

1. Introduction

All theories of syntax aspire to be able to analyze any construction found in any language. Thus Ingria's (1990) argument that both feature neutrality and the coordination of unlikes pose fundamental problems for unification-based theories presents a formidable challenge to those theories; moreover, it has often been assumed to automatically apply to their successors – constraint-based theories of grammar, exemplified by Head Driven Phrase Structure Grammar [HPSG] (Pollard and Sag 1994).

This paper shows that this claim does not in fact apply to HPSG. Instead, the nature of the type hierarchy used by HPSG for ontological specification provides a means to adequately and accurately analyze these phenomena without recourse to novel data structures.

I will first describe the phenomena under discussion and then discuss previous work on this topic; this will be followed by the proposed analysis, and finally a comparison of this analysis with another HPSG-based approach.

2. Overview of the Phenomena

2A. Feature Neutrality

Many languages allow for a word to be neutral between two or more values of a morphosyntactic feature; that is, the word's morphology does not uniquely identify a value for the feature. These words may appear in configurations where otherwise-conflicting constraints would be imposed on that word – in effect, the neutral form simultaneously possesses both feature values. The German data in (3) present an example of this phenomenon in a coordination construction.

- (1) *Er findet und hilft Männer.
he finds and helps men.ACC
- (2) *Er findet und hilft Kindern.
he finds and helps children.DAT
- (3) Er findet und hilft Frauen.
he finds and helps women.ACC/DAT

The verb *findet* requires its object to be accusative, while *hilft* requires a dative object. Thus the noun *Männer* in (1), which cannot be dative, cannot occur with *hilft*, while the noun *Kindern* in (2), which cannot be accusative, cannot occur with *findet*.¹ The noun *Frauen*, however, is neutral between accusative and dative case and is therefore acceptable in this configuration.

Neutrality is distinguished from the familiar phenomenon of ambiguity by precisely this property of simultaneity. The German subject-verb agreement² data in (4) – (6) give an

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¹ Switching the order of the conjuncts does not affect acceptability.

² In this paper, I use the terms *agreement* and *concord* interchangeably; the traditional dis-

illustration of an ambiguous form.

- (4) Sie singt
she sings.SG
- (5) Sie singen
they sing.PL
- (6) *Sie singt und singen
she/they sing.SG and sing.PL

While the form *sie* can act as either singular or plural, it cannot act as both at the same time. It is therefore considered ambiguous rather than neutral.³

A disjunctive description (for instance, [CASE *acc* ∨ *dat*]) represents a state of partial information: we know that CASE is either *acc* or *dat*, but we don't know which. These descriptions are quite suitable for ambiguous forms, as the form's context will fill in the missing information by indicating which way the disjunction should be resolved.

It has been recognized since (Zaenen and Karttunen 1984) that disjunctive descriptions cannot be used to accurately model neutrality. If the object corresponding to *Frauen* in (3) were specified by [CASE *acc* ∨ *dat*], sentence (3) could not be licensed: such a specification would have to describe an object with either [CASE *acc*] (which fails to satisfy the selectional requirements of *hilft*) or [CASE *dat*] (which fails to satisfy the requirements of *findet*).⁴

In the examples analyzed so far, we have focussed on a single aspect of morphosyntax: case. In general, however, one affix or word often encodes the value of multiple morphosyntactic features, as shown for German in (7).

- (7) der Antrag des oder der Dozenten
the petition of-the.GEN.SG or of-the.GEN.PL docent.MASC.GEN.(SG/PL)
'the petition of the docent(s)'

It is not enough to say that *Dozenten* is neutral between singular and plural: *Dozenten* cannot be taken as singular in (8).

- (8) *der Dozenten ist hier.
the.NOM.SG docent.NOM.SG is.SG here.

Instead, any theory of neutrality needs to be able to constrain the neutrality of one feature based on the value of another. Here, while it is true that *Dozenten* is neutral between singular and plural, a particular token of *Dozenten* can only act as singular while its case is not nominative.

One further wrinkle arises from the fact that many languages have NP-internal agreement (for example, determiner-noun agreement or noun-adjective agreement) in addition to NP-external agreement (for example, subject-verb). When multiple elements of a noun phrase are neutral, the resulting NP acts externally as if its agreement properties were the intersection of the individual neutralities. This is illustrated in (9) – (12).

inction revolving around information flow is not relevant here.

³ Several articles, including (Zaenen and Karttunen 1984) and (Pullum and Zwicky 1986), discuss other ways to distinguish neutrality from ambiguity; given that such a distinction exists, such tests are orthogonal to the analysis of neutrality itself.

⁴ This problem also holds when the lexicon contains two words with the phonological form of *Frauen*: one with [CASE *acc*] and one with [CASE *dat*].

- (9) Er hilft Dozenten.
he helps docents.DAT.PL
- (10) Er hilft den Dozenten.
he helps the.DAT.PL docents.DAT.PL
- (11) Er hilft der Frau.
he helps the.DAT.SG.FEM woman.DAT.SGFEM
- (12) *Er hilft der Dozenten.
he helps the docents

Sentences (9) – (10) show that *Dozenten* is a valid object of *hilft* and therefore can manifest dative case. Sentence (11) shows that the definite article *der* can also manifest dative case. In sentence (12), however, we see that the combined noun phrase *der Dozenten* cannot manifest dative case. Thus it is insufficient for each word to individually meet the case requirements of the verb: the NP itself may often be less neutral than its component forms. This may seem trivial, but it will be shown in section 3 that much of the existing literature on this topic has not dealt with this problem.

