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Decomposing Number Features

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1 Introduction

It is widely assumed that the morphological expression of number is dependent on dedicated number features like (±)singular, (±)plural, (±)augmented, Minimal, Group, etc (Noyer, 1992, 1998; Harley and Ritter, 2002; Corbett, 2000; Harbour, 2003a), among others. Though there are differences in opinions about what features exist in the ontology, it is essentially uncontested that morphological number includes, at some level, at least singular and non-singular categories. In this paper, I offer a counter-view, arguing that the features that underlie the morphological expression of number are "decompositional," in much the same way that standard semantic theories treat number (Link, 1983; Schwarzschild, 1992). Non-singular morphology is the result of mapping a set of multiple "atomic" features to an exponent. In short, there are no number features *per se*, rather plural is built from singular. I show that such a reanalysis allows a simple and intuitive explanation for a range of diverse phenomena, in particular, cases where there appears to be a mismatch between the features introduced in the derivation, and the features expressed by the morphology.

The argument is built on the empirical domain of *local effects*, or *Local Person Portmanteaux*,[1] in verbal agreement (Heath, 1991, 1998; Georgi, 2012). Local effects arise in local contexts, where a 1st or 2nd person (i.e., an individual who is "local" to the speech act) acts on another 1st or 2nd person (non-reflexively), and the resulting agreement morphology diverges from the expected pattern in the language. Such contexts have been described as "opaque and irregular" (Heath, 1998) with respect to the agreement morphology, since in many languages, unpredictable portmanteau forms are used in these contexts. The irregularity of local effects has recently been analyzed as an instance where the morphological component spells out a feature bundle comprising features from distinct syntactic sources (Bobaljik and Branigan, 2006; Georgi, 2011, 2012; Woolford, 2012; Oxford, 2014).

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[1] I use the term "portmanteau" loosely. Traditionally, "portmanteaux" are entirely opaque morphemes which combine the features of two distinct elements. Here, portmanteaux forms may be slightly transparent, or even homophonous with other morphemes.

This view has has been attractive as it attempts to reduce stipulated morphological mechanisms (proposed in, e.g., Noyer 1992; Harbour 2003a) to a more systematic procedure of Agree (Chomsky, 2000, 2001). Under the Agree view, a complex bundle of features is created in the syntax when a single probe is able to copy features from (that is, agrees with) multiple, distinct arguments. The resulting bundle is realized as an irregular portmanteaux form, due to the fact that it contains features from different sources. Thus, the irregularity of local effects reduces to the fact that what is being spelled out is a feature bundle that has been "cobbled together."

In fact, the "irregularity" of local effects is subject to its own systematicity. There are straightforward generalizations as to what kind of morphology can appear on the verb in local effects. The focus of this study is a subset of local effects in which the agreement morphology used in local contexts is syncretic with what is otherwise a non-singular category, as exemplified by Nocte (Tibeto-Burman) in (1) (Gupta, 1971; Trommer, 2006).[2]

(1) a. *ni we-ik-**e***
1pl read-PROG-**1pl**
'We are reading' (Gupta, 1971:17)

b. *nga-ma nang hetho-**e***
1sg-NOM 2sg teach-**1>2**
'I shall teach you' (Gupta, 1971:21)

In (1a), *-e* references a 1pl subject of an intransitive verb. In (1b), *-e* is used again when there is a 1sg subject acting on a 2sg object. Outside of local contexts, there are no other syncretisms; the agreement is decided by appealing to a person hierarchy where $1 > 2 > 3$.

To the extent that the pattern in (1) is a cross-linguistically attested pattern, it deserves an explanation. The present paper will address two questions related to (1).

Question 1 : What gives rise to local effects? That is, why do we see "abnormalities" in agreement morphology in the presence of two local arguments?

Question 2 : What gives rise to the syncretisms seen in local contexts? Specifically, why do local contexts syncretize with (1st person) plural morphemes.

In response to the first question, I essentially adopt the analysis discussed earlier where local contexts allow the creation of a feature bundle consisting of features from distinct features, which is consequently spelled out (Bobaljik and Branigan, 2006; Georgi, 2011, 2012; Woolford, 2012; Oxford, 2014). That is, somehow the derivation contrives a way to get features from two syntactically distinct arguments into one feature bundle. I will argue that this is due to *probe-relativization*, coupled with certain assumptions about the Agree relation.

The response to the second question is the heart of the paper. Following an idea in Trommer (2006), I argue that the syncretism results from how we represent plurality from a featural perspective. Specifically, plural morphology does not rely on features such as ±plural, or Group, etc. Rather, plural morphology is built from

[2] Examples are given in the orthographies used in the sources. I have simplified some of the glosses. Sources are given with the page number the example can be found on.

atomic INDIVIDUAL features, parallel to a standard semantic analysis of plurality (e.g., Link 1983; Schwarzschild 1992). In other words, the feature bundle that is built in local contexts is identical (enough) to a feature bundle which reflects a plural morpheme. Though sharing a core assumption with Trommer (2006), the proposal here differs in arguing that no additional assumptions are needed beyond the independently necessary processes of Agree and decompositional number. That is, the output of the syntax is realized as plural without additional post-syntactic processes.

A reanalysis of morphological features is important for a number of reasons. First, it argues directly against the proposals in Noyer (1992, 1998); Harbour (2003a, 2008b, 2014); Nevins (2011), where number is represented by maximally three bivalent features, [±singular], [±augmented], and [±group]. The proposal here improves on these analyses by correctly capturing the semantics of plurality, as well as foregoing stipulated post-syntactic operations on feature-bundles in order to derive the patterns of syncretism observed in languages like Nocte. Second, the decomposition of morphological number solves a number of difficult morphosyntactic issues, such as agreement with coordinated phrases, and phi-features on bound pronominals. While I will not give in-depth discussion of the analysis of these phenomena, the proposal here maps straightforwardly onto existing accounts, simplifying greatly many longstanding issues. Third, I'll suggest that markedness theories might ultimately be traced back to more basic cognitive limitations. Higher number categories, like "septal" number, are typologically ruled out because of general limits on cognition and the comprehension of sets of entities, following work within the cognitive sciences (Wynn, 1992; Malouf et al., 2015). As a corollary to this, the theory maps onto empirical evidence about the acquisition of numerosity, (Ramscar et al., 2011). Lastly, the analysis suggests a more transparent mapping between morphology and semantics, allowing a unified theory for both components of the grammar, in the spirit of — but crucially different from — Harbour (2008b). I understand this to be in line with a Minimalist view of grammar, as it seeks to reduce the number of representations required to generate meaning and sound.

The paper is organized as follows. I first present some case studies on local effects in section 2, illustrating the kinds of patterns that are observed in local contexts. I'll then lay out my view of morphological number in section 3, and in section 4 I illustrate how this theory captures the morphological expression of number in local contexts. I then lay out my assumptions concerning the Agree mechanism in section 5. In section 6 illustrate how this particular model of Agree coupled with the feature inventory proposed below can derive the patterns observed in local contexts. I then turn to previous analyses of similar phenomena in section 7, paying particular attention to Trommer (2006)'s Iconic Representation of Number. In section 8, I'll extend the proposed analysis of number features to other contexts. In section 9, I address some potential problems with the theory, and sketch possible solutions. I conclude in section 10.

2 Local effects, cross-linguistically

Heath (1991, 1998), in his survey of interactions between 1st and 2nd person, describes the typological variation in how local contexts might are morphologically expressed. The bolded items are relevant to the current discussion.

(2) *Heath's typology of irregularity in local contexts* (from Siewerska 2004:237)

a. marker disguised by partial phonological distortion
b. one of the two markers expressed by isolated suppletive allomorph
c. one of the two markers (elsewhere non-zero) expressed by zero
d. **number neutralization, sometimes including use of plural for semantic singular**
e. 1st or 2nd marker merged with (or replaced by) 3rd-person marker
f. entire combination expressed by unanalyzable portmanteau
g. entire combination expressed by zero (special case of portmanteau)
h. **inclusive (+2) marker replaces 1st or 2nd marker, or entire combination**
i. **merged 1/2 marker is part of both 1↔2 and 2↔1 combination**
j. subject and object markers compete for a single slot
k. co-occurring 1st and 2nd markers are widely separated
l. combinations with identical segments differ in tone

For instance, representing (2f), Ancash Quechua (Quechuan), as reported in Lakämper and Wunderlich (1998), uses the morpheme *-q* to express contexts where 1st acts on 2nd, while in other contexts, two morphemes are present. (In the following, I use an arrow (X→Y) to indicate the situation where X acts on Y.)

