 |
| 13 | Attributive 多 (*duō*, many) and 少 (*shǎo*, few) without degree specifiers | 5 |
| 14 | Usage of 二 (*èr*, two) vs. 两 (*liǎng*, two) | 4 |
| 15 | Usage of 不 (*bù*, no) vs. 没有 (*méiyǒu*, no) | 3 |
| 16 | Syntactic order of 也 (*yě*, also), 都 (*dōu*, all), 不 (*bù*, no) | 3 |
| 17 | Syntactic order of nominal 的 (*de*, possessive marker) modification | 2 |
| 18 | Other Errors | 348 |
| | Total | 544 |
| | Sentences w/errors | 490 |

Table 1: Distribution of Mandarin Chinese Error Tags by Frequency

as seen in (17). More generally, *ma* should never be used in sentences that are, by themselves, already questions.

(14) 你 要 什么 ？
nǐ yào shénme ?
2SG want Q.what ?
'What do you want?'

(15) *你 要 什么 吗 ？
nǐ yào shénme ma ?
2SG want Q.what Q.polar ?
(intended) 'What do you want?'

(16) 你 有没有 中文 书 ？
nǐ yǒu-méi-yǒu zhōngwén shū ?
2SG have-not-have Chinese book ?
'Do you have a Chinese textbook?'

(17) *你 有没有 中文 书 吗 ？
nǐ yǒu-méi-yǒu zhōngwén shū ma ?
2SG have-not-have Chinese book Q.polar ?
(intended) 'Do you have a Chinese textbook?'

We deal with this error by adding to the grammar an extra *mal* lexical entry for 吗 *ma*, shown in (18). This *mal* lexical entry – which is identified as a mal-rule by

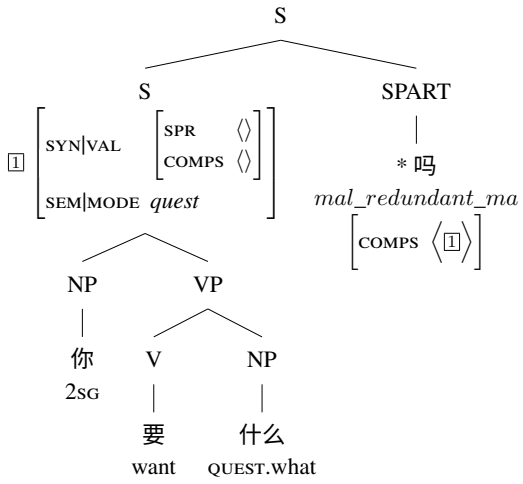
the type's name – provides a second entry for *ma* as a sentence final particle (i.e. *spart*). This sentence particle expects a single VP complement, that is defined to have empty values for SPR (specifier) and COMPS (complements). This guarantees that it modifies only complete sentences. It is also marked as $\left[\text{POSTHEAD } +\right]$, restricting its use to post-head position (i.e., a sentence final particle). Finally, and most importantly, its complement has a SEM|MODE value equal to *quest* – meaning that the sentence it selects must already be identified as a question.

In other words, the lexical entry for 吗 *ma* shown as (18) attaches only to full sentences that are already questions. Using this *mal* lexical entry in an existing grammar of Mandarin Chinese would allow it to parse ungrammatical sentences like the one shown in (19). All similar ungrammatical sentences, where a well formed question is followed by a redundant *ma*, can be detected using this same *mal* lexical entry.

(18)

$$\left\langle \text{吗}, \left[ \textit{mal\_redundant\_ma} \; \left[ \begin{array}{ll} \text{HEAD} & \textit{spart} \\ \text{POSTHEAD} & + \\ \text{SYN} & \left[ \begin{array}{ll} \text{VAL} & \left[ \text{COMPS} \left\langle \text{VP} \left[ \begin{array}{ll} \text{SYN|VAL} & \left[ \begin{array}{ll} \text{SPR} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{array} \right] \\ \text{SEM|MODE} & \textit{quest} \end{array} \right] \right\rangle \right] \end{array} \right] \end{array} \right] \right] \right\rangle$$

(19)




## 3.3 Use of Copula with Adjectival Predicates (ID-4)

We now look at the use of copula 是 *shì* with adjectival predicates. Examples (20) through (23) exemplify the simplest minimal pairs illustrating the usage of Mandarin adjectival predication. Even though these restrictions may differ in informal speech or contrastive constructions, in a prescriptive environment, adjectival predicates need to be modified by an adverbial phrase. In addition, adjectival predicates

should not use the copula verb (regardless of having been modified, or not, by an adverbial phrase). Because of this, in a beginner's classroom, examples (21) through (23) are problematic.

