On a Type-Based Analysis of Feature Neutrality and the Coordination of Unlikes
Michael W. Daniels
The Ohio State University

1. Introduction

(Ingria 1990) argues that both feature neutrality and the coordination of unlikes pose fundamental problems for unification-based theories of grammar[1]. This paper shows that this claim does not apply to constraint-based theories like HPSG. In fact, HPSG's multiple-inheritance type hierarchy provides a means to adequately and accurately analyze these phenomena without recourse to any novel data structures.

I begin by describing the phenomena under discussion, then discuss previous work on this topic, and conclude with the HPSG analysis.

2. Overview of the Phenomena

2A. Feature Neutrality

Many languages allow for a word to be neutral between two or more values of a concord feature. Such forms may appear in configurations that impose conflicting constraints on the value of that feature, as coordinate constructions often do. The German data in (1) present an example of this phenomenon.

(1) 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. The word *Frauen* is neutral between accusative and dative case and is therefore acceptable in this configuration. Sentences (2) and (3) show that agreement with each of the conjoined verbs is mandatory.

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

The noun *Männer* in (2) is accusative and cannot occur with *hilft*, while the noun *Kindern* in (3) is dative and cannot occur with *findet*; both sentences are therefore unacceptable.

Such neutrality contrasts with ambiguity, as illustrated in (4)–(6).

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

Here, 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. Several articles, including (Zaenen and Karttunen 1984) and (Pullum and Zwicky 1986), have tried to predict the distribution of neutrality versus ambiguity. The tests for distinguishing neutrality from ambiguity can be quite elusive, and it is not clear which makes a better null hypothesis.

It has been recognized since (Zaenen and Karttunen 1984) that disjunctive descriptions, commonly used to analyze ambiguity, cannot be used to accurately model neutrality. Since all objects (as opposed to object descriptions) in HPSG must be sort-resolved, a disjunctive description must be resolved in favor of one of the disjuncts. That is, if the object corresponding to *Frauen* in (1) were described by [CASE *acc* ∨ *dat*], sentence (1) could not be licensed: such a description would have to resolve to either [CASE *acc*] (in which case it will not satisfy *hilft*'s selectional requirements) or [CASE *dat*] (which fails to satisfy the requirements of *findet*). 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*] (note that in many frameworks, these situations are mathematically identical).

2B. Coordination of Unlikes

Now consider the problem of determining the CASE value of the coordinate NP *Männer und Kindern*. Items (7) – (8) 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*).

    (7) Er findet Männer   und Kindern.
            he finds men.ACC and children.DAT
    (8) 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 (9) – (11).

    (9) Er lehrt   Kinder.
            he teaches children.ACC
    (10) Er lehrt   Kindern.
            he teaches children.DAT
    (11) *Er lehrt   Männer   und Kindern.
            he teaches men.ACC and children.DAT

Here, 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.

Verbs like *lehren* stand in contrast to those with neutral selectional requirements, illustrated by the following Russian data from (Levy 2001). Under certain circumstances, some Russian verbs can take either accusative or genitive complements. These verbs can also take a coordinate complement where one of the conjuncts is accusative and the other is genitive. This is shown in (12).

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

This is essentially the same problem as 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 (13), where the conjuncts are an NP and an AP, respectively.

(13) He is a republican and proud of it.

In HPSG, the concept of category (i.e. the value of the CAT feature) allows for much more fine-grained distinctions: since the CASE value of the conjuncts in (7) differ, they too can be said to be mutually-unlike categories.

In essence, unlike coordination can be seen as 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.