(3) a. 2→1
rika-ma-nki
see-1obj-2
'You see me'

b. 3→1
rika-ma-n
see-1obj-3
'S/he sees me'

c. 3→2
rika-shu-nki
'see-2obj-2
'S/he sees you'

d. **1→2**
*rika-**q***
see-**1subj/2obj**
'I see you' (Lakämper and Wunderlich, 1998:121)

As *-q* is used to express the relationship of 1→2, it is assumed to be a portmanteau, spelling out the features of a 1st person subject and a 2nd person object in one morpheme.

Broadly, all the strategies for resolving agreement in local contexts can be reduced to the following six patterns (cf Liao 2010 for a similar list).

(4) i. both arguments realized normally
ii. completely unanalyzable portmanteau form
iii. partially unanalyzable portmanteau form[3]
iv. one argument has a partially reduced feature set
v. one argument has a fully reduced feature set
vi. **combined feature set**

It's important note that local contexts are not an "anything goes" environment. We do not see insertion of random features, or periphrasis. In general, what we find is either opacity, impoverishment of a feature set, or a combination of features. That is, the apparent irregularity of local effects is only superficial, and the list in (4) now requires explanation — a task that will not be fully completed here. It's also worth noting that there are no reported cases of "non-local effects," where in the context of 3→3, the morphology realizes irregular morphology. This also deserves an explanation.

This paper is mainly concerned with a subset of languages which display the pattern in (4vi), where instead of a unique morpheme, a form otherwise identical to (1st person) non-singular is employed in local contexts. Table 1 displays a collection of such languages.[4]

language	**morpheme used when 1→2**	**use outside of 1→2**	**source**
Nocte (Tibeto-Burman)	*-e*	1pl	Gupta 1971
Karuk (Hokan)	*kín-/nú/nu-́*	1pl	Macaulay 1992
Yimas (Papuan)	*ka-mpa-n*	1sg-3dl-2/3sg	Foley 1991
Wayampi (Tupí-Guaraní)	*oro=*	1pl.excl	Jensen 1990
Mapudungun (S.A. isolate)	*-u/-iñ*	dl/pl	Smeets 2008
Bolinao (Austronesian)	*=ta*	1dl	Liao 2010
Tongva (Uto-Aztecan)	*re=*	1pl	Pam Munro, p.c.
Anindilyakwa (Australian)	*ngarra-*	1pl.incl	Leeding 1989
Colloquial Ainu (Ishikari dialect)	*as-/an-*	1pl.excl/1pl.incl	Shibatani 1990
Maasai (Eastern Nilotic)	*kí-*	1pl	Payne et al. 1994

Table 1: Number syncretisms in local contexts

[3] This may be an affix which appears to display some recognizable parts, but also other unanalyzable parts.

[4] Table 1 is not exhaustive. These are the languages I feel confident enough in to report on. Moreover, some languages are representative of languages families, where syncretisms are prevalent (Tibeto-Burman, Austronesian). For additional languages, see Heath (1991, 1998); Siewerska (2004); Trommer (2006); Liao (2010). I also do not include Georgi (2011, 2012)'s examples of inclusive morphology, which are members of the pattern above. I discuss these briefly later in subsection 4.1. I will also confine myself to local contexts where 1→2, although local effects do obtain in both "directions" in some languages.

I'll exemplify this pattern using data from two languages. First, consider again Nocte, repeated from above. The agreement pattern is given in Table 2, with the "exceptional" cells framed.

A↓,O→	1sg	1pl	2sg	2pl	3/intrans
1sg	–	–	**-e**	**-e**	-ang
1pl	–	–	**-e**	**-e**	**-e**
2sg	-ang	**-e**	–	–	-o
2pl	-ang	**-e**	–	–	-an
3	-ang	**-e**	-o	-an	∅

Table 2: Nocte agreement (Gupta, 1971)

Outside of local contexts, the agreement morphology is entirely predictable by appealing to a person hierarchy, where 1>2>3 (cf, Silverstein 1976). That is, given any two arguments of a transitive verb, the agreement morphology reflects whichever argument outranks the other. So when there is a 1st singular argument and a 3rd singular or plural argument, only 1sg morphology appears on the verb; an *inverse* marker, *-h*, is used if the object outranks the subject.

(5) Nocte (Tibeto-Burman)

a. *nga -ma ate hetho* ***-ang***
1sg -ERG 3sg teach **-1sg**
'I shall teach him' (Gupta, 1971:21)

b. *ate -ma nga -nang hetho -h* ***-ang***
3sg -ERG 1sg -ACC teach -INV **-1sg**
'He shall teach me' (Gupta, 1971:21)

If we reverse the order of the arguments in (5b), so that 3sg acts on 1sg, then the agreement is predicted by the person hierarchy: the 1st person argument wins, and the inverse morpheme appears. Likewise, when 2→1, the 1st person object wins, and the inverse morpheme appears.

(6) *nang -ma nga hetho -h* ***-ang***
2sg -ERG 1sg teach -INV **-1sg**
'You shall teach me' (Gupta, 1971:21)

There are two things to keep in mind about the patterns so far: First, the hierarchy is entirely person-based, making reference only to person features, and not number features. Still, the second point is that "winning" the person hierarchy results in being able to reference *all* the phi-features of the pronoun on the verb. In (6), because 1st outranks 2nd, both the person and number features of the 1st person argument appear on the verb in the form of *-ang*. Altering the number of either argument does not effect which argument "wins" the agreement slot.

The system diverges in local contexts. Given every other cell in the paradigm, we expect agreement with the 1st subject, but instead, the morpheme *-e* is used, as

shown in (7b). *-e* otherwise appears to reference 1pl arguments, as in intransitives (7a).[5]

(7) a. *ni we -ik* ***-e***
1pl read -PROG ***-1pl***
'We are reading' (Gupta, 1971:17)

b. *nga -ma nang hetho* ***-e***
1sg -NOM 2sg teach ***-1→2***
'I shall teach you' (Gupta, 1971:21)

Thus, the appearance of *-e* when 1→2 is anomalous. Since 1st outranks 2nd elsewhere in the paradigm, we expect to find *-ang* here as well. Moreover, unlike with Ancash Quechua, the morpheme that surfaces is syncretic with another cell in the paradigm: 1pl.

A more complex example is provided by Mapudungun, a South American isolate (Smeets, 2008). Mapudungun employs a number suffix on the verb to mark agreement.

(8) a. *mütrüm-e-y-m-∅-ew*
call-IDO-IND-2-S-DS
' He/she/they called you (sg).'

b. *mütrüm-e-y-m-ün-ew*
call-IDO-IND-2-pl-DS
' He/she/they called you (pl).' (Smeets, 2008:156)

Like Nocte, the number suffix tracks a 1>2>3 person hierarchy, reflecting whichever argument ranks higher. For instance, Smeets provides the following chart for 3rd person subject in the indicative paradigm. There are a number of interesting complications in Mapudungun's agreement paradigm — many of them related to whether there is an "inverse" marker in Mapudungun. We are concerned here with the number affixes *-∅* singular, *-u* dual, *-iñ/ün* plural.[6]

I summarize in Table 4 what the number affix tracks across the entire agreement paradigm. (In the table, "–" in the object column represents an intransitive verb.)[7]

In general, number agreement tracks a person hierarchy, just like in Nocte. However, as can be seen in the table, there is irregularity in local contexts. When 1sg→2sg, the morpheme associated with dual number (*-u*) is employed (9a). In all other contexts where 1→2, the morpheme associated with plural number (*-iñ*) is employed (9b).

(9) Mapudungun (South American)

[5] Note that when 1pl→2 it's unclear whether we're seeing irregular morphology or the regular agreement. The analysis later suggest that this is technically a portmanteau as well.

[6] Smeets reports three agreement paradigms, indicative, conditional, and imperative. The conditional is the most morphologically transparent, and so I report it here. All paradigms display similar effects.

[7] If both arguments are 3rd, then number tracks whichever is topicalized. See Baker (2003); Arnold (1994); Smeets (2008) (and references therein) for discussion of agreement and topicalization in Mapudungun.

3→1sg	*-e-l-i-∅-mew*
3→1dl	*-e-l-y-u-mew*
3→1pl	*-e-l-y-iñ-mew*
3→2sg	*-e-l-m-∅-ew*
3→2dl	*-e-l-m-u-mew*
3→2pl	*-e-l-m-ün-i-mew*
3→3	*e-y-ew*
1sg→3	*-fi-l-i-∅*
1dl→3	*-fi-l-i-u*
1pl→3	*-fi-l-i-iñ*
2sg→3	*-fi-l-m-i*
2dl→3	*-fi-l-m-u*
3pl→3	*-fi-l-m-ün*
2sg→1sg	*-e-l-i-∅-∅*
2dl/pl→1sg	*-mu-l-i-∅*
2sg/dl/pl→1dl	*-mu-l-i-u*
2sg/dl/pl→1pl	*-mu-l-i-iñ*

Table 3: Conditional agreement paradigm in Mapunungun (Smeets, 2008:366)

Subject	**Object**	**What number tracks**
1	–	subj
1sg	2sg	*-u*
1	2	*-iñ* (if total ≥ 3)
1	3	subj
2	–	subj
2	1	obj
2	3	subj
3	–	subj
3	1	obj
3	2	obj
3	3	subj/obj

Table 4: Number suffix reference in Mapudungun

a. *kellu-e-y-**u***
help-IDO-IND-**dual**
'I helped you (sg).' (Smeets, 2008:160)

b. *kellu-w-y-**iñ***
help-1A-IND-**plural**
'I helped you (dl/pl)' or 'We (dl/pl) helped you (sg/dl/pl)'
(Smeets, 2008:159)

The descriptive generalization (observed by Smeets, p. 158) is that when 1→2, the number suffix references *the combined total number of speech-act participants*. In all other contexts, the number suffix merely reflects the number of the argument which ranks highest on the person hierarchy.