(20) 她 很 美 。
tā hěn měi .
3SG.FEM very beautiful .
'She is beautiful.' (lit. 'She is very beautiful.')

(21) * 她 美 。
tā měi .
3SG.FEM beautiful .
(intended) 'She is beautiful.'

(22) * 她 是 美 。
tā shì měi .
3SG.FEM COP.be beautiful .
(intended) 'She is beautiful.'

(23) * 她 是 很 美 。
tā shì hěn měi .
3SG.FEM COP.be very beautiful .
(intended) 'She is very beautiful.'

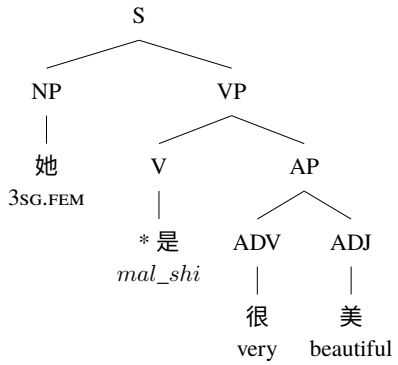
We will focus on detecting the use of 是 *shì* with adjectival predicates. In the interest of space, however, we will not delve in the related error concerning (21), dealing with the further requirement that adjectival predicates must be generally preceded by an adverbial intensifier. These are two different errors, and we will only discuss the first.

We address this error by creating a *mal* lexical entry for a dummy copula 是 *shì* that behaves like a transitive verb, but that selects only adjective phrases (AP) complements – shown as (24). This entry adds nothing to the semantics, just linking its own subject with the subject of the adjective.

Using this *mal* lexical entry, our grammar would be able to license sentences such as the one shown in (22)/(25), giving it the same semantics as the sentence without *shì*. Once again, this analysis generalises for other sentences where adjectival predicates are preceded by *shì*.

(24)
$$\left\langle \text{是}, \begin{bmatrix} mal\_shi \\ \textsc{syn} \quad \begin{bmatrix} \textsc{head} \ verb \\ \textsc{val} \quad \begin{bmatrix} \textsc{spr} \ \langle \text{NP} \rangle \\ \textsc{comp} \ \langle \text{AP} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\rangle$$

(25)




### 3.4 Bare Nominal Predicates (ID-18)

The third error class we will discuss concerns bare nominal predicates. In Mandarin Chinese, although adjectival predication happens without the use of a copula verb, nominal predication requires the use of a copular verb (是, *shì*) – rendering sentences like (27) ungrammatical.

(26) 我 是 大学生 。
wǒ shì dàxuéshēng .
1SG COP.be university.student .
'I am a university student.'

(27) *我 大学生 。
wǒ dàxuéshēng .
1SG university.student .
(intended) 'I am a university student.'

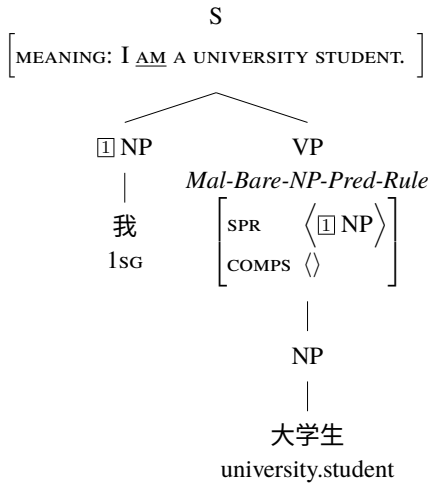
The contrastive behavior of adjectival predication is likely that the source of this error. Learners generalize this behavior and assume that nominal predication behaves similarly – and thus produce ungrammatical sentences.

We currently address this problem through the use of a *mal* 'pumping' rule, shown in (28). This pumping rule transforms any fully specified NP into something akin to an intransitive verb – i.e., it behaves like a VP in the sense that it expects an NP as specifier (i.e., a subject).