2B. Coordination of Unlikes

Now consider the problem of determining the CASE value of the coordinate noun phrase *Männer und Kindern*. Items (20) – (21) show that this phrase cannot be selected by a verb requiring an accusative object (like *findet*) or by one requiring a dative object (like *hilft*).

- (13) *Er findet Männer und Kindern.
he finds men.ACC and children.DAT
- (14) *Er hilft Männer und Kindern.
he helps men.ACC and children.DAT

This is the case even when the verb in question could occur with either case individually, as shown in (15) – (17).

- (15) Er lehrt Kinder.
he teaches children.ACC
- (16) Er lehrt Kindern.
he teaches children.DAT
- (17) *Er lehrt Männer und Kindern.
he teaches men.ACC and children.DAT

The verb *lehren* can take either the accusative *Männer* or the dative *Kindern*, but not the coordinate *Männer und Kindern*. Thus the verb *lehren* is said to have ambiguous selectional requirements: it can take either of two values, but not both simultaneously.

Ambiguous selectors like *lehren* stand in contrast to those in other languages with neutral selectional requirements. For instance, in Russian, some verbs under certain circumstances can take either accusative or genitive complements, as well as a coordinate complement where one of the conjuncts is accusative and the other is genitive. This is shown by the data from (Levy 2001) in (18).

- (18) Včera ves' den' on ožidal svoju podругu
 yesterday all day he expected self's.ACC girlfriend.ACC
 Irinu i zvonka ot svoego brata Grigorija
 Irina.ACC and call.GEN from self's.GEN brother.GEN Gregory.GEN
 'Yesterday he waited all day [for his girlfriend Irina] and
 [for a call from his brother Gregory].'

We can draw a parallel between this phenomenon and that of the coordination of unlike categories, as discussed in e.g. (Sag et al. 1985). This term traditionally refers to the coordination of distinct parts of speech, as in (19) – (14).

- (19) He is [a republican] and [proud of it].
 (20) I consider that [a rude remark] and [in very poor taste].
 (21) Robin walks [slowly] and [with great care].

In (19), the conjuncts are a noun phrase and an adjective phrase; in (20), a noun phrase and a prepositional phrase; and in (21), an adverb and a prepositional phrase. In each case, the coordinate phrase as a whole is a dependent of the verb.

In HPSG, the concept of category (i.e. the value of the *CAT* feature) allows for fine-grained distinctions: since the conjuncts in (20) have different values of *CASE* (a subfeature of *CAT*), they too can be said to be unlike categories.

Thus, as pointed out by (Bayer 1996), the coordination of unlikes is effectively the dual of feature neutrality: instead of multiple constraints needing to be true of a single object, a single constraint needs to be true of multiple objects. These two phenomena are linked by a single question: If we take coordinate phrases to have the same ontological status as non-coordinate phrases, then any feature appropriate for a normal phrase (*VAL*, *CASE*) must also be appropriate for a coordinate phrase. What are the values of those features?

Before answering this question, I review some of the previous and current work in this area.

3. Related Work

3A. Ingria 1990

Ingria uses data related to feature neutrality to criticize the standard treatment of agreement in unification-based grammars, in which objects are subject to token-identity constraints (i.e. the value of feature *x* must unify with *y*). Instead, he argues that agreement constraints should have the form of a non-distinctness check (i.e. the value of feature *x* must not contradict *y*). For example, this check would say that since [*CASE acc* \vee *dat*] is non-distinct from both [*CASE dat*] (the selectional requirement of *hilft*) and [*CASE acc*] (the selectional requirement of *findet*), it is an acceptable *CASE* value for *Frauen*.

It is unclear how, in the absence of unification, the problem of NP-internal agreement can be dealt with. Clearly the non-distinctness check is insufficient on its own: in example (12) above, both *der* and *Dozenten* are non-distinct with *DAT*, yet *der Dozenten* is an unacceptable object for *hilft*.

Ingria's objection to the use of token-identity is based on the assumption that anything that *CASE* values must be disjoint: anything that can unify with a certain *CASE* value cannot unify with any other *CASE* value. For instance, in a sentence like (3), the verb *hilft* requires [*CASE dat*] to hold of its object, while the verb *findet* requires [*CASE acc*]. No single object can meet both of these constraints. I will show in section 4 an analysis that falsifies this

assumption.

