How can feature-*sharing* be asymmetric? Valuation as UNION over geometric feature structures

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1. Introduction

This paper is about the grammatical process known as 'valuation': the transfer of feature values from one node in the syntactic structure (e.g. a nominal) to another (e.g. a verb or a marker of tense, aspect, or mood). Valuation is often thought of in terms of *copy-and-overwrite* (see, e.g., Chomsky 2000, 2001): the features found on one node are copied onto the other, replacing whatever featural representation may have been present at the target beforehand. One of the central challenges that this copy-and-overwrite approach has faced comes from what I will call "delayed valuation" effects (Andrews 1971, Frampton & Gutmann 2000, 2006, Pesetsky & Torrego 2007, *i.a.*). In section 2, I will discuss this challenge, and outline the main solution that has been put forth to address it: *feature-sharing* (see also Gazdar et al. 1985, Pollard & Sag 1994).

In section 3, I discuss a second challenge to the conventional theory of feature valuation from what I will call "privative valuation" effects (Béjar & Rezac 2003, 2009, Preminger 2009, 2014, *i.a.*): the fact that in syntax, traditional labels like '3rd person', 'singular', and 'nominative' seem to reflect not the presence of valued unmarked features, but the absence of valuation altogether. As has been shown, these effects cannot be handled in terms of extrinsic markedness hierarchies alone; instead, they require a structured representation of privative feature values in the syntax, in the spirit of what Harley & Ritter (2002) had proposed for the morphology of φ-features.[1]

At first glance, these two conclusions concerning feature valuation seem to be at odds with each other. In particular, if there is no representational difference between being '3rd person', 'singular', or 'nominative', and being unvalued, then it is not clear why—in a feature-sharing scenario—one of the featural representations that forms the input to the sharing operation should "win out" over the other, in determining the shared featural representation that results from the operation. I will present the elements of this problem in more detail in section 4.

In section 5, I will offer a possible solution to this puzzle, based on the idea that valuation is the result of a UNION operation, similar to the set-theoretic union operation (cf. Dalrymple & Kaplan 2000) but defined, crucially, over geometric feature structures of the type discussed in section 3.

Section 6 will offer concluding remarks, as well as an attempt to situate this proposal within a system that bifurcates syntactic agreement into *linking* and *copying* sub-components (Arregi & Nevins 2012, Bhatt & Walkow 2013, Marušič, Nevins & Badecker 2015, *i.a.*).

A note on terminology: the term UNION is not to be confused with UNIFICATION, as used in GPSG (Gazdar et al. 1985), HPSG (Pollard & Sag 1994), and elsewhere. For features borne by only one of its operands, UNIFICATION indeed amounts to set-union. But crucially, for features borne

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[1]The claim that Harley & Ritter's (2002) feature-geometries are the correct approach to the *morphology* of person and number has since been called into question (see, e.g., Harbour 2007, 2013). The claim here, however, is about the representation of these features in *syntax* (but see Nevins 2007).

by both operands (as is the case when it comes to agreement relations), UNIFICATION amounts to a representational condition prohibiting the operands from bearing conflicting feature values. A similar representational well-formedness condition is employed in "checking"-based theories in the GB/minimalism tradition. It has been shown elsewhere that theories based on such verification-of-equality conditions—be they UNIFICATION or "checking"—are ill-suited to handle φ-feature agreement (see Preminger 2014:95ff.). This is crucially different from the UNION operation that I propose here, which imposes no such verification-of-equality conditions on its operands.

2. Delayed-valuation effects

The first problem for the conventional, copy-and-overwrite approach to feature valuation comes from delayed-valuation effects. This refers to scenarios where two constituents enter into an agreement relation at a point in the derivation where the relevant feature value, which will ultimately be expressed on both constituents, is not yet available.[2] Subsequently, one of the constituents in question—but not the other—undergoes movement to a position in which an appropriate value can be acquired. And, in the situations in question, the value is then morphologically expressed on *both* of the original constituents (the one that moved, and the one that stayed behind).