This leads to one central question: If we take coordinate phrases to be phrases just like any other, such that they have all of the features that simplex phrases do (like valence, and case, and so on), how do we determine 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 feature neutrality to criticize the standard treatment of agreement in unification-based grammars, in which objects are subject to identity constraints (i.e. the value of feature X must be Y) which they must satisfy. 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).
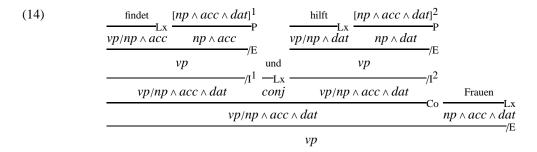
Thus, in a sentence like (1), the verb *hilft* traditionally imposes the requirement [CASE *dat*] on its object, while the verb *findet* requires [CASE *acc*]. No single object can meet both of these constraints.

Instead, in Ingria's proposal, [CASE *acc* $\lor$ *dat*] is non-distinct from both [CASE *dat*] (the selectional requirement of *hilft*) and [CASE *acc*] (the selectional requirement of *findet*), so it is an acceptable CASE value for *Frauen*.

This approach is unsuitable as a general approach to agreement, however. In languages with NP-internal (i.e. determiner-noun or noun-adjective) concord where both agreeing elements are neutral, the resulting NP acts externally as if its agreement properties were the intersection of the component neutralities. So while *der* is neutral between MASC.NOM.SG, FEM.DAT.SG, FEM.GEN.SG, and GEN.PL, and *Dozenten* is neutral between MASC.GEN, MASC.ACC, MASC.DAT, and MASC.NOM.PL, the noun phrase *der Dozenten* can only be MASC.GEN.PL. There is no way to account for this with Ingria's non-distinctness check. In essence, Ingria's account forces NP-internal agreement to be treated as a phenomenon completely different from other types of agreement.

3B. Bayer and Johnson 1995

Working within the framework of Lambek categorial grammar, (Bayer and Johnson 1995) presents an account of feature neutrality and unlike coordination that takes advantage of a certain type-logical theory of categories. Their analysis of (1) is given in (14).

(14)

$$
\begin{array}{c}
\cfrac{
  \cfrac{
    \cfrac{\text{findet}}{vp/np \land acc}\text{Lx} \quad \cfrac{[np \land acc \land dat]^1}{np \land acc}\text{P}
  }{
    \cfrac{vp}{vp/np \land acc \land dat}\text{/I}^1
  }\text{/E}
  \quad \cfrac{\text{und}}{conj}\text{Lx} \quad
  \cfrac{
    \cfrac{\text{hilft}}{vp/np \land dat}\text{Lx} \quad \cfrac{[np \land acc \land dat]^2}{np \land dat}\text{P}
  }{
    \cfrac{vp}{vp/np \land acc \land dat}\text{/I}^2
  }\text{/E}
}{
  \cfrac{vp/np \land acc \land dat \quad \text{Frauen}/np \land acc \land dat}{vp}
}
\end{array}
$$

In this derivation, the introduced arguments are weakened from $np \land acc \land dat$ to $np \land dat$ and $np \land acc$, respectively. This

allows each verb to combine with the introduced argument, forming categories which can be conjoined and combined with the actual argument *Frauen*. Similarly, unlike coordination is treated by weakening a category like *np* to *np* ∨ *ap*. This is illustrated in (15).

(15)

$$
\begin{array}{c}
\begin{array}{cc}
\dfrac{\text{wealthy}}{ap}\text{Lx} & \dfrac{\text{a republican}}{np}\text{Lx} \\
\end{array} \\
\end{array}
$$

wealthy ———Lx   a republican ———Lx
            ap   and   *np*
        ———Wk ─Lx ———Wk
became *np* ∨ *ap* *conj* *np* ∨ *ap*
———Lx ——————————————Co
vp/*np* ∨ *ap*   *np* ∨ *ap*
——————————————————————/E
                    vp

While this seems to be a quite elegant solution to the problem, (Bayer 1996) points out problems with the treatment of neutrality across features. In particular, a form neutral between NOM.PL and GEN.SG is represented by the meet of (*np* ∧ *nom* ∧ *plural*) and (*np* ∧ *gen* ∧ *singular*), which is (*np* ∧ *nom* ∧ *plural* ∧ *gen*∧ *singular*). This category can be weakened to (*np* ∧ *gen* ∧ *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[2].

