Chapter 13

Coordinate structures without syntactic categories

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13.1 Introduction

In a recent paper, Mary Dalrymple (2017) considers the syntactic category of coordinate structures consisting of conjuncts of different syntactic categories, as in the classical (1) (Sag *et al.* 1985, 117, ex. (2b)):[1]

(1) Pat is [a Republican]$_{\text{NP}}$ and [proud of it]$_{\text{AdjP}}$.

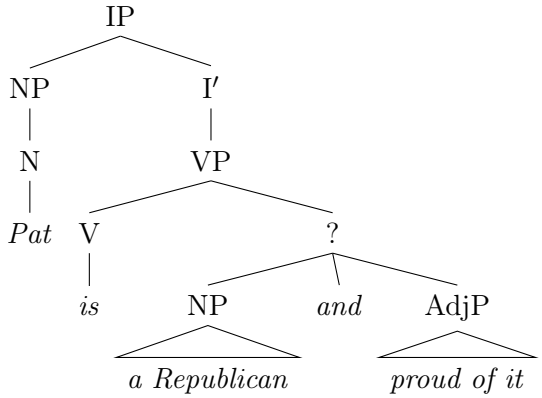
Assuming a constituent structure for (1) as in (2) below (cf. Dalrymple 2017, 33, ex. (1)),[2] the question is what syntactic category should be assigned to the constituent marked as '?'.

[1]For comments on a previous version of this chapter we are grateful to John Lowe and to two anonymous reviewers, whose insightful observations led to many improvements. Agnieszka Patejuk gratefully acknowledges the Mobilność Plus mobility grant awarded by the Polish Ministry of Science and Higher Education.

But our foremost gratitude goes to Mary Dalrymple. Her comprehensive, explicit, and highly readable "(not so) little red book" – Dalrymple 2001 – was our preferred source of knowledge about LFG when we entered the field, and it (and its second edition, Dalrymple *et al.* 2019) has remained an important reference. Throughout our LFG adventure, Mary has been very generous with her wisdom and time. We both had a good fortune to (distributively) work with Mary (Condoravdi *et al.* 2019, Dalrymple *et al.* 2020), and we have benefited enormously from the experience. Many thanks, Mary!

[2]Throughout this chapter, we assume that unlike category coordination joins conjuncts directly: there is no ellipsis ('conjunction reduction') involved, so coordinate structures are true constituents.

(2)



In this chapter, we are not concerned with the internal constituency structure of coordination, in particular, whether it is a flat structure, as in (2), or a binary branching structure with additional constituency levels, as often assumed in transformational approaches (e.g., Munn 1993, Zhang 2009, and many others). Whatever its constituency structure, many different proposals regarding the syntactic category label of the whole coordinate structure exist in the literature, all problematic in one way or another. The position that coordinate structures are headed by the conjunction bearing category Conj, i.e., that they bear the category ConjP (see, e.g., Johannessen 1998 among many others), is convincingly criticised in Borsley 2005. Dalrymple 2017 also rejects the proposals that the category of the coordinate structure is the same as that of the first conjunct (Munn 1993, Peterson 2004) or that there is a special category – call it UP – for unlike category coordination (Patejuk 2015), as neither makes it possible to impose category restrictions on each conjunct by constraining the category of the coordinate structure.[3]

For example, such category restrictions are imposed by *become*, which combines with NP and AdjP predicates, but not with PP predicates. Hence, the following contrast (from Sag *et al.* 1985, 142, ex. (67a–b)) is expected:

(3) a. Pat became [a Republican]$_{\text{NP}}$ and [quite conservative]$_{\text{AdjP}}$.
b. *Tracy became [a Republican]$_{\text{NP}}$ and [of the opinion that we must place nuclear weapons in Europe]$_{\text{PP}}$.

However, on the first of the two rejected approaches, the coordinate structures in both examples bear the same category NP (the category of the first conjunct), and on the second approach they both bear the special category UP. So the category of the coordinate structure as a whole does not distinguish between the configuration of conjuncts that satisfies the external constraints (as in (3a)), and one that does not (as in (3b)).

The solution proposed in Dalrymple 2017, to be presented in more detail below, is to gather all categorial information about conjuncts in the category of the coordinate structure. For example, the category of the coordinate

[3]Patejuk 2015 imposes such restrictions via an f-structure attribute CAT; cf. §13.5.

structure in (1) would be [N +, ADJ +], as one conjunct is nominal and the other is adjectival.

In this chapter we argue that the problem of the syntactic category of coordinate structures should be considered in the broader context of morphosyntactic and lexical constraints imposed on a given syntactic position. Such a change of perspective suggests another solution to the problem of the syntactic category of unlike coordinate structures, namely, that they do not have a syntactic category at all.

For example, consider the attested (4) (Sketch Engine; https://www.sketchengine.eu/; Kilgarriff *et al.* 2008, 2014):

(4) Xenocrates (Fr. 15) believed [that stars are fiery Olympian Gods]$_{\text{CP}}$ and [in the existence of sublunary daimons and elemental spirits]$_{\text{PP}}$.

Here, the argument of *believe* is a coordinate structure consisting of a CP and a PP. However, not just any CP or PP will do: the CP must be headed by the complementiser *that* (and not, say, *whether*) and the PP – by the preposition *in* (and not, say, *on*). So the predicate *believe* must require that its argument be either a CP[*that*] or a PP[*in*] (perhaps among other options, including an NP), and this requirement distributes to particular conjuncts in the coordinate structure in (4): the first conjunct satisfies the first alternative (CP[*that*]), while the second conjunct satisfies the second alternative (PP[*in*]). Assuming it is possible to distribute such more specific requirements to particular conjuncts, there is no need to posit any additional constraints on the coordinate structure as a whole; in particular, there is no need to require it to bear any specific syntactic category. This means that coordinate structures do not need any syntactic categories on top of the categories of their conjuncts.