Note that the same generalization that the agreement reflects the combined total of speech-act participants in local contexts is also descriptively true of Nocte, except that Nocte only makes a singular/plural distinction. We could say that *-e* in local contexts is simply the feature set associated with *me and you*, a 1pl feature set. In fact, I'll propose in the analysis that follows that this is precisely what is

happening in Nocte, Mapudungun, and all the languages in Table 1. The reason we see non-singular morphology when 1→2 is because the morphology is spelling-out the combined feature set of the subject and object.

3 Decomposing morphological number

For the next few sections, I'll step away from the data to give an overview of the theory of number features I propose. I introduce here the feature INDIVIDUAL (IND). This is a privative, atomic feature, which corresponds to a single atomic entity in the domain of discourse. In this way, a collection of IND features is a collection of individuals, and thus will correspond to non-singular.

(10) a. [IND] ⟷ singular
b. [IND, IND] ⟷ plural (or dual)
c. [IND, IND, IND] ⟷ plural (or trial)

Non-singular morphology will be spelled out whenever *at least* two IND features are present. Some languages will map (10b) to dual morphology, and (10c) to plural or trial, etc. English, which differentiates only two numbers, has only the first two correspondences. In principle, there is no limit on the number of IND features that can appear in a bundle. Under the Subset Principle (Halle, 1997), a bundle containing two, ten, or 100 IND features will be subject to the correspondence in (10b) in English. (I return in section 9 to the bounds of such a system.)

IND features can be specified, or restricted, with other features, e.g., ANIMATE, MASCULINE, etc., including person features. 3rd person is merely the presence of an IND feature: a single IND for 3sg, two for dual or plural, and so on. 1st and 2nd person categories employ PARTICIPANT (PART) and SPEAKER (SPKR).[8] Note that each IND feature in a bundle may be further specified. By contrastiveness, anything which is a speech-act participant, but not a speaker, will be second person (Cowper, 2005; Cowper and Hall, 2005). A language which makes use of two number and three person categories (like English) will have the following features specifications for its pronominal system.

(11) a. 1sg = "I" $\begin{bmatrix} \text{IND} \\ \text{PART} \\ \text{SPKR} \end{bmatrix}$ b. 2sg = "You (sg)" $\begin{bmatrix} \text{IND} \\ \text{PART} \end{bmatrix}$ c. 3sg = "S/he" [IND]

(12) a. 1pl = "We" $\begin{bmatrix} \text{IND IND} \\ \text{PART} \\ \text{SPKR} \end{bmatrix}$ b. 2pl = "You (pl)" $\begin{bmatrix} \text{IND IND} \\ \text{PART} \end{bmatrix}$ c. 3pl = "They" $\begin{bmatrix} \text{IND IND} \end{bmatrix}$

[8] These features are based on Harley and Ritter's (2002) feature geometry, but I refrain from using geometries to represent the relationships between the features to avoid confusion between a feature geometry and the lattice structure shown presently. The relationship between IND, PART, SPKR is one of entailment in the sense of a feature geometry, but the relationship between IND features is best viewed as a lattice.

Observe that 3rd person is represented as the absence of person features, following Benveniste (1971), but not the absence of features entirely, since it will still contain one (or more) IND features. This points to a difference between IND and PART/SPKR. I assume that IND defines a *type* of feature, namely, phi-features (as opposed to wh-features, EPP features, etc). But it is also "real" in the sense that each IND feature identifies a unique individual in the discourse. Features like PART and SPKR designate *values* of IND. That is, 1st person singular is an individual which has the values of a speech-act participant and a speaker. Because of this dependence on an IND feature, a PART feature without IND is semantically uninterpretable.

(13) Semantically uninterpretable feature bundle

$$*\begin{bmatrix} \text{IND} \\ \text{PART} \\ \text{PART} \\ \text{SPKR} \end{bmatrix}$$

The bundle in (13) would refer to a single individual who is two speech-act participants, an incoherent concept.

The proposed system is meant to recapitulate in morphology the semantic notion that plural entities are constructed from atomic elements (Link, 1983; Schwarzschild, 1992). Taking for instance a Linkian representation of plurality, a group of individuals will correspond to a point in the lattice, and will also correspond to a phonological form (by the Subset Principle).

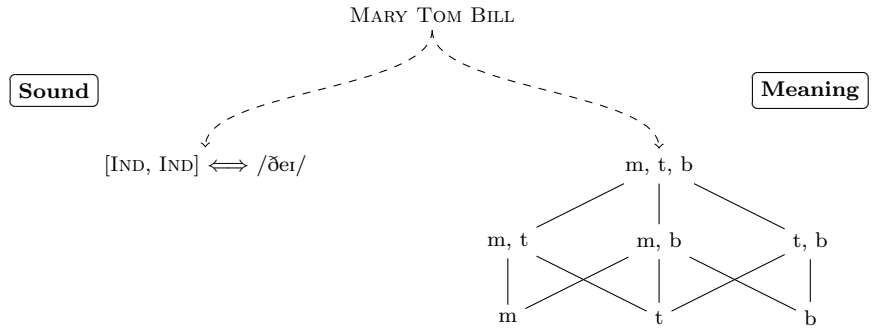


Fig. 1: The correspondence between representation, sound, and meaning

Any group of individuals, say *Mary, Tom, and Bill*, has a semantic interpretation, as it will correspond to a point in the Hasse diagram in Figure 1, and it will have a phonological interpretation, as it will be mapped to an exponent, according to the Subset Priniciple. Under such a view of number morphology, there is no need to endow any features with a particular semantics for number (as in e.g. Harbour 2003a *et seq*); the phi-features are a direct translation of the semantic theory.[9]

[9] Although it will not be relevant for the discussion below, I assume that properties can be predicated of IND features. For instance, [IND] combines with a property **chair**, yielding a single

The proposed theory of number and phi-features in general diverges from most previous theories in two important ways. First, *there are no number features*. That is, there is no morphological primitive representing "singular" or "non-singular." Second, *person and number are not distinct*. Traditionally, person and number categories utilize entirely different sets of features. In the proposed theory, it is impossible to specify the person features without also specifying the number features. Observe that this differentiates the present proposal from a closely related theory proposed in Trommer (2006), who also proposes that number features can be "atomized", using • to represent singular, and •• to represent non-singular, but employing additional features like ±1, ±2, ±3 for person categories. While I concur with Trommer's approach to number, I take the further step in linking the other features to the atomic features. I discuss Trommer's theory in more detail in section 7.

4 Portmanteaux and the realization of number

Under a derivational, late insertion model of syntax and morphology (as in Halle and Marantz 1993), the only way that irregularities in local contexts can be explained is by the interaction of the features of the subject and object. The agreement/spell-out mechanism (whatever it is) must take into consideration *both* the subject and object in local contexts in order to make the appropriate morphological choice. Given this interaction, and the assumption that morphology operates under a late insertion model of grammar, there are two choices.

1. **Conditioned allomorphy**
   One bundle's features are altered by the presence of the features in another bundle (Noyer, 1992, 1998; Harbour, 2003a).
2. **Portmanteaux**
   The features from both arguments are spelled out as a single exponent (Bobaljik and Branigan, 2006; Georgi, 2011, 2012; Woolford, 2012; Oxford, 2014).

In section 7, I critically examine the first choice, which has been the dominant analysis in the Distributed Morphology literature. I particularly focus on Trommer's (2006) approach to number which adopts this view. I'll argue though, that the second option is the correct one, and I'll assume as much for the time being. More specifically, I'll assume that the portmanteau analysis is the result of "bundling" the features of the subject and object into a single morphosyntactic locus on the verbal complex, as sketched in (14).[10]

(14) $[\ \ldots\ \text{Subject}_{[+F]}\ \ldots\ [\ \ldots\ \text{V}_{[+F,+G]}\ \ldots\ ]\ \ldots\ \text{Object}_{[+G]}\ ]$

instance of a chair. *Chairs* would also minimally involve two IND features. The reader should keep in mind that the semantic analysis of plurality is extremely complex and controversial, and I will not make any deep semantic claims here, other than the assumption that there is a notion of "atomicity", which is largely uncontroversial.