3C. Dalrymple and Kaplan 2000

(Dalrymple and Kaplan 2000) provides 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 a set of the values between which the form is neutral.

Thus in their analysis of (1), *Frauen* has [CASE {*acc*, *dat*}]. The verb *hilft* requires that its argument's CASE value have *dat* as a member, and similarly *acc* for *finden*. *Frauen* meets these conditions and (1) 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.

Another problem is that this approach strips sets of having any intrinsic meaning in the LFG framework. Sets can be used to represent collections of arbitrary numbers of items, neutral values, coordinations, and feature decompositions.

3D. Levy 2001

(Levy 2001) presents an HPSG-based approach in the spirit of (Dalrymple and Kaplan 2000) that centers around a new kind of object called a double-set. A neutral form like *Frauen* has a CASE value of {{*acc*}, {*dat*}}, and verbs impose a constraint like $\left[\text{CASE }\boxed{1}\right] \wedge \boxed{1} \trianglerighteq$ {{*dat*}} (essentially a lower-bound).

What makes this a particularly elegant theory is that the same data structure can also be used to handle unlike coordination: the coordination of an accusative NP and a dative NP would have CASE value {{*acc*, *dat*}}.

As presented, the theory only handles neutralization of a single feature. Levy speculates that his theory can handle neutrality across features (27–29) and suggests some potential avenues for further exploration.

Finally, one difference between this theory and the one proposed here concerns the treatment of non-fully-neutralizing languages. I use this term to refer to those languages where not every possible neutralization can be realized by a

---

[2] (Dörre and Manandhar 1995) may provide a categorial approach that resists this criticism (Martin Jansche, p.c.).

linguistic object. For example, (Dyla 1984) shows that while forms neutral between accusative and genitive case exist, forms neutral between nominative and accusative case do not exist.

When given a fully-neutralizing language, Levy's double-set lattice and the type hierarchy I will propose in section 4D are isomorphic. As explained below, my hierarchies will generally be smaller than Levy's lattice for any particular language.

4. A Type-Based Approach

The analysis presented in this section differs from the proposals discussed in the previous section in three main ways. It adds no new data structures or mechanisms to HPSG; it retains the use of structure-sharing in effecting agreement, and it shows how a single analysis can account for both NP-internal and -external agreement.

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. Using the type hierarchy given in (Pollard and Sag 1994) as a starting point, I consider 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: *binary-coord-phrase* and *iterated-coord-phrase*.

A *binary-coord-phrase* is licensed whenever the first daughter has $\left[\text{MARKING } \alpha_0\right]$ and the second daughter has $\left[\text{MARKING } \alpha_1\right]$ for some α. (Sag et al. 1985) gives the requirement $\alpha = \{\{both, and\}, \{either, or\}, \{unmarked, but\}\}$ while noting that the set of possible values for α is highly subject to idioletical variation.

Similarly, an *iterated-coord-phrase* is licensed whenever the first daughter has $\left[\text{MARKING } \beta_0\right]$, the last daughter has $\left[\text{MARKING } \beta_2\right]$, and all other daughters have $\left[\text{MARKING } \beta_1\right]$ for some β. Here $\beta \in \{\{unmarked, and, and\}, \{unmarked, unmarked, and\}, \{unmarked, unmarked, or\}, \{unmarked, or, or\}, \{neither, nor, nor\}\}$; this too may vary widely among idiolects.
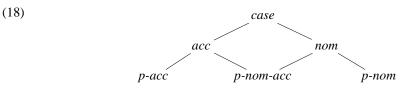
4B. Feature Neutrality

In the (Levine et al. 2001) treatment of parasitic gap constructions (as is standard in GPSG- and HPSG-style analyses of this phenomenon), a single object is used to represent the local properties of both the host and parasitic gaps. When different case requirements are imposed on the two gaps, the resulting sentence is only acceptable when the filler is case-neutral. This is illustrated in (16) and (17).