3B. Bayer and Johnson 1995

Working within the framework of Lambek categorial grammar, Bayer and Johnson (1995) present an account of feature neutrality and unlike coordination that takes advantage of a certain type-logical theory of categories. Their analysis of (3) is given in (22).

$$\begin{array}{c}
 (22) \quad \frac{\frac{\frac{\text{findet}}{vp/np \wedge acc} \text{Lx} \quad \frac{[np \wedge acc \wedge dat]^1}{np \wedge acc} \text{P}}{vp} \text{/E} \quad \frac{\frac{\frac{\text{hilft}}{vp/np \wedge dat} \text{Lx} \quad \frac{[np \wedge acc \wedge dat]^2}{np \wedge dat} \text{P}}{vp} \text{/E}}{vp} \text{/I}^1 \quad \frac{\text{und}}{conj} \text{Lx} \quad \frac{\frac{\text{Frauen}}{np \wedge acc \wedge dat} \text{Lx}}{np \wedge acc \wedge dat} \text{P}}{np \wedge acc \wedge dat} \text{Co}}{vp/np \wedge acc \wedge dat} \text{Co} \quad \frac{\text{Frauen}}{np \wedge acc \wedge dat} \text{Lx}}{np \wedge acc \wedge dat} \text{P}}{vp} \text{/E}
 \end{array}$$

The derivation starts with instances of lexical access (rule Lx). The verb *findet* has category $vp/np \wedge acc$, representing the fact that it wants an accusative object; *hilft* has category $vp/np \wedge dat$, as it wants a dative object; and *Frauen* has category $np \wedge acc \wedge dat$, representing its neutrality between accusative and dative case.

Then the category for *Frauen* is hypothesized after each conjunct. The first hypothesis is then weakened (rule P) from $np \wedge acc \wedge dat$ to $np \wedge acc$, and the second to $np \wedge dat$. This allows each verb to combine (rule /E) with the introduced argument, forming in each case the category vp . The hypothesis is then discharged (rule /I) for each conjunct, forming categories $vp/np \wedge acc \wedge dat$.

Since the conjuncts have the same category, the conjunction rule (rule Co) can be applied to form a single conjoined $vp/np \wedge acc \wedge dat$ category. As the last step, this category combines with the actual argument *Frauen* (rule /E).

In this example, the hypothesized object was weakened by meet elimination: the change from $a \wedge b$ to a . Categories can also be weakened by join introduction: the change from a to $a \vee b$. This is used in the analysis of unlike coordination, as illustrated in (23).

$$\begin{array}{c}
 (23) \quad \frac{\frac{\frac{\text{wealthy}}{ap} \text{Lx} \quad \text{and} \quad \frac{\text{a republican}}{np} \text{Lx}}{ap \text{ and } np} \text{Wk} \quad \frac{\text{became}}{vp/np \vee ap} \text{Lx}}{np \vee ap \text{ and } np \vee ap} \text{Co}}{np \vee ap} \text{Co} \quad \frac{\text{became}}{vp/np \vee ap} \text{Lx}}{vp} \text{/E}
 \end{array}$$

Here, the lexicon assigns *wealthy* category ap , *a republican* category np , and *became* category $vp/np \vee ap$. Each of the conjuncts is then weakened (rule P) to $np \vee ap$; these categories are then conjoined to form a single $np \vee ap$ category, which can combine with the category of *became*.

While this seems to be a quite elegant solution to the problem, (Bayer 1996) points out problems with the use of \wedge to represent the conjunction of orthogonal features as well as neutral feature values. In particular, a form neutral between NOM.PL and GEN.SG is represented by the meet of $(np \wedge nom \wedge plural)$ and $(np \wedge gen \wedge singular)$, which is $(np \wedge nom \wedge$

plural \wedge *gen* \wedge *singular*). This category can be weakened to (*np* \wedge *gen* \wedge *plural*), thus predicting that such a neutral form could be used in a context where GEN.PL was required. This is contradicted by the Finnish data in (Zaenen and Karttunen 1984), where the form *kirjansa* can be used for NOM.SG, GEN.SG, and NOM.PL, but not GEN.PL.⁵

3C. Dalrymple and Kaplan 2000

Dalrymple and Kaplan (2000) provide an LFG-based analysis of both feature neutralization and unlike coordination. In their account, coordinate phrases contrast with non-coordinate phrases by corresponding to a set of f-structures rather than a single f-structure. A constraint then holds of a set of f-structures exactly when it holds of each member of the set. Neutrality is represented by assigning the feature the set of those values between which the form is neutral.

Thus in their analysis of (3), *Frauen* has [CASE {*acc*, *dat*}]. The verb *hilft* requires that its argument's CASE value have *dat* as a member, and similarly *acc* for *findet*. *Frauen* meets these conditions and (3) is licensed.

This analysis shares some properties with Ingria's analysis and suffers from some of the same problems. As agreement is effected through what is in effect a subsumption check rather than a shared object, NP-internal agreement must be treated as a separate phenomenon. While Dalrymple and Kaplan acknowledge the existence of this problem (p. 795), they do not provide an analysis for it. Nor is any account given of neutrality across features

This approach also strips sets of having any intrinsic meaning in the LFG framework, increasing the possibility for unwanted interactions. Sets can be used to represent collections of arbitrary numbers of items, neutral values, coordinations, and feature decompositions.

3D. Levy 2001

Levy (2001), along with (Levy and Pollard 2002), presents an HPSG-based approach developed contemporaneously with this paper that centers around certain sets of sets (which Levy refers to as double-sets). Further discussion of Levy's approach will be deferred until the analysis in section 4 has been presented; this will allow for a detailed comparison of the two approaches.

It should be noted that Levy's theory only presents an analysis of single-feature neutralization. He speculates, however, that his theory can handle neutrality across features (pp. 27–29) and suggests some potential avenues for further exploration.