In the following sections, after presenting the analysis of Dalrymple 2017 in more detail in §13.2, we demonstrate more extensively in §13.3 – also on the basis of data from Polish – that disjunctive constraints on a syntactic position concern not only syntactic categories, but also lexical and morphosyntactic information contained in functional structures. In §13.4, we show that relocating such lexical and morphosyntactic information to c-structure categories is not a viable option. Instead, in §13.5 we provide an analysis based on the idea that syntactic categories are expressed within f-structures, and not within c-structures (or l-structures λ-projected from c-structures; cf. Kaplan 1995, Lowe and Lovestrand 2020). Abstracting away from theory-internal technical details, we believe this analysis to be in the spirit of Bayer 1996. Some consequences of this analysis, especially for distributivity and for structures with multiple co-heads, are considered in §13.6.

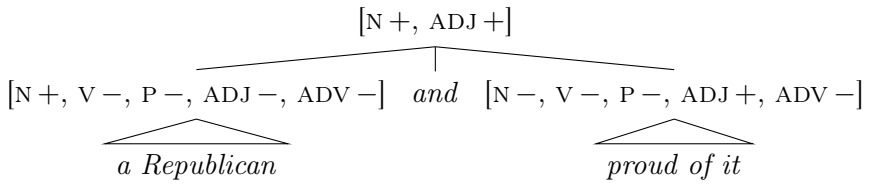
13.2 Dalrymple 2017

Dalrymple 2017 proposes to replace atomic syntactic categories such as N, V,

P, Adj and Adv with feature matrices containing binary attributes: [N ±, V ±, P ±, ADJ ±, ADV ±]. This proposal is only concerned with the representation of the basic syntactic category, and not with the projection level (so-called bar level) or the distinction between lexical and functional subtypes of a given category (e.g., the distinction between the lexical V on the one hand and the functional I and C on the other hand). For example, nouns and noun phrases bear the category [N +, V −, P −, ADJ −, ADV −], verbal projections – both lexical and functional – are of the category [N −, V +, P −, ADJ −, ADV −], etc. In this chapter, we also focus on the basic syntactic category, mostly ignoring other properties of constituency nodes.

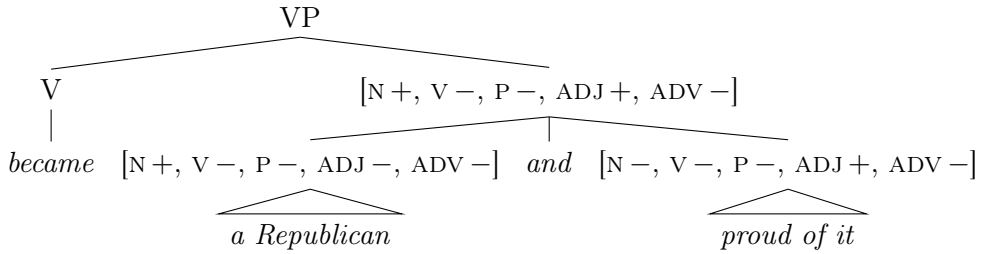
In the case of coordinate structures, appropriate constraints (stated on each conjunct in the coordination rule) ensure that information about '+'-valued category attributes of all conjuncts is present in the category of the coordinate structure (Dalrymple 2017, 48, ex. (50)). For example, the categories within the coordinate structure *a Republican and proud of it* are as indicated below:[4]

(5)



When lexical items constrain the category of their arguments, as *become* does, they specify which category attributes must be '−'-valued. In the case of *become*, its predicative argument may be nominal or adjectival, but not verbal, prepositional, or adverbial, so the category of this argument is specified by *become* as [V −, P −, ADV −]. This constraint, combined with the constraint on coordinate structures which results in the [N +, ADJ +] specification of the category of *a Republican and proud of it*, gives [N +, V −, P −, ADJ +, ADV −] as the final category of this coordinate structure:[5]

(6)

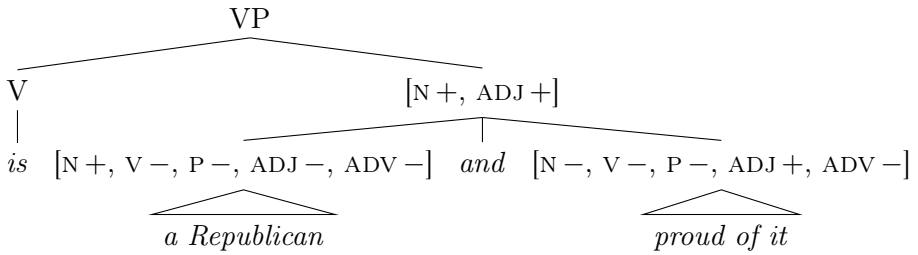


[4] One consequence of this, not discussed in Dalrymple 2017, is that the coordination of like categories has a different category than the conjuncts; e.g., a coordination of two nouns, i.e., constituents of category [N +, V −, P −, ADJ −, ADV −], has the category [N +] (unless external constraints happen to set the values of all other category attributes to '−'; see below).

[5] For readability, we do not replace the atomic categories V and VP with the feature matrix [N −, V +, P −, ADJ −, ADV −] in (6)–(7).