    (16) *whom even friends of ＿ believe ＿ should be closely watched.
    (17)   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) augments the type hierarchy with three new types: a neutral type *p-nom-acc* and two 'pure' subtypes *p-nom* and *p-acc*, as given in (18)[3].

---

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

(18)

$$
\begin{array}{c}
\textit{case} \\
\diagup \qquad \diagdown \\
\textit{acc} \qquad\qquad \textit{nom} \\
\diagup \quad \diagdown \qquad \diagup \quad \diagdown \\
\textit{p-acc} \qquad \textit{p-nom-acc} \qquad \textit{p-nom}
\end{array}
$$

Note that this is not part of the subsumption hierarchy of feature structure descriptions (which would have nodes corresponding to descriptions like *p-nom* ∨ *p-acc*) but merely a part of the type hierarchy showing which types are subtypes of which others.

Here, the type *p-nom-acc* represents neutrality between nominative and accusative case[4]; 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 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 appropriate for object descriptions, such as those found in valence constraints. A typical finite English verb selects complements with [CASE *acc*] and subjects with [CASE *nom*].

Then, as a description like [CASE *acc*] abbreviates the disjunction ([CASE *p-acc*] ∨ [CASE *p-nom-acc*]), the result of unifying [CASE *acc*] and [CASE *nom*] (as found in (17), for example) is no longer failure, but instead the constraint [CASE *p-nom-acc*].

In this kind of hierarchy, then, the central distinction is between types which begin with *p-* (which I will call 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 (the type at the bottom of the hierarchy) is both pure and non-pure.

Just as (18) serves as a case hierarchy for English, so may a similar hierarchy be constructed for German, which has a four-case system. 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 (1) is now straightforward. Recall that the verb *findet* imposes the constraint [CASE *acc*] on its object and *hilft* imposes the constraint [CASE *dat*] on its object. To determine the valence of a coordination from the valence of its conjuncts, the constraint in (19) is needed.

$$
(19) \quad \textit{coord-phrase} \rightarrow \begin{bmatrix} \text{VAL} & \boxed{2} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{VAL} & \boxed{2} \end{bmatrix}, \begin{bmatrix} \text{VAL} & \boxed{2} \end{bmatrix} \right\rangle \end{bmatrix}
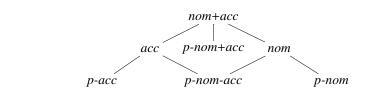$$

Thus the constraint that *findet und hilft* imposes on its object is the weakest that is consistent with both [CASE *acc*] and [CASE *dat*]: namely, [CASE *acc-dat*]. The word *Frauen* is listed in the lexicon as [CASE *p-nom-acc-dat-gen*], which is consistent with [CASE *acc-dat*]. The word *Frauen* is therefore an acceptable object for *findet und hilft*.

---

[4] When reading the type names, it is important to take the *p-* prefix as having scope over the rest of the name.
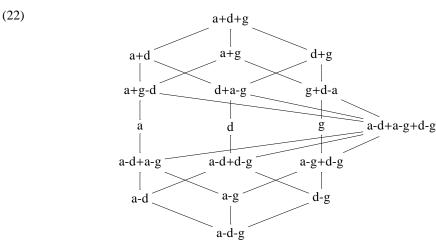
4C. Coordination of Unlikes

As seen above in (7) – (8), the CASE value of *Männer und Kindern* cannot be either *dat* or *acc* (or any subtype thereof). Instead, it must be a type more specific than *case* but less specific than *acc* or *dat*: a sort-resolved version of *acc* ∨ *dat*. I therefore introduce such a type *p-acc+dat* into the hierarchy (just as the hyphen mnemonically represents neutrality, the plus sign indicates coordination) as shown in (20).