Making use of (28) allows a grammar to parse sentence (27) and other similar sentences. The tree for this analysis is shown in (29). In it, we can see that 大学生 (*dà xué shēng* "university student") is pumped from an NP into a VP, capable of taking 我 (*wǒ*, "I") as its subject. In order to reconstruct the meaning, this rule also adds a copula predicate.

(28)
$$\begin{bmatrix} \textit{mal-bare-nppred-rule} \\ \textsc{syn} \begin{bmatrix} \textsc{head} \ \textit{verb} \\ \textsc{val} \begin{bmatrix} \textsc{spr} \ \langle \text{NP} \rangle \\ \textsc{comps} \ \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \longrightarrow \begin{bmatrix} \textsc{syn} \begin{bmatrix} \textsc{head} \ \textit{noun} \\ \textsc{val} \begin{bmatrix} \textsc{spr} \ \langle\rangle \\ \textsc{comps} \ \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

(29)




### 3.5 Non-Prototypical Complements (ID-5)

Our final set of examples are drawn from a lexical conflation between *China* (中国, *zhōngguó*) and *Chinese Language* (中文, *zhōngwén*). Although sentences such as (32) are not strictly ungrammatical, as shown by (31), learners often use (32) when they intend to say *I speak Chinese*.

(30) 我 说 中文 。
wǒ shuō zhōngwén .
1SG speak Chinese.lang .
'I speak Chinese.'

(31) 我 说 中国 。
wǒ shuō zhōngguó .
1SG speak China .
'I say China.'

(32) #我 说 中国 。
wǒ shuō zhōngguó .
1SG speak China .
(intended: 'I speak Chinese.')

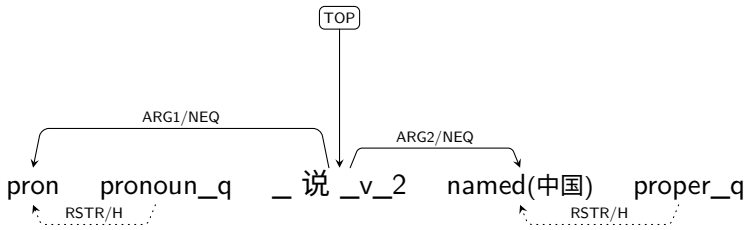
More generally, this class of errors addresses the use of unlikely (i.e. non-prototypical) complements. These are not stricly syntactic errors: the sentence is grammatical, but the meaning is unexpected.

According to our learner corpus, the conflation between *China* (中国, *zhōng guó*) and *Chinese Language* (中文, *zhōng wén*) happens most frequently as the complement of the verb 说 (*shuō*, "to speak, to say"). Learners often want to express the meaning of (30), but use 中国 (*zhōng guó*, "China") instead of 中文 (*zhōng wén*, "Chinese Language").

Even though it would be possible to detect the use of non-prototypical complements using *mal* lexical entries, it is much easier to dealt with it at the semantic level.

One advantage of working with grammars able to produce semantics is the fact that the semantic output can also be used to identify certain kinds of problems in language usage. This is especially relevant for non-syntactic issues such as non-prototypical complements. Lets consider the simplified semantic representation for (32) "I say China" (intended: "I speak Chinese") as a Dependency MRS (Copestake, 2009) shown as (33).

(33)




This semantic representation shows that *China* (中国, *zhōng guó*) is the ARG2 of 说 (shuō, *to speak, to say*) – i.e. *what is said*. So instead of creating a special *mal* lexical entry for 说 (shuō) – which would be a possible solution, a simple semantic check can be done to see if (中国, *zhōng guó*) is used as the ARG2 of the verb 说 (shuō). Given the deep semantic analysis performed by these kind of grammars, the semantic arguments are also easily detectable in the presence of discontinuous arguments (e.g. topicalization, etc.) – which can be a problem when using shallow text based methods.

This kind of semantic analysis is also our preferred method to deal with similar problems, such as the use of inappropriate classifiers in NP quantification.

# 4 Implementation in a Grammar

The errors described above, as well as many others omitted in the interest of space, have been implemented in ZHONG – a Mandarin Chinese HPSG grammar (Fan et al., 2015). ZHONG is a medium-sized HPSG grammar able to produce Minimal Recursion Semantics (Copestake et al., 2005; Copestake, 2007, MRS). Both ZHONG and the mal-rule extensions discussed in this paper are fully open-source.[1]

ZHONG currently contains more than 60 *mal rules* (including lexical entries) – which covers about half of the types of errors we were able to find in our learner corpus. As such, describing each individual rule would not be possible nor desirable, as many *mal rules* share design principles.