Assuming that the copula *be* does not impose any restrictions on the category of its predicative argument , the final category of the same coordinate structure in (1) will, however, be [N +, ADJ +]:

(7)



How do lexical items such as *become* impose restrictions on the category of their arguments? This is achieved with the use of the CAT predicate, first introduced in the context of implementational LFG work (Kaplan and Maxwell 1996), subsequently incorporated into theoretical LFG (e.g., Dalrymple 2001, 170–171). CAT takes two arguments: a feature structure f and a set of categories C, and it evaluates to true if there is a category in C which is also among the categories of c-structure nodes mapping to f. Formally (Kaplan and Maxwell 1996, 93, Dalrymple 2017, 39, ex. (24)):

(8) $\text{CAT}(f, C)$ iff $\exists n \in \phi^{-1}(f) : \lambda(n) \in C$

"$\text{CAT}(f, C)$ is true if and only if there is some node n that corresponds to f via the inverse ϕ correspondence (ϕ^{-1}) whose label (λ) is in the set of categories C."

For example, assuming that the predicative argument of *become* is the value of its PREDLINK attribute, the following lines in the lexical entry of *become* ensure that the predicative argument corresponds to a c-structure node whose category is not verbal, prepositional, or adverbial, i.e., whose category can only be nominal or adjectival (cf. Dalrymple 2017, 49, ex. (52)):[6]

(9) $\text{CAT}((\uparrow \text{PREDLINK}), \{\%\text{C}\})$
$(\%\text{C V}) = -$
$(\%\text{C P}) = -$
$(\%\text{C ADV}) = -$

In summary, the main points of the analysis of Dalrymple 2017 are: 1) atomic syntactic categories are replaced with [N ±, V ±, P ±, ADJ ±, ADV ±] feature matrices; 2) lexical items specify their own categories as full matrices (with one attribute valued to '+' and all the other ones to '−'); 3) governing predicates (and syntactic constructions) impose categorial restrictions by specifying '−' values of appropriate category attributes; 4) the coordination rule ensures that '+'-valued attributes of conjuncts are copied to the category matrix of the coordinate structure, resulting in multiple '+'-valued attributes

[6](9) uses the %C local name (variable) to pass a complex feature structure as an argument to CAT.

in the case of unlike category coordination (and possibly in the lack of some of the other category attributes, as in (7)); 5) all restrictions on syntactic categories are mediated by the CAT predicate.

13.3 Against syntactic categories of coordinate structures

The analysis of Dalrymple 2017 is an attempt to solve the longstanding problem of the syntactic category of unlike category coordination. Such unlike category coordinations may occur in positions constrained disjunctively: *become* requires its predicative argument to be nominal or adjectival, so this argument may be realised by an unlike coordination containing nominal and adjectival conjuncts. However, such disjunctive constraints may also target other morphosyntactic or lexical features, apart from syntactic categories. This is illustrated in (4), repeated below as (10), which shows that *believe* constrains its argument to be a CP[*that*] or a PP[*in*] (again, perhaps among other alternatives):

(10) Xenocrates (Fr. 15) believed [that stars are fiery Olympian Gods]$_{\text{CP}[that]}$ and [in the existence of sublunary daimons and elemental spirits]$_{\text{PP}[in]}$.

Other attested examples of this kind, also found via Sketch Engine, are:

(11) We all believe [in positive energy]$_{\text{PP}[in]}$ and [that what you give comes back]$_{\text{CP}[that]}$.

(12) We also believe [that you learn from your mistakes]$_{\text{CP}[that]}$ and [in second chances]$_{\text{PP}[in]}$.

(13) A true conservative believes [in a free economy]$_{\text{PP}[in]}$ and [that beyond protecting the public from force and fraud, the government should not interfere in private affairs]$_{\text{CP}[that]}$.

Various other English verbs constrain their arguments disjunctively this way, not just with respect to their syntactic categories, but also with respect to other features, including the choice of the idiosyncratic (non-semantic, 'case-marking') preposition. For example, *wait* may combine with an argument realised as a PP[*for*] or a CP[*until*]; the following attested examples come again from Sketch Engine:

(14) Next time you're thinking about seeing that upcoming sequel, consider waiting [for the DVD]$_{\text{PP}[for]}$ or [until it's out on Netflix]$_{\text{CP}[until]}$.

(15) They wait [until schools become severely overcrowded]$_{\text{CP}[until]}$ or [for a building system failure]$_{\text{PP}[for]}$ before fixing problems.

An even clearer case may be made on the basis of languages with richer morphosyntactic systems, such as Polish. For example, among possible realisations of an argument of *uczyć się* 'learn', there is a genitive NP and a PP headed by *o* 'about', cf. (16), while among possible realisations of an

argument of *przekazać* 'pass, transfer' is a dative NP and a PP headed by *do* 'to', cf. (17); the following attested examples come from the National Corpus of Polish (NKJP; https://nkjp.pl/; Przepiórkowski *et al.* 2011, 2012):

(16) Uczymy się z niej [tego co w życiu jest potrzebne]$_{\text{NP}[gen]}$ i [o tym, co nas otacza]$_{\text{PP}[o]}$.
learn.1PL REFL from it.F that.GEN what.NOM in life is necessary.NOM and about that.LOC what.NOM us surrounds
'We learn from it what is necessary in life and about what surrounds us.'

(17) Te książki, których nie uda się nam sprzedać, przekażemy [naszym filiom]$_{\text{NP}[dat]}$ oraz [do bibliotek szkolnych]$_{\text{PP}[do]}$.
those.ACC books.ACC which.GEN NEG manage.3SG REFL us.DAT sell.INF give.1PL our.DAT branches.DAT and to libraries.GEN school.GEN
'Those books that we do not manage to sell will be given to our branches and to school libraries.'