4. A Type-Based Approach

The analysis presented in this section differs from the proposals discussed in the previous section in two main ways. It adds no new data structures or mechanisms to the framework and it retains the use of structure-sharing in effecting agreement. As such it explicitly rejects Levy's (2001) claim that "the problems presented by [feature neutrality and unlike coordination] cannot be solved solely with the structural tools made available by HPSG's type hierarchy".

⁵ The work of Dörre and Manandhar (1995) on constraint-based Lambek calculi may provide an approach to features in categorial grammar that resists this criticism (Martin Jansche, p.c.).

4A. The Phrase Structure of Coordination

Before the analysis can be presented, I will present some baseline assumptions about the phrase structure of coordinate structures. I take the type *coord-phrase* to be a subtype of *non-headed-phrase*. Following (Sag et al. 1985), I assume two subtypes of *coord-phrase* for English: *bin(ary)-coord-ph(rase)* and *iter(ated)-coord-ph(rase)*.

A *bin-coord-ph* is licensed whenever the first daughter has [MARKING α_0] and the second daughter has [MARKING α_1] for some α . (Sag et al. 1985) gives the requirement $\alpha \in \{\{\text{both, and}\}, \{\text{either, or}\}, \{\text{unmarked, but}\}\}$ while noting that the set of possible values for α is highly subject to idiolectal variation.

Similarly, an *iter-coord-ph* is licensed whenever the first daughter has [MARKING β_0], the last daughter has [MARKING β_2], and all other daughters have [MARKING β_1] for some β . Here $\beta \in \{\{\text{unmarked, and, and}\}, \{\text{unmarked, unmarked, and}\}, \{\text{unmarked, unmarked, or}\}, \{\text{unmarked, or, or}\}, \{\text{neither, nor, nor}\}\}$; this too may vary widely among idiolects.

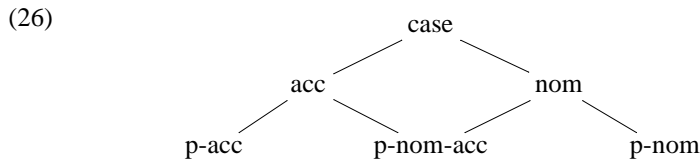
4B. Feature Neutrality

The analysis of feature neutrality developed in this paper is based on the (Levine et al. 2001) treatment of case-consistency for parasitic gaps. As is standard in GPSG- and HPSG-style analyses of parasitic gaps, the local properties of both the host and parasitic gaps are represented by a single object: all constraints affecting one affect the other. When different case requirements are imposed on the two gaps, then, the resulting sentence is only acceptable when the filler is case-neutral. This is illustrated in (24) and (25).

- (24) *whom even friends of ___ believe ___ should be closely watched.
(25) who even friends of ___ believe ___ should be closely watched.

Here the preposition *of* requires its object to have accusative case, while the verb *should* requires its subject to have nominative case. The accusative pronoun *whom* cannot satisfy both of these constraints, but the case-neutral pronoun *who* can.

To analyze this, Levine et al. (2001) augment the type hierarchy for CASE values with three new types: a neutral type *p-nom-acc* and two ‘pure’ subtypes *p-nom* and *p-acc*, as given in the portion of the signature shown in (26).⁶



Here, the type *p-nom-acc* represents neutrality between nominative and accusative case⁷; a type like *p-nom* represents a pure (non-neutral) case value.

Under this scheme, the only maximally specific types are *p-nom*, *p-nom-acc*, and *p-acc*. Case-neutral pronouns like *who*, as well as common and proper nouns, are listed in the

⁶ Typenames have been slightly modified from the (Levine et al. 2001) version for consistency with later sections.

⁷ When reading the type names, it is important to take the *p-* prefix as having scope over the rest of the name. For instance, the type *p-nom-acc* is the pure type corresponding to the neutralization of nominative and accusative case, not the neutralization of *p-nom* and *acc*.

lexicon as [CASE *p-nom-acc*], while case-specific pronouns like *he* or *whom* are listed as [CASE *p-nom*] or [CASE *p-acc*], as appropriate.

The remaining types – *nom*, *acc*, and *case* (which is equivalent to *nom* ∨ *acc*) – are only used in object descriptions, such as those found in valence specifications. For instance, a typical finite English verb selects a subject with [CASE *nom*] and selects complements with [CASE *acc*].

With this hierarchy, a description like [CASE *acc*] abbreviates the disjunction ([CASE *p-acc*] ∨ [CASE *p-nom-acc*]). Thus [CASE *acc*] and [CASE *nom*] now unify to [CASE *p-nom-acc*]. In effect, we are now able to model the intuition that *who* is both nominative and accusative.

The central distinction in this hierarchy, then, is between types which begin with *p*- (the pure types) and those that do not (the non-pure types). Pure types are maximally specific; they are the types found on linguistic objects. Non-pure types, in contrast, are found on linguistic descriptions (e.g. subcategorization requirements). Every non-pure type corresponds to a pure type. The non-pure type is usually the immediate supertype of the pure type, with one exception: the most neutral type (here, *p-nom-acc*) is both pure and non-pure.⁸

Just as (26) serves as a case hierarchy for English, so may a similar hierarchy be constructed for German, which has a four-case system. I will assume that such a type hierarchy would only contain those pure types which correspond to attested patterns of neutralization in the language, rather than containing a pure type for every potential subset of cases. For instance, no form in German is neutral between nominative, accusative, and genitive cases (to the exclusion of dative), and so there is no *p-nom-acc-gen* type in the hierarchy. (See section 4D for an illustration of the effect this has on a sample case hierarchy.)