(20)

```
                          nom+acc
                 ╱          │          ╲
             acc      p-nom+acc      nom
            ╱        ╱              ╲
      p-acc      p-nom-acc            p-nom
```

Recall that every non-pure type has a corresponding pure subtype and vice versa. Thus future diagrams like these can be considerably simplified by simply leaving out the pure types; their presence will be implicit from now on. Under this convention, (20) appears as in (21).

(21)

```
              nom+acc
          ╱            ╲
       acc              nom
          ╲            ╱
            nom-acc
```

To more fully illustrate the range of possibilities, it will be helpful to consider a three-valued case system. The corresponding diagram for such a system appears as (22).

(22)

```
                        a+d+g
                 ╱        │        ╲
          a+d          a+g          d+g
             │      ╳      ╳      │
          a+g-d       d+a-g       g+d-a
             │           │              ╲
             a           d           g    a-d+a-g+d-g
             │      ╳         ╳         ╱
        a-d+a-g     a-d+d-g     a-g+d-g
             │    ╳           ╳    │
          a-d          a-g          d-g
             ╲           │          ╱
                        a-d-g
```

(Note that in any expression containing both − and + signs, the − should take scope over the +. The lack of a row of types with the form *(a+g)-d* is deliberate: I postulate that no human language needs forms that are neutral between a case and a coordination of two other cases.)

This system is fully neutralizing: every possible neutralization of cases has an instantiation. Not all natural languages are fully neutralizing. A sample hierarchy for a three-case language where one particular combination of cases (here, nominative and accusative) fails to neutralize is given in (23).

(23)

```
                              a+n+g
                           /    |    \
                    a+n      a+g      n+g
                       \  X  /  \  X  /
                    a+g-n      n+a-g
                       |      /   |   \
                    a         n         g
                     \         |        /
                           a-g+n-g
                          /        \
                    a-g              n-g
                       \            /
                          a-n-g
```

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, must be represented by 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'[5]. The practical effect of this is that a coordination is at most as valent as its least-valent component.

This principle allows the analysis of all of the phenomena presented so far. For example (taking the hierarchy in (22) as an approximation of German), 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 (22) 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 assigned [CASE *p-acc*]. This coordination can therefore 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*] (the lowest type which is a supertype of both *acc* and *dat*) and cannot satisfy either of the constraints [CASE *acc*] or [CASE *dat*], as desired.

To account for the Russian data in (12), which illustrated selectional neutrality, note that a coordination with [CASE *p-gen+acc*] can be selected by the constraint [CASE *gen+acc*].

With the contrasting case of selectional ambiguity (recall (11)), the verb *lehren* is [COMPS ⟨[CASE *acc* ∨ *dat*]⟩] (rather than [COMPS ⟨[CASE *acc+dat*]⟩]). Thus the coordination *Männer und Kindern*, with [CASE *acc+dat*], is an acceptable object for this verb.

The acceptability of (13) can now be explained if it is assumed 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 –

---

[5] In formal terms, z' is constrained to be the least upper bound of x' and y' with respect to the isa* relation.

a join on non-pure types. For valence requirements, such as those from conjoined verbs as in (1), 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

It will be obvious by this point that the examples analyzed so far have been simplified: in many cases, one affix or word can encode the value of multiple agreement features, as shown for German in (24).

> (24) der Antrag des   oder der   Dozenten
>   the petition of-the.GEN.SG or   of-the.GEN.PL docent.MSC.GEN.(SG/PL)
>   'the petition of the docent(s)'

It is not enough to say that *Dozenten* is neutral between singular and plural number: this is not true in the nominative case, as seen in (25).
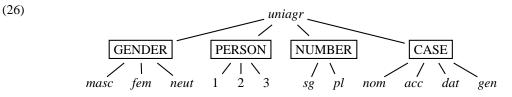
> (25) *der   Dozenten ist hier.
>   the.NOM.SG docent   is here.