Hence, it is not sufficient to say that *uczyć się* 'learn' constrains its argument to be nominal or prepositional: when it is nominal, it must occur in the genitive case, and when it is prepositional, it must be headed by the preposition *o* 'about' (which in turn takes a locative NP). Similarly, it is not sufficient to require the relevant argument of *przekazać* 'pass, transfer' to be nominal or prepositional: it must be a dative NP or a PP headed by *do* 'to' (which in turn takes a genitive NP).

Also, some Polish verbs, e.g., *myśleć* 'think' require their CP arguments to be headed by the complementiser *że*, while other, e.g., *chcieć* 'want', combine with CPs headed by the complementiser *żeby*:[7]

(18) Jan myślał, że/#żeby Maria przyszła.
Jan.NOM thought.3SG.M that Maria.NOM came.3SG.F
'Jan thought that Maria had come.'

(19) Jan chciał, żeby/*że Maria przyszła.
Jan.NOM wanted.3SG.M that Maria.NOM came.3SG.F
'Jan wanted Maria to come.'

The relevant argument of the verb *myśleć* 'think' may also be realised as a PP headed by *o* 'about', and that of the verb *chcieć* 'want' – as a genitive NP, so these arguments may be realised as unlike coordinations, as in the following attested examples from NKJP:

(20) Ale kładł się do łóżka, myślał [o psach]$_{\text{PP}[o]}$ i
but put.3SG.M REFL to bed thought.3SG.M about dogs.LOC and

[7] (18) with *żeby* is acceptable with a different meaning of *myśleć*, namely, 'want, plan', hence the use of # instead of *.

[że on sam mógłby być psem]$_{\text{CP}[\dot{z}e]}$.
that he.NOM alone.NOM could.3SG.M be dog.INST

'But he would go to bed, thinking about dogs and that he himself could be a dog.'

(21) Też chcemy [normalności]$_{\text{NP}[gen]}$ i [żeby nam się na głowę
too want.1PL normality.GEN and that us.DAT REFL on head
nie lało]$_{\text{CP}[\dot{z}eby]}$ – mówią lokatorzy.
NEG spill say.3PL tenants.NOM

'We too want normality and to have a roof over our heads – say tenants.'

Again, the disjunctive requirements of these verbs are not limited to syntactic categories, but refer to specific complementisers, prepositions, and grammatical cases. That is, relevant constraints are not expressible in terms of the syntactic category of the coordinate structure, even if – as in Dalrymple 2017 – it encodes syntactic categories of all conjuncts, but they must be able to refer to information present in f-structures of particular conjuncts: the values of CASE (for the grammatical case), PFORM (for the non-semantic preposition), and COMP-FORM (for the complementiser).

It might seem that in all these Polish examples it would suffice to express disjunctive constraints on syntactic positions solely in terms of information in f-structures of particular conjuncts, without any recourse to their syntactic categories. For example, the fact that the verb *chcieć* 'want' subcategorises for an argument a realised as an NP[*gen*] or a CP[*żeby*] (among other alternatives, not discussed here) may be expressed via an appropriately encoded (see below) disjunction of two constraining equations: (a CASE) $=_c$ GEN and (a COMP-FORM) $=_c$ ŻEBY.

However, in Polish, just as in English, syntactic categories must also be taken into account. This is most conspicuous in the case of subjects, which are normally nominal (or adjectival) phrases in the nominative case, but may also be realised as numeral phrases in the accusative case.[8] As expected, coordinate structures with nominative nominal (or adjectival) and accusative numeral conjuncts may also serve as subjects, e.g. (an attested example from NKJP):

(22) Nieopodal wejść do wieżowca pracowała [koparka]$_{\text{NP}[nom]}$
near entrances to skyscraper worked.3SG.F excavator.NOM.SG.F
i [kilku robotników]$_{\text{NumP}[acc]}$.
and few.ACC workers.GEN

'An excavator and a few workers worked near the entrances to the skyscraper.'

[8]This is the first approximation of the facts, but the full data present exactly the same problem; see Przepiórkowski 1999, §5.3 and references therein, as well as Przepiórkowski and Patejuk 2012 for an LFG analysis.

In this case, it would not be sufficient to require the subject s to be $(s \text{ CASE}) =_c \text{NOM}$ or $(s \text{ CASE}) =_c \text{ACC}$: only nominal (and adjectival) realisations are nominative and only numeral realisations are accusative. That is, both syntactic categories and morphosyntactic information must be referred to in the disjunctive specification of Polish subjects. The analysis of Dalrymple 2017 provides a partial solution to the problem of disjunctively specified constraints on a given syntactic position, a solution limited to syntactic categories. In §13.5 below, we propose a more comprehensive solution, on which categorial information is present in f-structures rather than in c-structures. But first let us consider a more conservative dual solution, on which morphosyntactic and lexical information is present in c-structures rather than in f-structures.