[10] There are a number of theories that can derive (14), including movement of Agr nodes, Cyclic and Multiple Agree, where a single probe can agree with multiple arguments (Béjar, 2003; Řezáč, 2003; Anagnostopoulou, 2003; Nevins, 2011), and constraints on where and when person features are realized (Woolford, 2012). Any of these are compatible with the proposed theory of number — although of course each theory will have to be modified to accommodate different phi-features.

Under the assumption that the syntax has managed to create (14), consider Nocte again, where 1→2 results in the morpheme *-e*, which is otherwise used to refer to 1pl arguments. Let's first posit the correspondence in (15), which will realize verbal agreement with a 1pl argument.

(15) $\begin{bmatrix} \textsc{Ind}\ \textsc{Ind} \\ \textsc{Part} \\ \textsc{Spkr} \end{bmatrix} \longleftrightarrow$ *-e*

This bundle realizes two IND features, one of which is specified as a 1st person. Importantly, this same array of features results from combining the feature sets of a 1sg and 2sg argument, as shown in (16).

(16) $\begin{bmatrix} \textsc{Ind}\ \textsc{Ind} \\ \textsc{Part}\ \textsc{Part} \\ \textsc{Spkr} \end{bmatrix} = \begin{bmatrix} \textsc{Ind} \\ \textsc{Part} \\ \textsc{Spkr} \end{bmatrix} + \begin{bmatrix} \textsc{Ind} \\ \textsc{Part} \end{bmatrix}$

Assuming that the bundle in (16) is built by the agreement mechanism, then the correspondence in (15) will apply under the Subset Principle. Thus, we explain the patterns of plural morphology appearing in local contexts as a consequence of the rules for spell-out.

The patterns in Mapudungun are similarly explained. When 1sg→2sg, the dual morpheme *-u* is used on the verb. In all other contexts where 1→2, the plural morpheme *-iñ* is employed. Suppose the following two correspondences between features and phonological exponence.

(17) a. $\begin{bmatrix} \textsc{Ind} \\ \textsc{Ind} \\ \textsc{Ind} \end{bmatrix} \longleftrightarrow$ *-iñ*

b. $\begin{bmatrix} \textsc{Ind} \\ \textsc{Ind} \end{bmatrix} \longleftrightarrow$ *-u*

The exponent in (17a) will be realized whenever there is a bundle containing three (or more) IND features (i.e., there are three people). Crucially, such a bundle will be derived not only when there is a non-singular, non-dual argument in the structure, but also any time the features of three or more individuals are realized as a portmanteau. (17b) will be realized whenever the total number of IND features is two — no more and no less. Thus, this will apply when 1sg→2sg.

Thus, the irregularities in local contexts are the result of interacting features from the subject and object. Under the assumption that these are portmanteaux, then the non-singular morphology seen in local contexts is explained by the fact that number morphology is decompositional. The portmanteaux are sufficiently similar (via the Subset Principle) to the category of (1st person) non-singular to be realized by the same morpheme.

4.1 Opaque portmanteaux and clusivity

The proposed analysis in fact covers contexts beyond those in Table 1. For instance, in languages like Ancash Quechua in which an opaque morpheme (*-q*) is

used in local contexts, the realization of (16) will be simply that morpheme. Such an approach would essentially classify opaque local effects as the realization of inclusive morphology, since the feature specifications of (16) are those of an inclusive category, which is defined as a group including minimally the speaker and the addressee, i.e., two speech act participants, one of which is the speaker.

In fact, Georgi (2011, 2012) takes precisely this line of reasoning, and argues that local effects are *all* instances of inclusive morphology. Such an analysis is supported by a number of languages which exhibit an inclusive/exclusive distinction in the agreement paradigm, and choose the inclusive marker in local contexts. For instance, Surinam Carib (Cariban), as reported in Hoff (1968, 1995); Hoff and Kiban (2009), exhibits such a pattern.

Subj↓ Obj→	1	2	12	3
1		**k**		s
2	**k**			m
12				kïs
3	y	ay	**k**	n

Table 5: Transitive agreement in Surinam Carib

The segment *-k* systematically occurs whenever there are two local persons in the derivation. In Georgi's analysis, this results from a probe on T agreeing with both arguments, and building a portmanteau — similar to what will be proposed later. The resulting bundle containing the features of 1st person and 2nd person is functionally equivalent to an inclusive and so is realized as inclusive morphology.

Observe, though, that Georgi's inclusive analysis does not easily extend to the data from Nocte and Mapundungun (or any of the languages in Table 1). For instance, in order for her analysis to capture the patterns in Nocte, we would either have to say that *-e* always realizes an inclusive 1pl, or that there are two, homophonous 1pl morphemes, one of which is an inclusive 1pl, and another which is ambiguous as to clusivity. Clearly neither of these solutions is ideal.

Moreover, there are actually languages which make an inclusive/exclusive distinction in the agreement paradigm, but choose the *exclusive* form in local contexts. Wayampi (Tupí-Guaraní) is one such language.

(18) Wayampi (Tupí-Guaraní)

a. *tataterno rape* ***oro-*** *inũ remẽ*
airplane path **1.excl-** make when
'When we made the airstrip' (Jensen, 1990:135)

b. ***oro-*** *esa remẽ*
1:2sg- meet when
'When I meet you(sg)' (Jensen, 1990:135)

This cannot be captured with Georgi's assumption about number features without further stipulating processes that can affect the content of the feature bundles — a subject to which I turn in section 7. The present analysis offers a more nuanced view of inclusive/exclusive syncretisms in local contexts. I do not assume that local effects are always the result of realizing an inclusive feature bundle.

Rather, the language merely realizes the feature bundle that is built by the agreement mechanism — which *might* correspond to an inclusive feature set, but need not.[11]

5 Building feature bundles in syntax: Agreement

In this section I will lay out an agreement system that can capture the data discussed above.

Formally, following Chomsky (2000, 2001), agreement is a formal syntactic relation (Agree) between a probe bearing uninterpretable/unvalued features, and an argument bearing interpretable/ valued features. Agree consists of two processes, *Match* and *Value* (Béjar, 2003; Arregi and Nevins, 2012; Bhatt and Walkow, 2013; Marušič et al., 2015). Match requires identity of *types* of features: phi-features Match other phi-features, *wh*-features Match *wh*-features, etc. Since Match is *type-identity* and IND defines a type, Match occurs when uninterpretable/unvalued IND (*u*IND) locates interpretable/valued IND within some minimal syntactic domain.[12] Value is *feature-copying*, where the features of the goal get copied onto the probe, which checks and deactivates the relevant features on the probe. In its simplest form *u*IND on T Matches with IND on DP, and the probe's feature is valued and spelled out accordingly. I'll assume that Value copies all the features of the goal onto the probe, not just those in correspondence. (This assumption is subject to parametric variation and will be slightly revised later.) So a probe *u*IND which Values with a goal $\begin{bmatrix} \text{IND} \\ \text{PART} \end{bmatrix}$, will copy both the IND and PART feature to the probe, realizing 2nd person agreement. Likewise, the same probe when it agrees with an argument bearing two IND features will copy both IND features to the probe. The result is the realization of non-singular 3rd person agreement.

Following Béjar (2003); Řezáč (2003); Nevins (2011); Preminger (2011) I assume that probes can be *relativized*, meaning that they can be further specified to look for certain types of individuals. For instance, a probe like $\begin{bmatrix} \text{uIND} \\ \text{uPART} \end{bmatrix}$ is relativized to agree with speech-act participants. By stipulation, in order for a relativized probe to Value any of its uninterpretable features, it must do more than Match; it must find a goal bearing at least one feature which is dependent on IND. So the probe just mentioned will fail to Value (i.e. copy) any features from a 3rd person argument, as 3rd person does not bear a PART feature. This formulation captures the idea that some arguments, namely those without 1st/2nd person features, are "invisible" to agreement in many languages (Alexiadou and Anagnostopoulou, 2006; Béjar and Řezáč, 2003).

Lastly, I adopt the idea that Agree can act "cyclically" (Béjar, 2003; Řezáč, 2003; Béjar and Řezáč, 2009). A probe situated on v acts in Merge order, probing

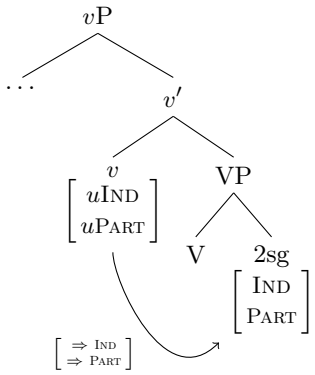
[11] In the analysis proposed in section 5, the data from Wayampi is accounted for by allowing parametric variation in the agreement process for whether a second PART feature is copied into the feature bundle.