Similarly, the determiner *der* is neutral between MSC.NOM.SG, FEM.DAT.SG, FEM.GEN.SG, and GEN.PL.

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 ¬*nom*] ∧ [NUM *sg*]) ∨ ([NUM *pl*]) in the same way that [CASE *nom*] ∨ [CASE *acc*] was replaced with [CASE *p-nom-acc*].

For illustration, consider a variation on the Russian verb in (12) that may take either NOM.SG or ACC.PL objects (but not NOM.PL or ACC.SG). That verb cannot be selecting [CASE *p-nom-acc*], as that would improperly exclude non-neutral forms. Neither can it select for [CASE *nom* ∨ *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.

> (26)

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 (18), so could these values of UNIAGR form the basis of a unified agreement hierarchy for German.

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 certainly define a *same-case* relation such that *same-case*([1], [2]) holds exactly when [1] and [2] are of types whose CASE dimensions are the same. Similar relations could be defined, as needed, for NUMBER, GEND, and PERS. 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. 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.

Works Cited

Bayer, Samuel. 1996. The coordination of unlike categories. *Language 72*(3), 579–616.

Bayer, Samuel and Mark Johnson. 1995. Features and agreement. In *Proceedings of the Thirty-Third Annual Meeting of the Association for Computational Linguistics* 70–76. Cambridge, Massachusetts.

Corbett, Greville. 1983. Resolution rules: Agreement in person, number, and gender. In Gerald Gazdar, Ewan Klein, and Geoff Pullum, eds., *Order, Concord, and Constituency* 175–206. Dordrecht: Foris.

Dalrymple, Mary and Ronald M. Kaplan. 2000. Feature indeterminacy and feature resolution. *Language 76*(4), 759–798.

Dörre, Jochen and Suresh Manandhar. 1995. On constraint-based Lambek calculi. Technical Report HCRC/TR-69 University of Edinburgh.

Dyla, Stefan. 1984. Across-the-Board dependencies and Case in Polish. *Linguistic Inquiry 15*(4), 701–705.

Ingria, Robert J. P. 1990. The limits of unification. In *Proceedings of the Twenty-Eighth Annual Meeting of the Association for Computational Linguistics* 194–204. Pittsburgh, Pennsylvania.

Kathol, Andreas. 1999. Agreement and the syntax-morphology interface in HPSG. In Robert Levine and Georgia Green, eds., *Studies in Contemporary Phrase Structure Grammar* 223–274. Stanford: CSLI.

Levine, Robert, Thomas Hukari, and Michael Calcagno. 2001. Parasitic gaps in English: Some overlooked cases and their theoretical implications. In Peter Culicover and Paul Postal, eds., *Parasitic Gaps* 181–222. Cambridge, MA: MIT Press.

Levy, Roger. 2001. Feature indeterminacy and the coordination of unlikes in a totally well-typed HPSG. Unpublished draft of March 19, 2001. Available from `http://www.stanford.edu/~rog/`.

Müller, Stefan. 2001. Case in German: Towards an HPSG analysis. In W. Detmar Meurers and Tibor Kiss, eds., *Constraint-Based Approaches to Germanic Syntax* 217–256. Stanford: CSLI.

Pollard, Carl and Ivan Sag. 1994. *Head-Driven Phrase Structure Grammar*. Chicago: University of Chicago Press.

Pullum, Geoffrey and Arnold Zwicky. 1986. Phonological resolution of syntactic feature conflict. *Language 62*(4), 751–773.

Sag, Ivan. 1997. English relative clause constructions. *Journal of Linguistics 33*(2), 431–483.

Sag, Ivan, Gerald Gazdar, Thomas Wasow, and Steven Weisler. 1985. Coordination and how to distinguish categories. *Natural Language and Linguistic Theory 3*, 117–171.

Zaenen, Annie and Lauri Karttunen. 1984. Morphological non-distinctiveness and coordination. *Eastern States Conference on Linguistics 1*, 309–320.