The analysis of (3) (repeated below) is now straightforward.

- (3) Er findet und hilft Frauen.
 he finds and helps women.ACC/DAT

Under the system described above, the verb *findet* imposes the constraint [CASE *acc*] on its object and *hilft* imposes the constraint [CASE *dat*] on its object. The constraint in (27) models the fact that each verb’s selectional specifications must be satisfied by the dependents of the coordination (an outgrowth of what is often referred to as Wasow’s generalization (Pullum and Zwicky 1986)).

$$(27) \text{ coord-phrase} \rightarrow \left[\begin{array}{l} \text{VAL} \quad \boxed{2} \\ \text{DTRS} \quad \left\langle \left[\text{VAL} \quad \boxed{2} \right], \left[\text{VAL} \quad \boxed{2} \right] \right\rangle \end{array} \right]$$

Thus the constraint that the coordination of the two verbal heads *findet und hilft* imposes on its object is the logical conjunction of the constraints [CASE *acc*] and [CASE *dat*]: namely, [CASE *acc-dat*].

Returning to (3), the word *Frauen*, as a word neutral between all four cases, is listed in the lexicon as [CASE *p-nom-acc-dat-gen*]; this is consistent with [CASE *acc-dat*] and *Frauen* is therefore an acceptable object for *findet und hilft*.

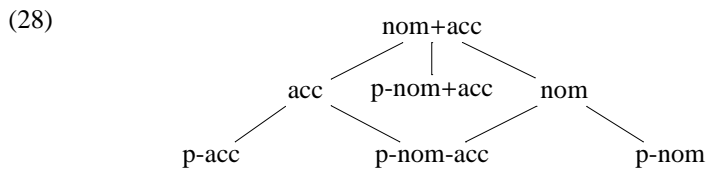
⁸ We could avoid this awkwardness by introducing a type *nom-acc* in the place of *p-nom-acc* that would then only dominate *p-nom-acc*, but such unary branching in a type hierarchy is seen as equally awkward by many.

4C. Coordination of Unlikes

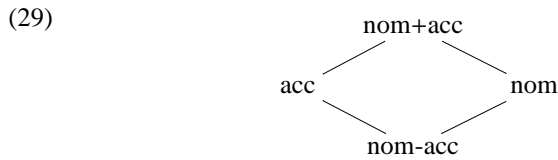
Recall that the data in (20) – (21) (repeated below) show that the *CASE* value of the coordinate noun phrase *Männer und Kindern* cannot be either *dat* or *acc* (or any subtype thereof), or else it would be selectable by either *findet* or *hilft*.

- (20) *Er findet Männer und Kindern.
 he finds men.ACC and children.DAT
 (21) *Er hilft Männer und Kindern.
 he helps men.ACC and children.DAT

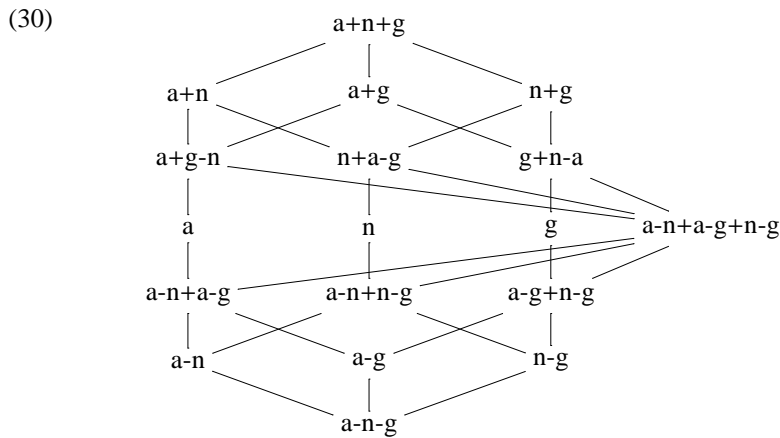
Instead, it must be a type more specific than *case* but less specific than *acc* or *dat*: a type that in effect reifies $acc \vee dat$. I therefore introduce a new type *p-nom+acc* into the hierarchy, as shown in (28).



Just as the hyphen mnemonically represents neutrality, the plus sign indicates coordination. With this addition, the placement of the pure types has become completely predictable: no pure type dominates any other type, and every pure type is either equal to its corresponding non-pure type or is immediately dominated by it. Thus we can considerably simplify these diagrams by leaving out the pure types; their presence will be implicit from now on. Under this convention, (28) appears as in (29).



To more fully illustrate the range of possibilities, it will be helpful to consider a three-valued case system. The corresponding simplified diagram for such a system appears as (30).