[12] Here, I abstract away from what either "unvalued" or "uninterpretable" means, although see Pesetsky and Torrego (2007) for why these are not the same thing. For the discussion here, both terms are short-hand for "interface illegible."

the object first. If it fails to value its features on an object (say, if the object is 3rd person), it is allowed to expand its search domain to include a specifier.

The system is exemplified in (19). The following illustrate the agreement system. In the trees, a dashed line represents successful Match and failed Value; a solid line represents successful Value. ⇒ indicates a feature that has been Valued on that cycle.

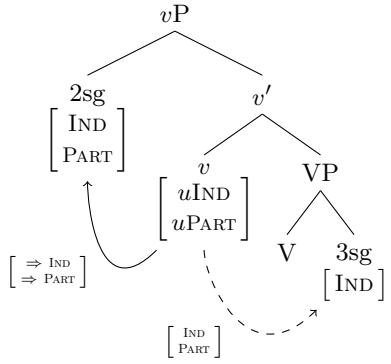
(19) a. Agree on first cycle
[successful Match and Value]



Step 1: Probe Matches with the object (*u*IND find IND).

Step 2: Probe Values with the object, copying object's features to the probe.

b. Agree on second cycle
[Successful Match on first cycle but failed Value; successful Match and Value on second cycle]



Step 1: Probe Matches with the object (*u*IND finds IND)

Step 2: Probe fails to Value with object; cycles upwards

Step 3: Probe Matches with the subject.

Step 4: Probe Values with the subject.

The crucial aspect here is that only Value can deactivate a *u*IND feature, thereby halting the probe process. Thus, even though Match is successful with the 3sg

object in (19b), because there is nothing to Value any of the features on the probe, *u*Ind remains active for a second cycle. Note that Value is dependent on Match. Part cannot be valued without there being type-identity first.

The mechanism proposed in this section will be elaborated with examples in the next few sections, and additionally the theory will be complicated slightly to deal with parametric variation. It should be noted, however, that there is nothing radical in the proposed agreement mechanism. The switch to a different feature system requires revisions to the conditions under which the various pieces apply, but the pieces of agreement themselves have been independently proposed.

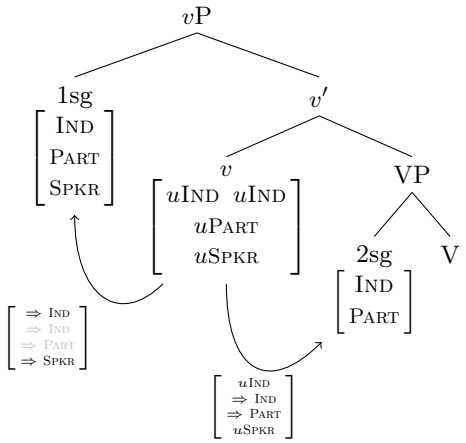
6 Applying the analysis

I propose that for the languages discussed in this paper, v comes with a probe relativized as in (20).[13]

(20) $\begin{bmatrix} u\text{Ind} & u\text{Ind} \\ u\text{Part} & \\ u\text{Spkr} & \end{bmatrix}$.

In Nocte, 1st person plurals will fully value the probe, and all else will leave the probe with unvalued features.[14] In only one configuration of features, when there is a 2nd object and 1st subject, will the probe be able to agree with both arguments.

(21) *nga-ma nang hetho -e*
'I shall teach you (sg)'
[Match and Value on first cycle; Match and Value on second cycle]



[13] Despite the rather stipulatory nature of this probe, which appears to be specified to look for a 1pl argument, I suggest in fact that the probe is specified to look for *two individuals* (one of which is 1st person), as we would expect from a transitive verb. We could call this "probe bundling", by analogy to Voice bundling (Pylkkänen, 2008). Note that there is an intuitive motivation for agreement under the proposed analysis: We see agreement morphology because verbal predicates need to be saturated by arguments, i.e., individuals in the discourse. Some languages have stricter requirements about what kind of individual the verb is looking for, that is, whether the individual is 1st, 2nd, or 3rd person.

[14] See Preminger (2011) for why (some) unvalued features will not lead to a crash.

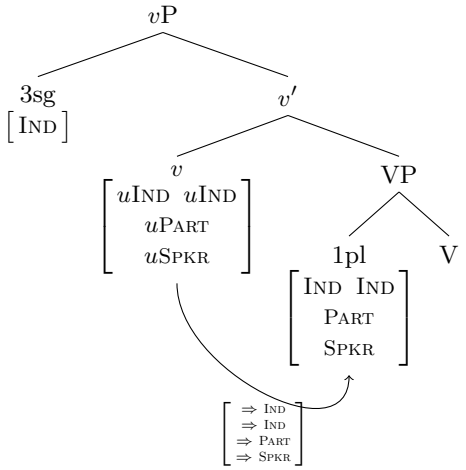
Step 1: Probe Matches with object
Step 2: Probe Values with object, copying *u*IND, *u*PART; cycles upward
Step 3: Probe Matches with subject
Step 4: Probe Values with subject, copying *u*IND, *u*PART, *u*SPKR to the probe.

On the initial search, *u*IND and *u*PART on the probe are Valued by the corresponding features of the 2sg object. The presence of the additional *u*IND initiates a second cycle, and the probe is able to agree again with the subject, copying IND, PART, and SPKR to *v*. (As assumed above, successful Value copies all the argument's features to the probe.) The resulting bundling, $\begin{bmatrix} \text{IND}\ \text{IND} \\ \text{PART}\ \text{PART} \\ \text{SPKR} \end{bmatrix}$ is functionally equivalent to a 1st plural, as discussed earlier, and so will be realized by the correspondence in (22).

(22) $\begin{bmatrix} \text{IND}\ \text{IND} \\ \text{PART} \\ \text{SPKR} \end{bmatrix} \longleftrightarrow$ *-e*

This same bundle will be copied to the probe in 1pl↔3 contexts.

(23) a. *ate-ma nang-nang hetho-h-e*
'He shall teach us'
[match and value with object]

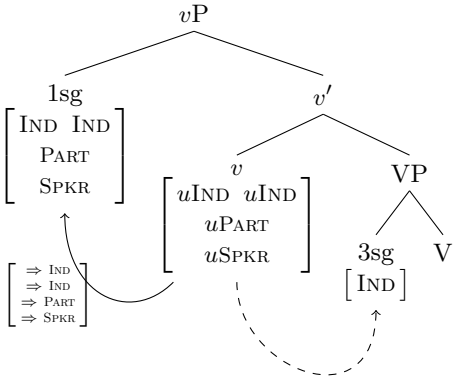


Step 1: Probe Matches with object.

Step 2: Probe Values with object.

b. *no-ma ate-bang chien-t-e*
'We asked him'

[Match with object, but no value; Match and value with subject]



Step 1: Probe Matches with object.

Step 2: Probe fails to Value with object; cycles upward.

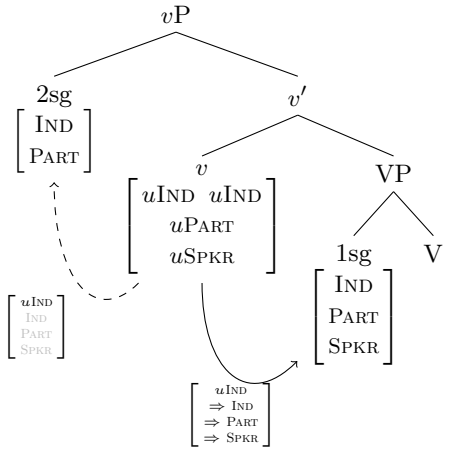
Step 3: Probe Matches with subject.

Step 4: Probe Values with subject.

In all cases in which there is 1pl argument, and in those cases where there is a 2nd object and 1st subject, the resulting bundle will be functionally identical, and subject to the rule in (22).

The opposite configuration, 2→1, will leave an unvalued [*u*Ind] feature on the probe, but a second cycle will only be able to Match, not Value. In this context, second cycle agreement will fail to copy features, since feature-copying for relativized probes is dependent on Part/Spkr values being available on the probe.

(24) *nang -ma nga hetho -h -ang*
'You shall teach me'
[Match and value on first cycle; Match and no Value on second cycle]



Step 1: Probe Matches with object

Step 2: Probe Values with object, copying features to Probe.

Step 3: Probe Matches with subject.
Step 4: Probe fails to Value with subject

This in effect recapitulates the arguments for Cyclic Agree: the specifications of the object are more prominent in a sense, in that they determine (more than the subject) how the agreement will be spelled out. This cyclic approach also captures the appearance of the inverse morpheme *-h*: it only appears when there is no valuation with the subject. We can assume that this is simply the spell-out of v, which is contextually determined based on how many cycles there have been.