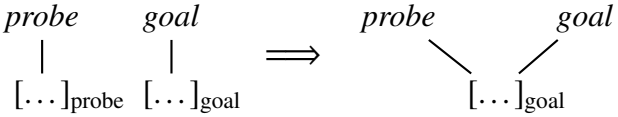
One of the earlier discussion of such effects from a generative perspective is found in Andrews' (1971) work on participial case-concord in Ancient Greek (AG) (see also Ross 1967:80–88, cited by Andrews, on stranded attributive modifiers in Latin).

(1) emmenomen hois ho:mologe:samen dikaiois ousz, e: ou? (AG)
we.abide.by which.DAT we.have.agreed just.DAT being.DAT or not
'Do we abide by those things which we consider just, or not?' [*Andrews 1971:138*]

Two aspects of (1) are of particular importance to the present discussion. First, the morphology on the participial predicate (*dikaiois ousz* "just.DAT being.DAT") is determined by the case found on the relative pronoun *hois* ("which.DAT")—in this instance, dative. Second, the relative pronoun bears the case that it does by virtue of the syntax of the matrix clause—in this instance, dative case is assigned by the verb *emmenomen* ("we.abide.by") to its complement.

Assuming that the nominal and the participial predicate are base-generated in some sort of small-clause configuration, it is surprising to find that a case value that is assigned in a derived position can be transmitted back to the "stranded" participial predicate.

This puzzle, and others like it, have led in recent years to the proposal that valuation results not in the copying of features, but in *feature-sharing* (Frampton & Gutmann 2000, 2006, Pesetsky & Torrego 2007, *i.a.*). The central idea is that when two constituents enter into an agreement relation, the result is one single feature bundle, that is subsequently shared by both constituents:

(2) 

[*cf. Frampton & Gutmann 2006:128*]

[2] Or, in representational terms: two constituents that are not lexically specified for a particular feature value are local to each other only in one part of the structure; the element that is lexically specified for the relevant feature value is in a distant part of the structure; and only one of the two original constituents has an occurrence/instance that is local to this third, lexically-specified element. But the feature value in question is expressed on all three.

Further modifications to this feature bundle (e.g. a later valuation operation applying to it) will then appear to affect both constituents. And crucially, this will be so even if the two constituents in question are no longer local to one another, by the time this further modification occurs.

In an example like (1), then, the relative pronoun and the participial predicate enter into a feature-sharing relation at their base positions (e.g. within the small-clause projected by the participial predicate). From this point on, the feature bundle associated with the relative pronoun and the feature bundle associated with the participial predicate are literally one and the same syntactic object. Consequently, whatever mechanism it is that allows the case assigned by the verb *emmenomen* ("we.abide.by") to affect the case of the relative pronoun will automatically affect the features of the stranded participial predicate, as well.

3. Privative-valuation effects

The second problem for the conventional view of feature valuation concerns what it is, exactly, that gets transmitted when valuation occurs. Traditionally, features like PERSON, NUMBER, and GENDER (or NOUN-CLASS) are thought of as multivalent attributes; and to bear "valued features" is to have a specified value for each of these attributes (e.g. *2nd person*, *dual*, and *feminine*, respectively). Setting aside, for the moment, the issue of feature-sharing (§2), valuation would then consist in copying a series of attribute-value pairs (e.g. {PERSON:*2nd*, NUMBER:*dual*, etc.}) from one syntactic node to the other.

But this flat, multivalent representation of feature values has proven inadequate, at least with respect to φ-features and case. Considerations of space preclude a faithful reproduction of the arguments here, but they hinge on configurations where one can show that taking categories like '3rd person', 'singular', and 'nominative' to involve actual valuation yields incorrect predictions elsewhere in the grammar. Instead, the picture that emerges is one in which, e.g., so-called "singular morphology" on a functional element is simply what one finds when the element has *not* entered into a successful agreement relation with a bearer of [plural]. Crucially, this could be because there was no bearer of [plural] to be agreed with in the first place (e.g. the relevant nominal, that is being agreed with, is singular), or because the agreement relation has been somehow disrupted. And this has a parallel in the realm of case morphology: "nominative" on a noun phrase is simply what one finds when a noun phrase has failed to acquire case values like, e.g. [dependent]. See Preminger 2009, 2011, 2014, Kornfilt & Preminger 2015, and Levin & Preminger 2015, among others, for further discussion.[3] (It is crucial, in this respect, that we not lose sight of the distinction between 'unmarked' case, e.g. nominative, and 'default' case, e.g. accusative in English; see Schütze 2001, *i.a.*.)