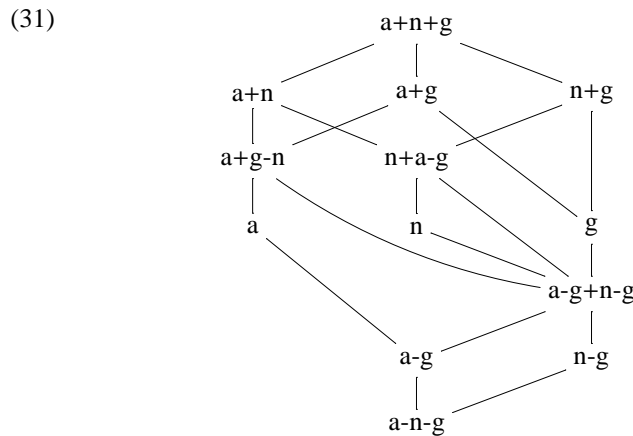


Note that in any expression containing both – and + signs, the – takes scope over the +.

In one sense, these names are purely iconic: none of the constraints presented in this paper would fail if we replaced type names like $a-n$ and $a+n$ with types like *banana* and *pineapple*. On the other hand, if we want to talk about how these hierarchies are developed, it helps to consider the types as members of the free bounded distributive lattice over the basic cases (here, a , n , and g) with operators $+$ and $-$ serving as meet and join. Thus the lack of a row of types with the form $(a+g)-n$ is deliberate: by distribution, this is equivalent to $a-n+g-n$.

The hierarchy in (30) represents that of a fully neutralizing language: every possible neutralization of the basic cases has an instantiation. Not all natural languages are fully neutralizing, however. For example, (Dyła 1984) shows that in Polish, there are forms neutral between accusative and genitive case exist, but there are no forms neutral between nominative and accusative case.

A sample hierarchy for a three-case language where this particular combination of cases (nominative and accusative) fails to neutralize is given in (31).



This is a sublattice of (30) in which $a-n$ and all coordinations involving $a-n$ have been removed.

The constraint that relates the CASE value of a coordination to the CASE value of its conjuncts can now be stated. Since the conjuncts, being phrases, are linguistic objects, each has a pure CASE value. Let the CASE values of the conjuncts be x and y , and let the corresponding non-pure types be x' and y' . Finally, let the CASE value of the coordination be z with corresponding non-pure type z' . Then it must be the case that z' is the lowest type such that z' is identical to or a supertype of x' and y' ⁹. The practical effect of this is that a coordination is at most as valent as its least-valent component. For example, if x is neutral between cases A, B, and C, while y is neutral between B, C, and D, then the coordination of x and y is only neutral between B and C.

This principle allows the analysis of all of the phenomena presented so far. Envision a hierarchy similar to (30) in which all the n s have been changed to d s and take this as an approximation of German. Then the result of coordinating $p-acc$ and $p-acc-dat$ is $p-acc$. To see this, take $x = p-acc$ and $y = p-acc-dat$. Then $x' = acc$ and $y' = acc-dat$. Find acc and $acc-dat$ in (30) and notice that acc is a supertype of $acc-dat$. Thus $z' = acc$ and $z = p-acc$. Therefore, the coordination of accusative *Männer* and syncretic *Frauen* is

⁹ In formal terms, z' is constrained to be the least upper bound of x' and y' with respect to the subtype relation.

assigned [CASE *p-acc*]. As such, this coordination can occur anywhere a simple accusative NP can occur but nowhere that requires a dative NP.

Similarly, as neither *acc* nor *dat* are supertypes of the other, the coordination of accusative *Männer* and dative *Kindern* receives [CASE *p-acc+dat*]. Here, $x = p-acc$ and $y = p-dat$, so $x' = acc$ and $y' = dat$. Then $z' = acc+dat$ and $z = p-acc+dat$. This type cannot satisfy either of the constraints [CASE *acc*] or [CASE *dat*], as desired.

We can now return to the Russian data in (18) (repeated below), which illustrated selectional neutrality.

- (18) Včera ves' den' on ožidal svoju podругu
 yesterday all day he expected self's.ACC girlfriend.ACC
 Irinu i zvonka ot svoego brata Grigorija
 Irina.ACC and call.GEN from self's.GEN brother.GEN Gregory.GEN
 'Yesterday he waited all day [for his girlfriend Irina] and
 [for a call from his brother Gregory].'

Here, the coordination *podругu i zvonka* receives [CASE *p-gen+acc*], and as such it can be selected by the constraint [CASE *gen+acc*] (which must therefore be part of the valence specification of *ožidal*).

With the contrasting case of selectional ambiguity (recall (17), shown below), the verb *lehren* must be analyzed as having [COMPS ⟨[CASE *acc ∨ dat*⟩] (rather than [COMPS ⟨[CASE *acc+dat*⟩])]. Thus the coordination *Männer und Kindern*, with [CASE *acc+dat*], is not an acceptable object for this verb.

- (17) *Er lehrt Männer und Kindern.
 he teaches men.ACC and children.DAT

The acceptability of (19) (repeated below) can now be explained.

- (19) He is [a republican] and [proud of it].

Assume that the features appropriate for a type *p-a+b* are exactly those appropriate for both *a* and *b*. Since the feature PRED is appropriate for both adjectives like *proud of it* and nouns like *a republican*, it is appropriate for the coordination type *p-noun+adj*. Furthermore, since both *proud of it* and *a republican* are [PRED +], the coordination is also [PRED +]. The copula *is* merely constrains its argument to be [PRED +], so the sentence is licensed.