The proposed system has a number of immediate benefits. First, we can explain why irregularities in agreement are prevalent in local contexts. This is because of the probe relativization. Indeed, given the featural ontology proposed in section 3, we would not expect to find agreement irregularities outside of local contexts. It would be impossible to specify the probe to preferentially look for, say, 3rd person arguments over 1st or 2nd.

Second, we can explain the "unidirectionality" of the irregularities: for the languages examined here, local effects only occur when 1→2, and not when 2→1. This is because of probe relativization, the locus of the probe on v, and the ability for agreement to act cyclically. A probe which is specified to look for 1st person arguments will be "incomplete" after finding a 2nd person, and so keep looking have the chance to agree twice. If the probe encounters a 1st person argument, it "bleeds" any further probing.[15]

Finally, given the features proposed, we can account for at least some of the range of morphological possibilities that arise in local contexts. Opaque portmanteaux, inclusive markers, and non-singular morphology are all the result of realizing a bundle of features comprised of multiple IND features, and languages may vary as to how they realize this bundle. In some languages, it will be an opaque portmanteaux due to a highly specified rule of exponence. In some languages it will be an inclusive morpheme, because the bundle is featurally identical to an inclusive. And in some languages, it will be (1st person) plural, because of the Subset Principle. And of course, a probe that is not relativized as in (20) will not Agree with multiple positions. This is the case in the majority of world's languages.

6.1 Local bleeding

The system as such also explains a curious fact about many of the local effects: they are sensitive to the number of the object. Consider Karuk (Hokan) (Macaulay, 1992). When 1→2sg, the morphology that surfaces is syncretic with whatever is used to reference 1pl subject agreement. Thus, the pattern is consistent with the languages discussed above. However, if the number of the object non-singular, then the local effects disappear, and the morphology associated with "normal" 2pl object agreement appears. I show the paradigm for Positive agreement in agreement

[15] However, there are some languages in which irregularities exist in 2→1 contexts, in addition to 1→2. This can achieved by having the probe relativized to look for two speech act participants, in which case it will agree with two arguments, independent of grammatical role. Crucially, I am unaware of any language in which local effects exist in 2→1 contexts, but not 1→2 contexts.

in Table 6. The same pattern can be observed in all agreement paradigms (Optative and Negative moods) in Karuk. The framed cells are portmanteaux, and the bolded forms in the 2pl column are the morphemes of interest.

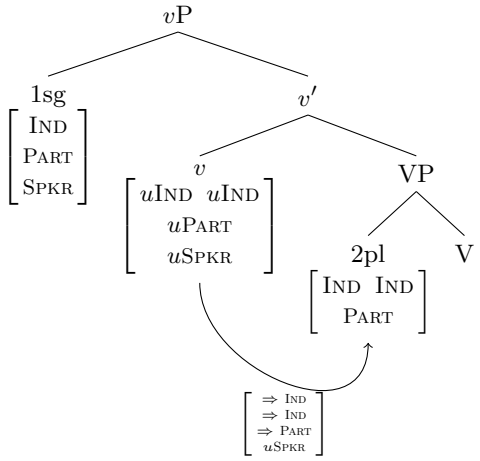
Table 6: Karuk agreement (Positive paradigm) (Macaulay, 1992)

A↓,O→	1sg	1pl	2sg	2pl	3sg/intrans	3pl
1sg	–	–	**nu-**	**kik-...-ap**	ni-	ni-
1pl	–	–	**nu-**	**kik-...-ap**	**nu-**	**nu-**
2sg	ná–	kín-	–	–	∅-	∅-
2pl	kaná-	kín-	–	–	ku-	ku-
3sg	ná-	kín-	ʔi-...-ap	**kik-...-ap**	ʔu-	ʔu-
3pl	kaná-	kín-	ʔi-...-ap	**kik-...-ap**	kun-	kín-

I call this *local bleeding* since the local effects appear to be bled when there is a 2nd plural object. That is, the paradigm "reverts" to an expected pattern when the 2nd person object is plural. A similar pattern is observed in Yimas (Papuan, Foley 1991), where we find a portmanteau contained 1st person and dual morphology in 1→2sg contexts, but simply morphology reflecting the person and number of the object in 1→2non-singular contexts.

The proposed analysis can straightforwardly capture local bleeding. In Karuk, a plural object will value the second *u*IND feature on the probe. Thus, a second cycle will not be able to Match, despite the fact that it has a useable *u*SPKR.

(25) 1→2pl = *kik...ap*
[Match and Value on first cycle; no second cycle possible]



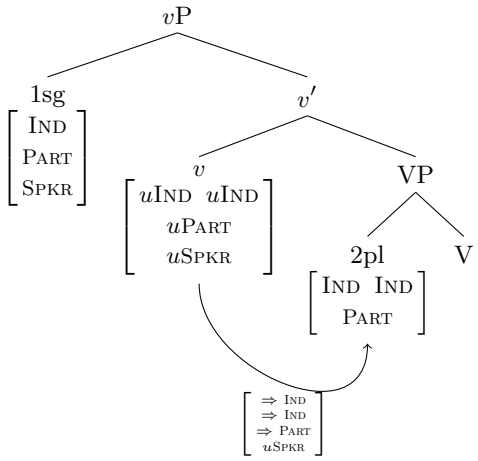
Step 1: Probe Matches with object
Step 2: Probe Values with object, copying IND, IND, and PART.

Even though the probe has an unused *u*SPKR feature, it cannot Value with the subject, because there is no *u*IND to Match.[16]

[16] I'll assume that for Karuk, as opposed to Nocte, the difference between subject and object agreement is reflected in the spell-out of the agreement morphemes themselves. This is essen-

While Karuk displays local bleeding, Nocte does not. This difference can be explained by parameterizing what is copied upon successful Value. In Karuk, any successful Value requires that all the features of the argument be copied onto the probe, checking as many features as possible. In Nocte, on the other hand, Value only copies the features which are in a direct relation. Such a difference corresponds to Preminger (2011)'s concept of "granularity" of agreement. Karuk-type probes are "coarse" in that they copy any and all phi-features. Nocte-type probes are "fine-grained" in that they only copy the features which are in correspondence.[17,18]

(26) a. Coarse agreement: (Karuk, . . .)
[Match and Value on first cycle deactivates all *u*IND; no second cycle is possible]

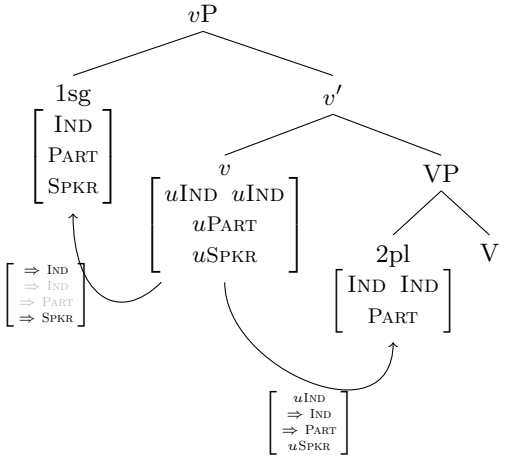


tially saying that while the inverse configuration in Nocte is marked with a dedicated inverse morpheme *-h*, the inverse configuration in Karuk is expressed in the form of the agreement.

[17] Note that this requires a slight modification to the derivation of Nocte given in the previous section. Nocte's probe will not have an "extra" PART feature in local contexts. This has no effect on the analysis, as the bundle will still be realized as 1pl.

[18] Georgi (2012) in fact comes to a similar conclusion in her approach. In Georgi's analysis Local Person Portmanteaux result from the copying of positive values of phi-features. Some languages have set a parameter such that they will copy all the features of an argument (including negatively valued features) when the argument bears a positive value, while others only copy the positive values and nothing else.

b. Fine-grained agreement: (Nocte, . . .)
[Match and Value on first cycle leaves an active *u*IND; Match and Value on second cycle]



To be clear, this does not solve the entirety of the agreement in Karuk. However, it does provide a manner for deriving *interactions* of person and number in agreement. That is, the importance of local bleeding is that the number specifications of the object seem to be "overriding" the person hierarchy effects, which are otherwise in effect in Karuk. Such interactions of phi-features are difficult to derive in derivational approaches to agreement, and in fact, a number of recent theories have expressly attempted to disassociate person and number in syntax (Taraldsen, 1995; Nevins, 2011; Preminger, 2011). Such a separation comes at a cost, however, as we now are unable to handle precisely the sort of situation that appears in Karuk, where the number features can determine the outcome of agreement in person-based agreement hierarchy.[19] Indeed, recent case-studies in agreement have proposed that some languages have *composite probes*, where the probe bears both person and number features, and is allowed to value then at the "best match" target (Coon and Bale, 2014; Deal, 2015) (see also van Urk 2015). The interaction of person and number is what is lost in an approach that completely dissociates person and number in agreement. Under the present proposal, however, person and number are not separate, and so are expected to interact to some degree, dependent on the other parameters of the agreement system.