The process of transferring the *mal-rules* described in this paper, which are fairly theoretical, into an implemented grammar such as ZHONG is not always simple. Each individual grammar has its own idiosyncrasies, and the final form

[1] https://github.com/delph-in/zhong

of some of the *mal-rules* described above had to be adapted to match ZHONG's type hierarchy.

Our current method is to implement *mal-rules* in a graded fashion – i.e., starting with errors made by beginners before moving on to higher levels of proficiency. This mainly helps the applicability of our efforts (i.e., the grammar can immediately be used in learning systems targeting low proficiency learners). It is also important to note that *mal-rules* are not constrained by the current level of complexity of a grammar. A well designed *mal-rule* will always accompany the complexity of a grammar as it grows. For example, a subject-verb disagreement error will always be relevant, regardless of the complexity of the subject or of the verb phrase in question.

More importantly, the design of our *mal-rules* is targeted specifically at a level of granularity that would be adequate to use for student feedback.

## 4.1 Learner Treebanks

Following what was discussed above, the number of generated corrections for an ungrammatical sentence is often greater than what we would expect. Despite employing logical constraint-based approaches to generate parses, normal/prescriptive HPSG grammars often make use of treebanks to produce parse ranking models and order the available parses by likelihood. This is usually seen as a necessary step for implemented grammars, since without it a grammar's analysis is usually quite useless.

This is also an issue when we use *mal-rules*. With the addition of *mal-rules*, grammars become increasingly more ambiguous. This is not necessarily bad in the sense that this ambiguity is reflected on the ability to predict multiple different corrections for the same ungrammatical input, but it becomes a problem when parsing grammatical sentences, because *mal-rules* will be competing with descriptive rules.

Using a parse-ranking model that has been trained in the absence of *mal-rules* will inevitably produce cases where very unlikely parses are ranked higher than very likely errors. This is why it is important to invest early in treebanks that contain learner data – which we have named Learner Treebanks (Morgado da Costa et al., 2022).

Morgado da Costa et al. (2022) provide a full account of the design and impact of using Learner Treebanks alongside *mal-rule* enhanced grammars. These treebanks enable the creation of *mal-rule* enhanced parse ranking models Toutanova et al. (2005), which help rank multiple corrections in order of likelihood, while avoiding having to resort to creative ways to be able to perform well (e.g., the use of very restrictive vocabulary, the use of other methods to filter the results, or the of sub-optimal heuristics to select the best parse – e.g., select the parse with fewest number of mal-rules). For these reasons, we have also stared working on a new Learner Treebank for Mandarin Chinese.

## 5 Conclusion

Scholars are trying to elaborate on the role of formal linguistics in the wider field of Computational Linguistics[2] (currently dominated by statistical/neural-based methods). This paper discusses an excellent example of the continued relevance of computational grammars. Working with computational grammars to perform error detection alongside language teachers has also proved to be productive in managing their expectations over the balance between quality and performance – something 'black-box' statistical systems have a hard time doing.

This paper describes, in some detail, how to perform grammatical error detection using HPSG grammars. It shows that *mal-rules* in HPSG enable the prediction of multiple corrected forms for a single ungrammatical sentence – which is arguably an extremely important feature in language education contexts. Most of the current work in GED and GEC uses optimization-based statistical models that are designed to provide a single 'best' result. The use of *mal-rules* can free systems from this restriction, and open new ways of looking at how the problems of Grammar Error Detection and Correction could be redefined for the future.

Finally, this paper also makes contributions to the specific field of Mandarin Chinese Grammatical Error Detection. We analyze and design *mal-rules* to detect some of the most common errors made by second language learners of Mandarin Chinese, based on empirical data collected for our new learner corpus for Mandarin Chinese. More than 60 *mal-rules* have been implemented in ZHONG. The work that will be presented in this paper is being conducted as part of a larger project looking into building a Computer Assisted Language Learning system to help learners of Mandarin Chinese improve their language proficiency. In the near future, we will integrate this grammar in an online language tutoring system, where learners can test their knowledge of Mandarin Chinese and where each *mal-rule* (and semantic check) will be linked to corrective feedback messages describing the errors and how best to correct them.

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[2]See, for example: https://gdr-lift.loria.fr/bridges-and-gaps-workshop/

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