To take another example, the English verb *become* is like *be* in that its arguments can be of varying categories; unlike *be*, its arguments cannot be prepositional or verbal. Under this system, *become* would subcategorize for [HEAD *noun+adj*]; just as with *be*, the coordination *a republican and proud of it* meets this constraint.

For any given feature, the relationship between its value for the conjuncts and its value for the coordination depends on the feature in question. As presented above, CASE in English and German illustrates one type of combination – a join on the corresponding non-pure types. For valence requirements, such as those from conjoined verbs as in (3), the value of the mother's feature is the unification of the daughter features' values. Among other agreement features, like PERSON, NUMBER, and GENDER, more elaborate constraints might relate mother values to daughter values; see (Sag et al. 1985) for a discussion of these features in English conjoined NPs and (Corbett 1983) for a cross-linguistic discussion of such relationships.

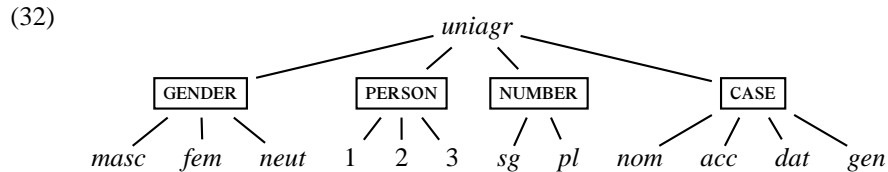
4D. Neutrality Across Features

We now return to the last set of data presented in section 2A. As given in section 4B, the analysis of feature neutralization only holds when values of a single feature are being neutralized. The phenomenon of neutralization across features must still be accounted for.

Recent proposals (e.g. Kathol 1999) represent morphosyntactic agreement information in HPSG as a bundle of features (CASE, PERSON, NUMBER, and GENDER). If the values appropriate for these features were augmented as above, adding new types to represent neutralizations, there would still be no way to replace a constraint like $([CASE \neg nom] \wedge [NUM sg]) \vee ([NUM pl])$ in the same way that $[CASE nom] \vee [CASE acc]$ was replaced with $[CASE p\text{-}nom\text{-}acc]$.

For illustration, consider a variation on the Russian verb in (18) that may take either NOM.SG or ACC.PL objects (but not NOM.PL or ACC.SG). That verb cannot be selecting $[CASE p\text{-}nom\text{-}acc]$, as that would improperly exclude non-neutral forms. Neither can it select for $[CASE nom \vee acc]$, as discussed in section 2A. There needs to be a way to account for this interdependence.

In the mathematical tradition of reducing new problems to ones already solved, multiple inheritance can reduce the problem of neutrality across features to that of single feature neutrality. Just as phrases are classified along dimensions of clausality and headedness in (Sag 1997), morphosyntactic information can be represented in terms of one feature UNIAGR and one type *uniagr* which is cross-classified in terms of person, number, gender, and case.



Each value of *uniagr* is an element of the cross-product over the possible values of each of the component features. (For example, one such value would be *masc.3.sg.acc*, corresponding to the German pronoun *ihn*).

Only those feature combinations actually attested on some lexical item are part of the type hierarchy. Just as *nom* and *acc* form the basis of the case hierarchy for English in (26), so could these values of UNIAGR form the basis of a unified agreement hierarchy for German.

Every constraint expressible in the old system has an equivalent constraint in this system. The full hierarchy of these types is too large to provide in full, so I will use some naming conventions: each type component will consist of four fields separated by dots. Within each field, the initial letter/digit of the analogous type in (32) will indicate that dimension of the UNIAGR value. For example, the constraint $([GEND masc] \wedge [PER 3rd] \wedge [NUM sg] \wedge [CASE dat])$ is equivalent to $[UNIAGR m.3.s.d]$ under this system. I will omit the dots whenever a field has just one member, so that the aforementioned type would appear as *m3sd*.

For notating types that are neutral between several of these values, I will put both letters in a single field: thus *m3s.da* is a type neutral between *m3sd* and *m3sa*. If more than one field has multiple letters, then that type is neutral between the cross-product of the variants: i.e. *mf.3.sp.n* is neutral between the four types *m3sn*, *m3pn*, *f3sn*, and *f3pn*.

In general, by removing any character (except the last in a field), one moves from subtype to

immediate supertype. Thus *mf.3.sp.n* is an immediate subtype of *m3.sp.n*, *f3.sp.n*, *mf.3sn*, and *mf.3pn*.

For neutralizations where such a full product is not appropriate, I will continue to use the dash notation: *m3sd-f3sa* is a type neutral between *m3sd* and *f3sa* that (unlike *mf.3s.da*) excludes *f3sd* and *m3sa*. As before, removing a dashed component yields an immediate supertype of the type in question: thus *m3sd* is an immediate supertype of *m3sd-f3sa*.

Finally, the omission of a field abbreviates the disjunction of all possible values for that field. So *msn* abbreviates (*m1sn* \vee *m2sn* \vee *m3sn*). This is different from *m.123.sn*, which is neutral between all three persons.

These rules form the names of the non-pure types; the corresponding pure typename is again formed by prefixing with *p-*.

The acceptability of (7), repeated below, can now be accounted for.