[19] Separated person and number probes are what Béjar (2003, 2008); Béjar and Řezáč (2009) claim in their discussion of agreement in Karuk. In their system, ϕ-probes can be divided into π-probes for person and ω-probes for number. In some languages, these π-probes and ω-probes are located on different heads. In this way, they account for the fact that in a language like Erza Mordvinian (Uralic), the preferred controller of the number probe is the subject (because ω-probe is located above the subject) while the preferred controller for the person probe is the object (because the π-probe is located on v). However, in Karuk, because the object is the preferred controller for both number and person, they argue that both probes are hosted on the same head, but that each can still act separately. Given separate probes, we expect person features of one argument and number features of one argument to each be reflected on the verb. But that is not always the case. In some instances (namely, 1→2sg), the surface form does not cleanly express the features of either argument, and what shows up is contingent on how both ω and π are valued. In these contexts, what π agrees with is contingent on how ω agrees.

7 Previous analyses of local effects

I will now compare the proposed analysis with previous attempts of explaining local effects. These previous accounts are almost all efforts to account for the "portmanteau" nature of the morphology. That is, the analyses are designed to explain the fact that local contexts result in unanalyzable/unsegmentable portmanteau forms.

For instance, Heath (1991, 1998) describes local effects as essentially a result of pragmatics, claiming that local contexts are pragmatically marked, and speakers tend to obviate or avoid them entirely. While it may (or may not) be true that speakers tend to avoid local contexts, this does not in fact offer a clear explanation about the morphological systematicity observed in these situations. Nor in fact does it explain why there should be a morphological reflex at all. Whether transparent 1st/2nd morphology is used or not, a phrase expressing "I saw you" still *means* "I saw you", and so it is unclear why a morphological change is better from a pragmatic point of view.

Perhaps the most straightforward way to deal with local effects is with a set of accidentally homophonous affixes. I illustrate with Nocte. Recall that the morpheme *-e* is used consistently with all unambiguous 1pl referents, and it also shows up in local contexts. The following two correspondences in (27) can be postulated. (There may be other features, e.g., [-sg], etc.)

(27) a. $\begin{bmatrix} +1 \\ +\text{pl} \end{bmatrix} \rightarrow e_1$

b. $\begin{bmatrix} +1 \\ +\text{sg} \\ +2 \\ +\text{sg} \end{bmatrix} \rightarrow e_2$

There are a few reasons why this is not a suitable approach. First, it fails to capture why this precise syncretism occurs. That is, given the accidental syncretism story, we might expect local contexts to be accidentally syncretic with any category, e.g., 3pl or 2sg. The fact that there is a predominance for syncretism with a 1pl category is unexplained. Moreover, we'd have to posit the exact same accidental homophony across a number of different languages. This suggests that we're missing a generalization.[20]

Given the well-known presence of such morphological irregularities, and the desire to avoid accidental homophonies as in (27), many proposals have been put forth to try to derive why such irregularities target one particular cell of the agreement paradigm. That is, why are there local effects, but no systematic cross-linguistic irregularities in "non-local contexts," i.e., when 3→3? This observation has in fact been foundational in the development of Distributed Morphology, which takes these patterns as evidence for post-syntactic operations that work on the feature bundles. In Distributed Morphology, the syncretism that we see in the

[20] A more blunt argument against having two spell-out rules as in (27) relies on the fact that two [+sg] features is *intuitively* a plural entity. That is, we intuitively understand that two [+sg] features are equivalent to a plural, and, abstracting away from formalisms, it is not surprising that the two should be homophonous. The question is one of mechanics: how do we mechanically derive the plural morphology without attributing to the grammar "intuition"?

local effects discussed in this paper is explained by allowing a bundle of features to be contextually "adjusted" (either post-syntactically or in the narrow syntax). That is, the reason we see syncretism is because some feature bundle has been transformed to look like another feature bundle.

What I consider to be the most fleshed-out theory of post-syntactic feature adjustment is Harbour (2003c, 2008a) *et seq.*[21] Harbour takes on the challenge using the complex data from Kiowa (Tanoan), motivating a process called "Feature Insertion", which works in conjunction with Impoverishment (i.e., Feature Deletion) to derive the surface patterns of agreement. (In fact, his rules are established mainly to account for local effects, specifically when there's a 1st person subject and a 2nd person "internal" argument.) In his system, there's an Impoverishment rule that first deletes the features of the subject in the context of a non-singular 1st subject (A=Agent) and 2nd indirect object (G=Goal), (28). Then there is a general well-formedness constraint that regulates against a feature bundle lacking number features, (29). In such cases, the unmarked feature is inserted.[22]

(28) *Impoverishment*
αF $\longrightarrow \emptyset$ / $[_A \_\_]$ $[_G\ ]$ (Harbour, 2003b:576)

(29) *Feature Insertion*
$\emptyset \longrightarrow$ [−singular] (Harbour, 2003b:562)

Adapting this account into Nocte, we would say that when 1→2, the number features of the subject are deleted by an impoverishment rule like (28), and then the subject feature bundle is subject to the insertion rule in (29).[23] This would yield the correct morphology (allowing for an extra stipulation that only one feature bundle is spelled out). But the question is the status of the feature deletion mechanism. This is a purely formal device to derive the surface patterns. In other words, such processes are simply a formal recapitulation of the surface patterns.

However, even if we can justify this sort of story, there are actually empirical problems when there is a more complex interaction. Consider Mapudungun again. Recall that when 1sg→2sg, dual morphology is used, and when 1→2, and the total number of participants is greater than 2, plural morphology is used. With Harbour's system, it doesn't seem possible to derive the correct pattern. Whenever 1→2 the Impoverishment rule will delete all the number features, and then Feature Insertion will insert [−singular]. That is, we should expect that in all contexts of 1→2 the result should be a general *plural* insertion, not sometimes dual and sometimes plural. Moreover, it's not clear how we could handle the inclusive distinctions discussed in subsection 4.1. Presumably a narrower set of Impoverishment/Insertion rules can be proposed to cover the data, but the more specific the stipulation, the higher the theoretical cost.

Trommer (2006) makes, I think, the most significant headway towards a solution. Like Harbour, Trommer argues that local effects are all post-syntactic in nature, and result from the ordering of insertion of vocabulary items and abstract

[21] See also Noyer (1992, 1998, 2001).

[22] The complexities of Kiowa's number system are well beyond the scope of this paper. I merely discuss a small subset of the relevant data.

[23] Note that even in this theory, it is assumed that the agreement mechanism morphosyntactically localizes the features. Instead of being realized as a portmanteau, this local relationship triggers the adjustment rules.

markedness constraints. In this way, the cross-linguistic presence of person hierarchies and local effects are somewhat epiphenomenal in that there is nothing built into the mechanism of agreement or spell-out which we can point to as the source of the portmanteau forms, apart from appeals to abstract notions of markedness. Putting aside whether this is a productive way to formalize person hierarchies, Trommer (2006) correctly recognizes the importance of the syncretism in languages like Nocte, and proposes that number "features" are represented by "•". Singular is [•] and non-singular is [••]. The parallel to the proposal above should be clear.

Formally, one problem for this approach, as pointed out by Georgi (2011), is that it makes portmanteau allomorphy (and local effects) a non-local (in the morpho-syntactic sense) phenomenon. Without some mechanism for allowing the interaction of the features of the subject and object, the mechanism massively over-generates where portmanteaux should appear, as any feature present in the syntax may trigger allomorphy of some other feature.

An equally serious issue involves how Trommer specifies his Vocabulary Items (VIs). He relies on "suppressing" VIs, which are null morphemes spelled out in the context of some feature. "I propose to shift perspective and to treat the phenomenon not as a competition process, but as direct suppression of features with lower prominence in the context of a head with higher-prominence features" (Trommer, 2006:223). For instance, he proposes the following VI.

(30) $\emptyset \leftrightarrow$ [+2] / [-3]

This VI operates (in an ordered list with others) so that 2nd person will be spelled out as null in the context of a non-3rd person. In this way, person hierarchy effects are the result of making sure that null morphology bleeds the insertion of more "default" morphology.[24] The problem is that this system allows a VI such as in (31)

(31) $\emptyset \leftrightarrow$ [-1] / [-2]

This VI would suppress non-1st arguments (2nd/3rd) in the presence of non-2nd arguments (1st/3rd). Thus, we could potentially have a situation in which

[24] The full set of VIs are given in (i). The brace notation ({}) allows for a contextual trigger that may or may not be on the same head.

(i) a. -h ↔ [−1 Nom] / [−3 Acc]
b. **-e ↔ [+1•] / {−3•}**
c. ∅ ↔ [+3] / [−3]
d. ∅ ↔ [+2] / [−3]
e. -an ↔ [+2 ••]
f. -ang ↔ [+1]
g. -o ↔ [+2]
h. -a ↔ [+3]

The crucial VI is (ib), which expresses -*e* when [+1•] are in the presence of [−3•] on the same head, or when it's on another head.