Like the delayed-valuation effects discussed in section 2, capturing these effects necessitates a departure from the conventional model of agreement and valuation (as articulated in, e.g., Chomsky

[3]The works cited here are by no means the earliest to suggest something of this sort. Concerning case, the reader is referred to Bittner & Hale (1996:2–7) and Asbury (2008:130–132)—as well as Caha (2009), who proposes that all case values stand in a hierarchical relation to one another. To get the result argued for by Preminger (2011, 2014), Kornfilt & Preminger (2015), and Levin & Preminger (2015), the only modification one would need to make to Caha's system is that nominative, instead of being represented in its own right, be represented by the *absence* of the representations associated with accusative, dative, and so on. Concerning φ-features—and in particular, 3rd person—similar ideas can be found as far back as Forchheimer 1953. What is important for the current purposes, however, is the claim that the relevant categories ('3rd person', 'singular', 'nominative', etc.) represent the absence of feature values *in the syntax*—and it is not clear, at least to me, that Forchheimer can be understood as making that particular claim.

2000, 2001). In the conventional model, an agreeing category (e.g. a finite verb) that has *failed* to have its features overwritten by those of an appropriate agreement controller (e.g. a nominal argument) is an illegitimate syntactic object. Instead, we need a theory in which agreeing with, e.g., a singular noun phrase is—for number-agreement purposes—akin to not having agreed with anything at all. One approach to this might be a view of φ-features as unstructured sets of privative values (cf. Dalrymple & Kaplan's 2000 s(PEAKER) and H(EARER) features, for example). However, as shown by Harley & Ritter (2002), such an approach misses significant generalizations; in particular, certain phenomena require recourse to a (positively-specified) feature borne by all non-3rd-person nominals (1st person exclusive, 1st person inclusive, and 2nd person). And as shown in Preminger 2011, 2014, such a feature must be active within syntax proper, since it is required in order to account for omnivorous person effects in languages like Kaqchikel (and other languages of the Kichean branch of Mayan):

(3) a. ja rat x-**at**-ax-an ri achin
FOC you(sg.) COM-**2sg**-hear-AF the man
'It was you(sg.) that heard the man.'

b. ja ri achin x-**at**-ax-an rat
FOC the man COM-**2sg**-hear-AF you(sg.)
'It was the man that heard you(sg.).'

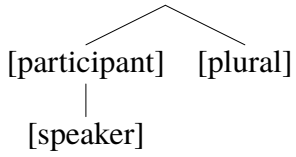
(4) a. ja yïn x-**in**-ax-an ri achin
FOC me COM-**1sg**-hear-AF the man
'It was me that heard the man.'

b. ja ri achin x-**in**-ax-an yïn
FOC the man COM-**1sg**-hear-AF me
'It was the man that heard me.'

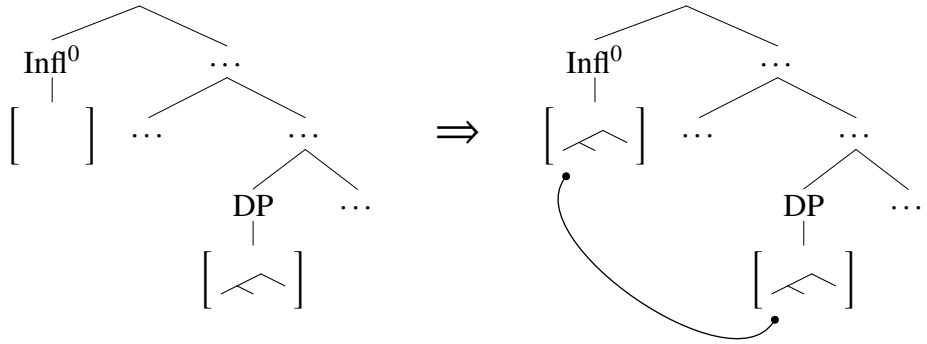
(5) ja ri xoq x-ϕ-tz'et-ö ri achin
FOC the woman COM-3sg.ABS-see-AF the man
'It was the woman who saw the man.'