- (7) der Antrag des oder der Dozenten
 the petition of-the.GEN.SG or of-the.GEN.PL docent.MASC.GEN.(SG/PL)
 ‘the petition of the docent(s)’

Using the naming conventions just described, we can write the lexical entries in (33) – (35).

- (33) $\left[\begin{array}{l} \text{PHON} \quad \text{der} \\ \text{UNIAGR} \quad p\text{-}m.123.s.n\text{-}f.123.s.dg\text{-}mfn.123.p.g \\ \text{VAL} \quad \left\langle \left[\text{UNIAGR} \quad msn \vee fsd \vee fsg \vee pg \right] \right\rangle \end{array} \right]$
- (34) $\left[\begin{array}{l} \text{PHON} \quad \text{des} \\ \text{UNIAGR} \quad p\text{-}mn.123.s.g \\ \text{VAL} \quad \left\langle \left[\text{UNIAGR} \quad msg \vee nsg \right] \right\rangle \end{array} \right]$
- (35) $\left[\begin{array}{l} \text{PHON} \quad \text{Dozenten} \\ \text{UNIAGR} \quad p\text{-}mfn.123.s.adg\text{-}mfn.123.p.nadg \end{array} \right]$

This encodes the fact that the German article *der* is neutral between MASC.NOM.SG, FEM.DAT.SG, FEM.GEN.SG, and GEN.PL; the article *des*, between MASC.GEN.SG and NEUT.GEN.SG; and the noun *Dozenten*, between MASC.GEN, MASC.ACC, MASC.DAT, and MASC.NOM.PL.

Then if we assume as before that coordination involves the unification of the individual conjuncts’ agreement constraints, the coordination *des oder der* will be looking for a noun consistent with $[\text{UNIAGR} (msg \vee nsg) \wedge (msn \vee fsd \vee fsg \vee pg)]$.

The type *p-mfn.123.s.adg-mfn.123.p.nadg* is a subtype of *msg*, so the first conjunct is satisfied, and it is also a subtype of *fsd*, so the second conjunct is satisfied. Hence *Dozenten* is compatible with the selectional requirements of *des oder der* and (7) is acceptable.

One side effect of this approach is that it becomes less straightforward to account for phenomena in which elements are constrained to agree in one aspect of UNIAGR but not the others. For example, in German there are examples where two phrases must have the same case but may vary in person, number, and/or gender (see (Müller 2001) for one example of this). Since it is not possible to structure-share part of a type, such a relationship cannot be directly notated.

Given the existence of relational constraints, however, one could define a **same-case** relation such that **same-case**(α , β) holds exactly when α and β are of types whose **CASE** dimensions are the same. Similar relations could be defined as needed for **NUMBER**, **GENDER**, and **PERSON**. This may have an intuitive feel of “one step forward, two steps back” (as relations are now needed to provide what once came “for free”) but it does account for a wider range of the data than any standard theory of agreement. At any rate, more work is certainly needed in this area.

5. Levy 2001

Having developed a theory of feature neutrality and unlike coordination for HPSG, it is now possible to compare it to the other extant HPSG account of these phenomena, namely (Levy 2001).

As mentioned above, Levy uses sets of sets to model neutrality and coordination; the internal sets represent coordination and the external set represents neutrality. In particular, a neutral form like *Frauen* is assigned [**CASE** $\{\{acc\}, \{dat\}\}$], while the coordination of an accusative NP and a dative NP would be given [**CASE** $\{\{acc, dat\}\}$].

Like (Dalrymple and Kaplan 2000), verbs impose a lower-bound constraint of the form [**CASE** α] \wedge $\alpha \supseteq \{\{dat\}\}$ (where the \supseteq symbol can be thought of as “at least”).

The central difference, then, is that Levy does not modify the type hierarchy in any way other than to change the appropriateness conditions on **CASE**: instead of taking values of type *case*, it now takes values of type *set(set(B))*, where *B* is the set of basic cases for the language. Levy thus avoids having both pure and non-pure types. Then, since **CASE** values are no longer ordered with respect to the type hierarchy, the bounded nature of subcategorization must be made explicit with the additional \supseteq constraint. (In the proposal given in section 4, subcategorization is effected directly through supertypes, which implicitly represent the disjunction of all maximally-specific types they dominate.)

When given a fully-neutralizing language, Levy’s double-set lattice and the type hierarchy proposed in section 4D are isomorphic; this is shown in (Levy and Pollard 2002). For a partially-neutralizing language, however, the analysis in section 4 can model this partiality directly, as exemplified by (31) as compared to (30); Levy’s analysis must treat all non-neutralizing combinations of values as accidental gaps.

6. Conclusion

The constraints that relate a mother’s feature values to those of its daughters are quite complex, and this paper only begins to explore the nature of these relationships. By examining **CASE** as both a valence feature (as is relevant to the analysis of feature neutrality) and as an inherent morphosyntactic property (as relevant to the analysis of unlike coordination), I hope to have made some progress in this area.

In general, Ingria’s assessment of unification-based theories of grammar does not apply to constraint-based theories like HPSG: the type hierarchy can directly represent indeterminate feature values as well as coordinations of unlike categories, resulting in a theory of feature neutralization and unlike coordination that does not need to add anything new to the HPSG framework.

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