13.4 Morphosyntactic and lexical features in c-structure?

As mentioned in §13.2, disjunctive categorial constraints on arguments may be encoded via the CAT predicate. For example, the requirement that the argument of *believe* – suppose it is OBL[9] – is a CP or a PP (or coordination thereof) may be succinctly stated as follows:

(23) $\text{CAT}((\uparrow \text{OBL}), \{\text{CP}, \text{PP}\})$

But what about the more specific requirement that this argument be realised as a CP[*that*] or a PP[*in*] (or coordination thereof)? An idea suggested by an anonymous reviewer is to use complex categories, i.e., c-structure labels such as CP[that] and PP[in]. Such complex categories work in the same way as usual categories; for example, phrases of the category PP[in] have two constituents, P[in] and NP, and the preposition *in* is lexically specified as bearing the category P[in]. Then, the more specific requirement that the relevant argument of *believe* should be a CP[*that*] or a PP[*in*] (or coordination thereof) may be encoded as:

(24) $\text{CAT}((\uparrow \text{OBL}), \{\text{CP[that]}, \text{PP[in]}\})$

One clear problem with this solution is that it requires not only all conjuncts to bear one of the two categories, but also the whole coordinate structure to bear either the category CP[that] (even though it contains a PP[in] conjunct) or the category PP[in] (even though it contains a CP[that] conjunct). So in order for this idea to work, one of the categories of conjuncts should be arbitrarily selected as a label for the whole coordinate structure.[10]

[9]Following Patejuk and Przepiórkowski 2016, we assume that the grammatical function of such arguments is OBL rather than, say, COMP.

[10]Sometimes arguments are given for the claim that the category of the coordinate structure is the same as that of its first conjunct (Munn 1993, Peterson 2004), but – as discussed in Bruening and Al Khalaf 2020 – to the extent that these arguments are

Also, such an analysis is less attractive when applied to Polish prepositions, as these are distinguished not only by their lemma,[11] but also by the grammatical case they require. For example, there are two prepositions *o* 'about, for': one – used in (16) and (20) above – that takes the locative case, as in *myśleć o czymś* 'think about something.LOC', and another combining with the accusative case, as in *prosić o coś* 'ask for something.ACC'. This means that, for instance, the requirements of *myśleć* 'think' as used in (20), which may combine with a CP[*że*] or a PP[*o*] (with a locative NP object inside this PP), should be encoded with the help of a slightly more complex category PP[o,loc]:

(25) CAT((↑ OBL), {CP[że], PP[o,loc]})

While this added complexity is not a technical problem, it is a conceptual problem: apart from PFORM and COMP-FORM, also the value of CASE is redundantly repeated in complex categories within c-structure. Note that this redundancy cannot be removed by representing these values in c-structure complex categories only: all FORM features occur in functional equations encoding government, and CASE additionally occurs in functional equations encoding agreement. This means that removing these features from f-structure would necessitate major changes in how government and agreement are encoded in LFG grammars.

In fact, considerations of case assignment in Polish show that grammatical case cannot be encoded within complex categories only. Consider the attested (26) (from NKJP):

(26) Dziś prof. Kolenda zupełnie nie przypomina
today professor.NOM.M Kolenda.NOM.M utterly NEG remind.3SG
sobie [tamtych wydarzeń]$_{\text{NP}[gen]}$ i [że w ogóle tam był]$_{\text{CP}[że]}$.
himself those.GEN events.GEN and that at all there was.3SG.M
'Today Prof. Kolenda completely does not recall those events or that he was there at all.'

This example involves unlike category coordination, with an NP[*gen*] and a CP[*że*], so it might seem that the relevant requirements of the verb *przypominać sobie* 'recall' could be encoded this way:

(27) CAT((↑ OBL), {CP[że], NP[gen]})

However, the genitive case in (26) is licensed by the negation on the verb, i.e., this is the case of the well-known phenomenon of Genitive of Negation: the 'structurally-cased' argument of a verb bears the accusative case in the

valid, the category of coordination should be the same as that of the conjunct closest to the governor of the coordinate structure. Because of the dubious nature of such arguments, we maintain that assigning one of the different categories of conjuncts to the whole coordinate structure is arbitrary.

[11] It makes sense to talk about lemmata of Polish prepositions, as many of them have two forms, with and without the final vowel *e* (depending on the following constituent), e.g., *w/we* 'in', *pod/pode* 'under', etc.

absence of negation and the genitive case in the presence of negation.[12] That is, in a sentence like (26) but with negation (and negative polarity items) removed, the relevant NP must occur in the accusative case:

(28) Dziś prof. Kolenda przypomina sobie
today professor.NOM.M Kolenda.NOM.M remind.3SG himself
[tamte wydarzenia]$_{\text{NP}[acc]}$ i [że tam był]$_{\text{CP}[że]}$.
those.ACC events.ACC and that there was.3SG.M
'Today Prof. Kolenda recalls those events and that he was there.'

Does this mean that the relevant constraint should be as in (29)?

(29) CAT((↑ OBL), {CP[że], NP[acc], NP[gen]})

The answer is no, as (29) is insensitive to the presence or absence of negation. Rather, the right encoding could be something like (30),[13] where the case value %C depends on the presence of negation (cf. Patejuk and Przepiórkowski 2014).

(30) CAT((↑ OBL), {CP[że], NP[%C]}) ∧
[[%C = ACC ∧ ¬(↑ NEG)] ∨ [%C = GEN ∧ (↑ NEG) =$_c$ +]]

However, we are not aware of any theoretical LFG work that would make use of complex categories constructed on the fly, as in (30), and also our attempts to implement this analysis in XLE – a platform for implementing LFG grammars (Crouch *et al.* 2011) – failed.

In summary, while the idea of encoding disjunctive constraints via the CAT predicate and complex categories might seem attractive at first, and – ignoring the problem of the arbitrary category of the whole coordinate structure – could be made to work for simple cases, it is not clear how to extend it to the full range of data in morphologically more complex languages such as Polish.