I have argued (Preminger 2014:39ff.) that these privative-valuation effects arise because what gets probed for and transmitted under agreement is feature-geometric representations along the lines proposed by Harley & Ritter (2002):

(6) a. A SIMPLIFIED φ-FEATURE GEOMETRY[4]



b. FEATURE-GEOMETRIC VALUATION



Thus, in examples like (3a–b, 4a–b, 5), what is being probed for is not nominalhood or φ-features in general, but specifically [participant] (though see Preminger 2014:54ff. for some important caveats, in particular concerning the morphosyntactic clitichood of the relevant agreement markers).

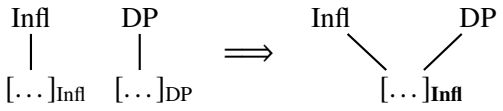
On the approach sketched in (6a–b), agreement with a singular argument will look like no agreement at all (as far as number agreement is concerned) because the representation of 'singular' is simply the absence of the [plural] dependent in the φ-feature geometry (cf. (6a)). Thus, both scenarios—agreement with a singular nominal, and no agreement at all—involve a failure to locate an accessible [plural]-bearing nominal target; and so both scenarios result in the same representation on the probing head.[5]

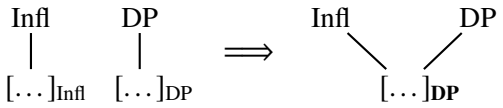
4. The problem

In this section, I will highlight an apparent puzzle that arises when one juxtaposes the conclusions of section 2 (feature sharing) with those of section 3 (feature-geometric valuation).

Consider, first, the initial representation in (6b), above. This is the representation of a clause prior to Infl^0 probing for a DP with which to agree. But notice that, in feature-geometric terms, the feature content of Infl^0 at this stage of the derivation is already a valid φ-featural representation: the absence of [participant], [plural], and so forth means that Infl^0 already bears the feature structure it would bear had it *already successfully agreed with a 3rd person singular nominal*.

Now consider the view of valuation as feature sharing (§2). On that view, the post-valuation representation involves linking both nodes to the feature-structure originally borne by the valued member of the agreement relation. The problem is that, given the results in section 3, each of the nodes entering into this agreement relation already carries a valid φ-featural representation; on what grounds, then, should sharing favor one outcome in (7a–b) over the other?

(7) a. 

b. 

Note that the choice between (7a) and (7b) is empirically consequential. If the grammar were to choose (7a), it would mean that agreement between Infl^0 and *any* DP would result—regardless of

[4] In this (radically) simplified φ-feature geometry, [plural] is the feature that distinguishes plural expressions from all other nominal expressions; [participant] is the feature that distinguishes 1st/2nd person pronouns from all other expressions; and [speaker] further distinguishes 1st person pronouns from all other [participant]-bearers. See Harley & Ritter (2002) and McGinnis (2005), *i.a.*, for much more detailed discussion.

[5] A reviewer raises a question concerning the apparent similarity between (6b) and syntactic movement *qua* Internal Merge. Considerations of space preclude me from discussing this important issue in sufficient detail here, but I will mention a few relevant considerations. On the one hand, if one were to adopt the assumptions of the *Nanosyntax* framework (Starke 2009), whereby syntactic terminals may not contain (or consist of) more than a single syntactic feature, then as best I can tell the conclusion that (6b) amounts to syntactic movement becomes inescapable. On the other hand, viewing (6b) as an instance of movement raises nontrivial questions regarding cyclicity in general and the Extension Condition in particular (since the node being modified, Infl^0, is not the root of the entire structure). Perhaps this concern could be folded-in with similar concerns regarding head movement, and could even be afforded a similar solution (Matushansky 2006).

the DP's initial features—in 3rd person singular agreement morphology. And, more damagingly, it would result in the DP's own features being changed to 3rd person singular.

One could imagine various ways to ensure that (7b) is consistently chosen. For example, the grammar could consult an extrinsic markedness hierarchy in evaluating which of the two pre-existing feature structures ends up surviving under feature-sharing. In addition to being ad hoc, however, such a solution would seem to duplicate the very markedness asymmetries already encoded in the φ-feature geometry itself.

Another possibility would be "reading the asymmetry off of the structure" so to speak, which could be done in a number of ways. Assuming that agreement is subject to a consistent structural condition that probes must c-command their goals, one could posit that the c-commander must always have its features replaced by the c-commandee. This approach would run into problems, however, with sisterhood relations (which entail mutual c-command). Assuming we do not want to categorically rule out agreement under sisterhood, this solution will not do. An alternative would be to appeal to the head vs. phrasal status of the operands; but this again runs into problems if the goal happens to be non-branching and if, adopting Bare Phrase Structure (Chomsky 1994), we reject the primitive distinction between heads and phrases. That is because, in such a case, both operands would be "heads" in the relevant sense.

Finally, we could bite the bullet and resort to a diacritic: a specification on Infl stating that it must (try to) have its features replaced by the features of another node. At first glance, this seems almost unavoidable. Regardless of the asymmetry issue sketched in (7a–b), something must cause probing by Infl; and given the results surveyed in §3, the cause cannot be the φ-featural state of Infl before probing (since, as noted, the initial state of Infl is already a viable φ-featural representation, *viz.* 3rd person singular). Thus, the results surveyed in §3 already countenance an "I must act as a probe" diacritic. The question is only whether this diacritic can serve to solve the asymmetry problem noted here, concerning which feature-set will be replaced by another; and I argue that it cannot.[6] The reason is that the probe-goal asymmetry is *contextual*; a node that is a probe at an earlier stage in the derivation can serve as a goal at a later stage, and vice versa.

Examples of probes that subsequently act as goals abound. For instance, any articulated theory of DP structure where number features originate lower than D (following Ritter 1991, 1992), coupled with the view of DP as a locality domain, entails that number features must reach the D(P) layer despite not originating there. But of course, D(P) and its number features are able to subsequently act as goals for probing by, e.g., an Infl node.[7]

It is the converse pattern, however, that is of relevance here: a node acting first as a goal, and subsequently as a probe. The stranded participial predicate data in §2 instantiates this pattern: assuming that participial modifiers that exhibit case-concord with the nominal that they modify are probes (for which the nominal acts as a goal), it follows that the moving nominal in (1) first acts as a goal for its participial modifier. But it acquires valued case features later in the derivation, meaning it acts as a probe *after* having acted as a goal. If it were the "I must act as a probe" diacritic that resolved the asymmetry in (7a–b), then it would be the case features on the nominal that would be replaced by those on the participial predicate (since, to explain (1), we must assume that the nominal bears the relevant diacritic). This, in turn, means that in all instances where—unlike in (1)—a nominal receives case in situ, replacement of the nominal's case features with

[6]Thanks to the reviewers for thought-provoking discussion of this issue.

[7]For a concrete example of this derivational dynamic and its consequence, see Preminger 2009:628–635.

those of the participial predicate would be the last word on case-concord. That falsely predicts that all such in situ configurations would exhibit nominative morphology (i.e., the absence of valued case features), regardless of the syntactic environment.[8]

I therefore conclude that the (contextual) asymmetry between probes and goals will not serve to resolve the asymmetry in (7a–b). In the next section, I propose that strictly speaking, neither (7a) nor (7b) is correct; and that the feature structure that results from sharing is not the product of replacing one set of features with another, but of a *set-union*-like operation carried out over the two input geometries.

5. A solution

In this section, I propose that the product of feature sharing is not arrived at by picking one of the two input representations outright; instead, it arises combinatorially, as the output of an operation performed over both inputs. It has previously been proposed—most notably, perhaps, by Dalrymple & Kaplan (2000)—that certain syntactic operations involve *set-union* over φ-featural representations.[9] As noted above, however, representing φ-features as unstructured sets of privative features is inadequate; 'meta-nodes' such as [participant] (see (6a)) are required, for both syntactic and morphological reasons.