13.5 Syntactic categories within f-structure

A solution in terms of the CAT predicate (and simple rather than complex grammatical categories) is also considered in Dalrymple 2017, 41 and it is rejected, although on different grounds: it leads to redundancies in the case of disjunctive specifications of grammatical categories within phrase structure rules. Dalrymple 2017 illustrates this problem with a rule for prepositional constituents, which consist of a preposition and an NP or PP constituent (or a coordination thereof), e.g. (the NOW corpus, Davies 2013, here cited after Dalrymple 2017, 36, ex. (10a)):

(31) I removed them from [the box]$_{\text{NP}}$ and [under the bed]$_{\text{PP}}$.

[12] This is a simplification; see Przepiórkowski 2000 for the full range of data.

[13] For clarity, we explicitly mark conjunction of constraints with ∧ in such more complex constraints, in place of the LFG convention of using whitespace only.

The basic – but unsuccessful – version of the relevant rule might be:

(32) $\mathrm{P}' \longrightarrow \underset{\uparrow=\downarrow}{\mathrm{P}} \quad \underset{(\uparrow \textsc{obj}) = \downarrow}{\{\mathrm{NP}|\mathrm{PP}\}}$

This handles the cases where the phrase following P is an NP or a PP, but it does not handle the unlike category coordination cases, such as (31), on either of the two approaches to syntactic categories of unlike coordinations rejected in Dalrymple 2017. First, on the approach of Patejuk 2015, the category of the coordinate phrase would be UP, clearly not handled by (32). Second, on the approach of Peterson 2004, the category of the coordinate structure is that of the first conjunct, i.e., NP in the case of (31). This latter approach fails in the case of coordinate structures whose first conjunct is an NP or a PP, but in which there are other kinds of phrases among other conjuncts. That is, (32) coupled with the approach of Peterson 2004 would sanction the following sequence as syntactically well-formed:[14]

(33) I removed them from $[\text{the box}]_{\mathrm{NP}}$ and $[\text{there}]_{\mathrm{AdvP}}$.

In order to impose the constraint that each conjunct should be either an NP or a PP, the rule in (32) would have to be extended to something like (34) (Dalrymple 2017, 41, ex. (29)):

(34) $\mathrm{P}' \longrightarrow \underset{\uparrow=\downarrow}{\mathrm{P}} \quad \underset{\substack{(\uparrow \textsc{obj}) = \downarrow \\ \mathrm{CAT}(\downarrow, \{\mathrm{NP}, \mathrm{PP}\})}}{\{\mathrm{NP}|\mathrm{PP}\}}$

Dalrymple 2017, 41 notes that such redundant annotations "would have to appear throughout the grammar, to prevent the appearance of unlike category coordination structures with conjuncts that are not allowed in particular contexts", and for this reason rejects this solution.

We propose to get rid of this redundancy by replacing both the c-structure (or l-structure) encoding of the syntactic category and the distributive CAT predicate with the distributive f-structure attribute CAT.[15]

[14] The actual grammatical status of (33) is unclear to us, but given that phrases such as *from there* are acceptable (e.g., *From there to here, from here to there, funny things are everywhere!*, Dr. Seuss, "One Fish, Two Fish, Red Fish, Blue Fish"), rule (32) should perhaps be extended to (i) below.

(i) $\mathrm{P}' \longrightarrow \underset{\uparrow=\downarrow}{\mathrm{P}} \quad \underset{(\uparrow \textsc{obj}) = \downarrow}{\{\mathrm{NP}|\mathrm{PP}|\mathrm{AdvP}\}}$

Similarly, locative prepositions may be followed by verbal constituents, as long as these constituents denote locations (as in *But from where he was standing, he could see her perfectly...*, Jennifer E. Smith, "This is What Happy Looks Like"), which suggests that (32) should be extended even further. In fact, it is difficult to find purely categorial violations of constraints on arguments of prepositions that would not at the same time be semantic violations. Nevertheless, the general point made in Dalrymple 2017 – that rules such as (32) do not work as intended in the sense that they do not constrain grammatical categories of all conjuncts – is still valid.

[15] The attribute CAT was used for this purpose in Patejuk 2015, in an analysis of unlike coordination in Polish. There, it mostly repeated information present in c-structure labels. The current analysis goes further, as it proposes to encode syntactic categories *solely* via

For example, the following rule corresponds to (32) and (34):

(35)
$$\begin{array}{lcccc} \bullet & \longrightarrow & \bullet & & \bullet \\ & & (\downarrow \textsc{cat}) =_c \mathrm{P} & & (\downarrow \textsc{cat}) \in_c \{\mathrm{P}, \mathrm{N}\} \\ & & \uparrow = \downarrow & & (\uparrow \textsc{obj}) = \downarrow \end{array}$$

Here, bullets represent c-structure nodes.[16] Following Dalrymple 2017, we ignore here the issue of encoding bar levels, etc. However such information is encoded, it could be explicitly represented by replacing bullets in such rules with symbols X (for bar level 0), X′ (for bar level 1) and XP (for bar level 2, assuming this is the maximal bar level), e.g.:[17]

(36)
$$\begin{array}{lcccc} \mathrm{X}' & \longrightarrow & \mathrm{X} & & \mathrm{XP} \\ & & (\downarrow \textsc{cat}) =_c \mathrm{P} & & (\downarrow \textsc{cat}) \in_c \{\mathrm{P}, \mathrm{N}\} \\ & & \uparrow = \downarrow & & (\uparrow \textsc{obj}) = \downarrow \end{array}$$

While rules such as (35) or (36) look quite different than the usual LFG rules such as (32), a notational convention may be introduced according to which constraints such as $(\downarrow \textsc{cat}) =_c \mathrm{P}$ or $(\downarrow \textsc{cat}) \in_c \{\mathrm{P}, \mathrm{N}\}$ are represented via 'categories' in rules. That is, (32) could be understood as a notational variant of (36), one that makes references to the CAT attribute implicit.