Here, I propose a counterpart of the set-theoretic UNION operation, which is defined over feature-geometric representations of the kind discussed in section 3, rather than over unstructured sets:

(8) FEATURE-GEOMETRIC UNION

Let x and y be two feature-geometric representations. $z = \textsc{union}(x, y)$ is defined as follows:

(i) for r, the absolute root[10] of the feature geometry: $r \in z$;

(ii) for every feature-geometric node $n \in z$, and for every node d that is a feature-geometric dependent of n: $d \in z$ **iff** $d \in x$ or $d \in y$.

Because a node cannot be a member of one of the input geometries unless its parent (in the complete geometry) is also a member of the same input geometry, the output of (8) is guaranteed to be a well-formed feature-geometric representation.

This captures the fact that when a node with no feature values enters into a feature-sharing relation with a node that carries (marked) feature values, it appears that the system simply "chooses" the node with marked features as the output of sharing (cf. (7a–b), above). On this proposal, that is a consequence of the disjunctive clause in (8.ii), along with the privative nature of marked features (at least within syntax; see fn. 1). Also derived is the fact that the output of feature sharing is readily usable as input to a subsequent feature-sharing relation. There is no need to mark the resulting feature structure as still 'active' or some such; it is a viable input to a subsequent application of (8) simply by virtue of being a feature-geometric object.[11]

[8] This would be the case-theoretic counterpart of the false prediction generated by (7a), that all nominals would end up with 3rd person singular morphology.

[9] For Dalrymple & Kaplan (2000), the resolution of PERSON, GENDER, and MORPHOLOGICAL CASE in coordination structures is achieved via set-union.

[10] E.g. Harley & Ritter's (2002) REFERRING EXPRESSION node.

6. Some concluding remarks

In this paper, I have presented two recent developments in the theory of syntactic agreement—feature sharing, and feature-geometric agreement—along with very brief synopses of the kinds of facts that have motivated each of the two. I then presented an apparent puzzle that arises when these two results are juxtaposed with one another: given that a complete lack of values is itself a valid φ-featural representation (*viz.* 3rd person singular), why would feature-sharing consistently choose the more marked of its two operands as the output of the sharing operation? In section 5, I proposed a solution in terms of a UNION operation defined not over sets, but over feature-geometric representations (8).

One might wonder how to situate this proposal in the context of recent approaches that bifurcate the pre-theoretic notion of 'agreement' into two components: one that establishes a link between the probe and the goal, and is operative in syntax; and the other that transfers actual morphological content from the goal to the probe, and operates postsyntactically (Arregi & Nevins 2012, Bhatt & Walkow 2013, Marušič, Nevins & Badecker 2015, *i.a.*). Following others, I will refer to these components as *Agree-Link* and *Agree-Copy*, respectively.

Since the proposed feature-geometric UNION operation determines the morphosyntactic features that each node will ultimately bear, it is tempting to place it squarely within the *Agree-Copy* component, and hence squarely outside of syntax. But recall that the crucial motivation for feature sharing, in the first place, came from instances in which the result of valuation was then transmitted over unbounded structural distances (cf. the "stranded participial predicate" effects discussed in section 2). Insofar as there is a meaningful distinction between the computations we label as 'syntax' and those which we label 'morphology'/'post-syntax', nonlocality of this kind is as unambiguous an indicator of the syntactic nature of a given relation as one could ever find. I therefore suggest that the relevant UNION operation must be thought of as part of syntax proper. Any linearization-sensitive effects attributed to *Agree-Copy* should then be seen as overriding the features already transmitted under *Agree-Link* (instead of taking *Agree-Copy* to be the sole mechanism for transmitting feature values).

Finally, note that the kind of facts that motivated Dalrymple & Kaplan's (2000) set-union approach to φ-feature agreement were very different from the facts considered here, and primarily involve instances of conflict resolution—e.g. what happens when the agreement controller consists of a coordination of two differently-valued nominals. Whether their results can be preserved under the current, feature-geometric approach is a question that I leave for future work.

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[11] We have not eliminated the need, in this system, to extrinsically designate those nodes that engage in probing in the first place; see §4 for discussion.

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