An immediate advantage of representing syntactic categories within f-structure is that this eliminates a certain redundancy in more traditional c-structure rules. Consider (32) again. P is annotated as the head of this construction (↑=↓), which means that this is a prepositional construction, so that the category of the left-hand side of the rule must be a P′ or perhaps a PP. That is, the 'P' in 'P′' on the left-hand side of the rule is really redundant. On the encoding proposed here, it is mentioned only once that the value of the head's CAT is P, and the head constraint ↑=↓ ensures that the constituent defined by this rule also bears the syntactic category P.[18]

Replacing the CAT predicate with the CAT attribute is also conceptually advantageous, as it is not clear what role such special-purpose predicates should play in theoretical LFG. Unlike some formalisations of Head-driven Phrase Structure Grammar (HPSG; Pollard and Sag 1994), LFG does not have any built-in mechanisms for defining such predicates, i.e., each such

this f-structure attribute.

[16] This convention is also used in Dalrymple 2017, 50, ex. (55).

[17] Similarly, on the proposal of Lowe and Lovestrand 2020 to replace the single BAR l-structure attribute with two l-structure attributes, L and P, which encode the level of the current projection and the level of the maximal projection, appropriate templates defined there could be added to rules such as (35). In the case of rule (35), the first bullet on the right-hand side should be adorned with the @HEADX template, specifying this constituent as a projecting head, and the second bullet – with the @INT template, specifying this constituent as a maximal projection and its mother as a level 1 projection (and, hence, the head marked by the previous bullet as a level 0 projection).

[18] Interestingly, getting rid of this deficiency of X′ theory is also one of the aims of Lowe and Lovestrand 2020, where CAT is also defined as a distributive feature, albeit in l-structure, rather than f-structure, and for technical reasons independent of coordination.

predicate is a primitive of the theory, extending its language.[19] Also, CAT seems to be the only predicate of this kind used in some theoretical work, so without it – and, hence, without any such built-in predicates – LFG would be a leaner theory.

In the context of the current chapter, the advantage of encoding syntactic categories within f-structure is that now all constraints on syntactic positions refer uniformly to f-structures. For example, in the case of *believe*, the relevant constraint on the OBL argument would be:[20]

(37) $(\uparrow \textsc{obl}) = \%\textsc{c} \wedge$
$[[(\%\textsc{c}\ \textsc{cat}) =_c \mathrm{V} \wedge (\%\textsc{c}\ \textsc{comp-form}) =_c \textsc{that}] \vee$
$[(\%\textsc{c}\ \textsc{cat}) =_c \mathrm{P} \wedge (\%\textsc{c}\ \textsc{pform}) =_c \textsc{in}]]$

The intention of this constraint is that the value of $(\uparrow \textsc{obl})$ – or that of any conjunct within $(\uparrow \textsc{obl})$ – should be either CP[*that*] or PP[*in*]. In standard LFG, as well as in XLE, this constraint does not work as intended, but – as we will see in the following section – it is possible to encode its intended effect.

Similarly, the basic (simplified) constraint on Polish subjects – nominative when nominal (or adjectival) or accusative when numeral – could be defined as below:

(38) $(\uparrow \textsc{subj}) = \%\textsc{s} \wedge$
$[[(\%\textsc{s}\ \textsc{cat}) \in_c \{\mathrm{N}, \mathrm{A}\} \wedge (\%\textsc{s}\ \textsc{case}) =_c \textsc{nom}] \vee$
$[(\%\textsc{s}\ \textsc{cat}) =_c \mathrm{Num} \wedge (\%\textsc{s}\ \textsc{case}) =_c \textsc{acc}]]$

Again, the intention of this constraint is that the value of $(\uparrow \textsc{subj})$ – and every conjunct within it – is either an NP[*nom*] (or an AdjP[*nom*]), or a NumP[*acc*].

In either case, when the f-structure constrained this way is a hybrid structure corresponding to unlike category coordination, this f-structure does not have its own CAT attribute. That is, unlike category coordination has no syntactic category; only f-structures of particular conjuncts bear the CAT attribute. On the other hand, in the case of like category coordination, there is a sense in which the coordinate structure does have a syntactic category, namely, the same as the category of all the conjuncts. This follows from the definition of distributive properties (including values of distributive features), cf. Dalrymple and Kaplan 2000, 779:

(39) For any distributive property P and set s, $P(s)$ iff $\forall f \in s.\, P(f)$.

[19] The most comprehensive and widely assumed formalisation of HPSG is that provided by the Relational Speciate Re-entrant Language (RSRL; Richter 2004), which extends the earlier SRL (King 1989, 1994) with variables, a restricted form of quantification, and relations. In RSRL, relations are defined within grammars, so an analogue of the CAT predicate would in HPSG be encoded as part of the grammar, without the need to further extend the underlying formalism.

[20] Assuming that C also belongs to basic categories, the constraint $(\%\textsc{c}\ \textsc{cat}) =_c \mathrm{V}$ in (37) should be replaced with $(\%\textsc{c}\ \textsc{cat}) =_c \mathrm{C}$.

Because of the bi-conditional (iff) in (39), since all conjuncts f of a like category coordination s have the same value of the CAT attribute, also s can be said to have the same value of CAT.

Let us recapitulate. The main idea of the current proposal is that syntactic categories should be expressed as values of the distributive f-structure attribute CAT. This means that hybrid feature structures corresponding to unlike category coordinations do not have any syntactic category (above syntactic categories of particular conjuncts): not UP, not the category of the first conjunct, not a matrix [N ±, V ±, P ±, ADJ ±, ADV ±]. Advantages of this solution include: 1) getting rid of the built-in CAT predicate (and, hence, built-in predicates of this kind in general), 2) removing some redundancy from c-structure rules, and – most importantly for the topic of this chapter – 3) uniform expressibility of disjunctive constraints on syntactic positions as f-structure constraints.

There are, however, two outstanding issues, to which we turn next.

13.6 Syntactic categories, distributivity, and co-heads

The first problem with the above proposal is that, in standard LFG, constraints such as (37) and (38) do not work as intended. For example, the intention of (37) is that the disjunction be distributive, i.e., that it be evaluated for each conjunct in a coordinate structure. Then, some conjuncts could satisfy the first alternative (CP[*that*]), while others could satisfy the second alternative (PP[*in*]). Unfortunately, in standard LFG such disjunctions are evaluated once, with the effect that either all conjuncts must be CP[*that*], or all conjuncts must be PP[*in*]. This problem is discussed in Przepiórkowski and Patejuk 2012, where two solutions are proposed. The conservative solution (suggested to us by Mary Dalrymple), extensively adopted in Patejuk 2015, is to encode such constraints via off-path constraints. The liberal solution is to extend the formalism in a way that makes it possible to mark certain constraints as distributive: "to understand (non-)distributivity not as a property of features, but as a property of statements" (Przepiórkowski and Patejuk 2012, 485).[21]

While we believe that the liberal solution allows for a more natural encoding of disjunctive constraints, the conservative solution does not require extending the formal apparatus of LFG. Using off-path constraints, (37) could be encoded as follows:

[21] Along the same lines, Kaplan 2017, 133–134, fn. 6, proposes to extend the LFG formalism by introducing DISTRIB: "an explicit operator declaring that an arbitrary description P is a distributive property when it is applied to an f-structure f that happens to be a set".

(40) $(\uparrow \textsc{obl} \quad \textsc{pred} \quad)$
$[(\leftarrow \textsc{cat}) =_c \mathrm{V} \wedge (\leftarrow \textsc{comp-form}) =_c \textsc{that}]$
$\vee\, [(\leftarrow \textsc{cat}) =_c \mathrm{P} \wedge (\leftarrow \textsc{pform}) =_c \textsc{in}]$

Note that such cumbersome encodings of disjunctive constraints are needed independently of the issue of the representation of syntactic categories and other main points of the current chapter.

The other potential difficulty concerns co-heads. For example, Dalrymple *et al.* 2019, 183, ex. (125), propose the following rule for I′:

(41) $\mathrm{I}' \longrightarrow \begin{pmatrix} \mathrm{I} \\ \uparrow{=}\downarrow \end{pmatrix} \quad \begin{pmatrix} \mathrm{VP} \\ \uparrow{=}\downarrow \end{pmatrix}$

This rule corresponds to the I′ constituent *is yawning*, with the I constituent *is* and the VP *yawning*. Assuming – as apparently done in Dalrymple 2017 – that both I and VP have the same basic category V and differ only in the functional vs. lexical subtype of this category (perhaps encoded in c-structure labels), such a rule is not a problem: both constituents contribute the same $\textsc{cat} = \mathrm{V}$ information.

Let us, however, assume that I and V are different syntactic categories. Then a clash of CAT values contributed by the two constituents would ensue. Fortunately, a relatively simple modification of the above rule suffices to solve this potential problem:

(42) $\mathrm{I}' \longrightarrow \begin{pmatrix} \mathrm{I} \\ \uparrow{=}\downarrow \end{pmatrix} \quad \begin{pmatrix} \mathrm{VP} \\ \uparrow/\textsc{cat} = \downarrow/\textsc{cat} \\ (\uparrow \textsc{cat}) = \mathrm{I} \end{pmatrix}$

This solution uses the restriction operator '/' (Kaplan and Wedekind 1993); $\uparrow/\textsc{cat} = \downarrow/\textsc{cat}$ means here that the f-structures of I′ and VP are the same except possibly for the value of the CAT attribute. Additionally, VP explicitly states that its c-structure mother bears the category I, so even if the first constituent is missing and the I′ rewrites only to VP, the I′ constituent still has the I value of CAT. Other cases of c-structure rules with multiple co-heads, including those discussed in Lowe 2020 in the context of mixed syntactic category constructions, can be handled in a similar way.

13.7 Conclusion

The issue of the syntactic category of unlike category coordination has been elusive for decades, with a plethora of proposals, all deficient in one way or another. The proposal of Dalrymple 2017 – to represent syntactic categories as $[\textsc{n}\pm, \textsc{v}\pm, \textsc{p}\pm, \textsc{adj}\pm, \textsc{adv}\pm]$ matrices – is the most recent attempt,[22] one that successfully handles disjunctive category restrictions.

[22] We do not consider here the account of Bruening and Al Khalaf 2020, as it effectively denies the existence of unlike category coordination.

In this chapter, we propose to broaden the perspective and consider disjunctive constraints which are not limited to syntactic categories, but which also take into consideration morphosyntactic and lexical properties. We present an account on which syntactic categories are encoded in f-structures, so all constraints on syntactic positions uniformly refer to f-structures only. On this solution, the issue of syntactic categories of coordinate structures is void: same category coordinations have – via the definition of distributive properties – the same category as that of all the conjuncts, while unlike category coordinations do not need – and, on our proposal, do not have – syntactic categories on top of the different categories of their conjuncts.

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