1st is suppressed in the context of 3rd, giving rise to a 3 > 1 hierarchy. Such a hierarchy is unreported.[25]

I should note that the two theories of featural decomposition are distinct as well, though they are superficially similar. Trommer proposes an additional constraint (essentially an implicature for the morphology) that restricts [•] to mean "one" when there's something else that means "more than one". Semantically, then, [•] and [IND] have opposite meanings. [IND] means "one"—or more accurately, "is atomic," while [•] on its own means "one or more." Moreover [IND IND] means "one or more," while [••] means strictly greater than one. The difference is important because, as pointed out by a number of authors, plurals include atomic elements, and do not mean strictly greater than two (Sauerland et al., 2005; Bale et al., 2011) among others. Thus, it's not clear that Trommer's approach actually aligns the semantic and morphological components in a meaningful way.[26]

An explanation that is more in line with what I've proposed above is offered by Georgi (2011, 2012) as well as Woolford (2012). Although using different frameworks, both accounts argue that local effects are the result of spelling out a feature bundle which is comprised of the features of two distinct arguments. Starting with Woolford, she argues that (some) agreement portmanteaux are the result of post-syntactic alignment constraints, which require that all person features be aligned with the edge of the verb. Consider the tableau in Table 7, where the input consists of a 2nd person clitic, a 1st person agreement morpheme, and the verb stem. The constraint says "align local features with the left-edge of the verb".[27]

		2ndCl 1stAgr verb	[local]→verb
☞	a.	pormanteau-verb	
	b.	2ndCl-1stAgr-verb	*

Table 7: Woolford's derivation for morphological portmanteau

The idea behind this analysis is that in order to satisfy the requirement that all the person features are aligned with the edge of the verb, a portmanteau form is used, which expresses (opaquely) both the 1st and 2nd person features. The b. form in Table 7 loses because the 2nd person clitic violates the alignment constraint. As noted by Woolford (p. 6), this analysis runs into difficulty when we consider that local effects are very often *unidirectional*. For instance, in Nocte, we see local effects when 1→2, but not when 2→1. An alignment analysis fails to capture this

[25] Note that switching [-1] and [-2] in (31) (as it's not clear to me which feature should have a lower prominence in terms of markedness) would not fix the matter, since then we'd expect 3 > 2.

[26] An additional difference is that in the system proposed in this paper, there is an inherent connection between person and number, in that the former cannot be represented without the latter. This is not the case in Trommer's system, where the person features are at least conceptually independent from the number features. Although I believe my proposal is supported in the data, I concede that more investigation is needed.

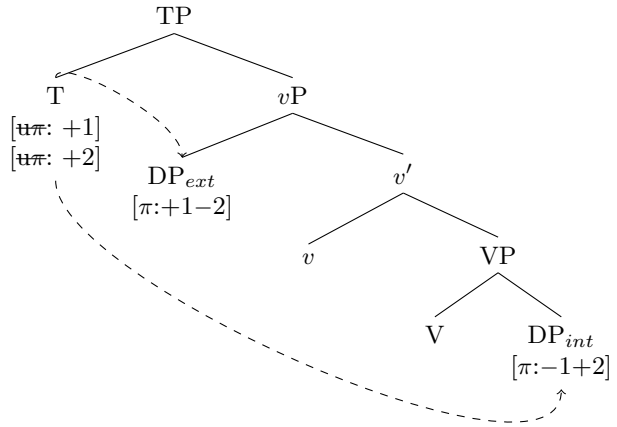
[27] Woolford argues that there are two ways to construct agreement portmanteaux. In the first way, agreement mechanisms in the syntax can build a features bundle. For all intents and purposes this is what I argue as well, although, with some basic differences which are outside the scope of this paper. The second way, outlined in the tableau in (7), post-syntactic alignment constraints require a feature bundle to be built after syntax.

asymmetry, since both contexts should be expected to be subject to the constraint on person alignment. Woolford argues that the unidirectionality comes from the fact that "there are no 2→1 morphemes in the lexicon" (p. 7). Additionally, we can overcome the issue by creating constraints which make reference to grammatical function, but not without introducing additional complications, like whether the post-syntactic component is able to recognize a subject from an object.

However, even if Woolford's arguments in favor of an alignment analysis are successful, we now have to deal with languages like Nocte and Karuk in which the "portmanteaux" form is syncretic with the form used for 1pl. The only thing Woolford can say here is that there is accidental homophony. The combination of 1st and 2nd person features results in a morpheme that happens to be syncretic with a morpheme that corresponds to a plural category. I addressed above why this is problematic.

Finally, Georgi (2011, 2012) offers an Agree-based account similar to my own. She proposes that a probe situated high in the structure can build a complex feature bundle by copying the phi-features from two distinct sources in the syntax. In her view, *all* opaque portmanteaux that arise in local contexts are essentially inclusive morphemes — morphemes expressing 1st and 2nd person. To derive this, she allows probes to "target only positive values of person features" (Georgi, 2011:1).[28] (She assumes that only 1st and 2nd person have positive values of person features.) In this way, a transitive verb with two local arguments will derive a complex feature bundle. In (32), a probe on T copies the positive [+1] feature from the subject and the positive [+2] feature from the object creating a bundle with [+1+2] bundle on T.

(32) Positive-feature copying (Georgi, 2011:3)



She predicts that there should be a systematic syncretism between inclusive morphology and local effects, since [+1+2] is the feature specification for inclusive morphology. As noted above, this prediction is borne out in a number of languages, where the inclusive morpheme appears in local contexts. However, there

[28] I noted earlier that she also proposes that this may be parametric, so that some languages can copy all the features of an argument that is agreed with.

are a number of problems with this approach as well. First, like Woolford, it is unclear how she can derive the unidirectionality seen in languages like Nocte. That is, if a probe can target the positive values of person features of the subject and object, why would one configuration of positive values (e.g., 1→2) result in local effects, while the other (2→1) result in a non-portmanteau form? The second and third problems for Georgi have already been mentioned. First, there are languages that utilize the exclusive morpheme in local contexts. And second, she has no way of handling languages like Nocte, which uses a general 1pl morpheme, not 1 inclusive. She would have to postulate, like Woolford, an accidental syncretism.

In general, the proposal presented in this paper has the advantage of not only being mechanically simpler, since it forgoes the stipulated post-syntactic processes needed in traditional Distributed Morphology to derive the patterns in favor of the processes of agreement which we need anyway. The proposal is also able to explain the range of variation in morphological expression of local effects, i.e., why syncretisms occur (and what the syncretisms are). Moreover, it correctly captures *when* local effects arise, i.e., why they are predominantly unidirectional.

8 Implications and Extensions

Reformulating number as morphologically decompositional allows us to capture a range of further data. Notably, whenever there is an apparent mismatch between the number features introduced in the syntax and the number features expressed in the morphology.

8.1 Resolved agreement

Consider first Resolved Agreement, in which coordinated phrases trigger agreement with a predicate. In (33), plural agreement on the verb reflects the semantic notion of a set of individuals, but, crucially, cannot be due to a plural feature on either of the arguments.

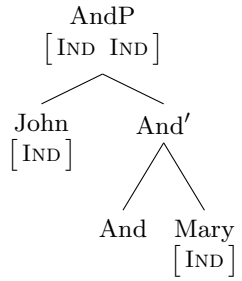
(33) a. John and Mary are eating rice
b. *Juan y María comieron arroz*
Juan and Maria ate.3pl rice
'Juan and Maria ate rice'

English is rather a poor example of this phenomenon, considering the overall lack of verbal inflection, (33a), but languages which encode more on the verb also show plural agreement in these situations, e.g., Spanish, (33b).[29] Again, the form of the verb is intuitively plural given that the subject phrase is a plural entity, consisting of two people. But this does not explain why morphology should reflect a feature [+plural] when none has been merged in the derivation. Under

[29] Note that a default agreement approach in the context of coordinated subjects is difficult to maintain because languages still retain certain featural information, like person and gender/noun class. Furthermore, languages which display further number distinctions, like dual, are sensitive to how many elements are coordinated. Thus, it is unlikely that And^0 comes with a default [+plural] feature.

the decompositional approach to morphological number proposed in this paper, the plural morphology seen on the verb is derived straightforwardly via feature percolation, where the features of the two arguments are collected on AndP, which is what the verb agrees with.

(34) Coordination with feature percolation



The appearance of plural morphology is a natural consequence of coordination, rather than a stipulation about features.

8.2 Split-antecedent pronominal binding

Consider next split-antecedent pronominal binding. In these contexts, the bound pronoun is necessarily plural and in fact reflects the phi-features of both of its (structurally independent) antecedents (Heim, 2008; Sudo, 2012).

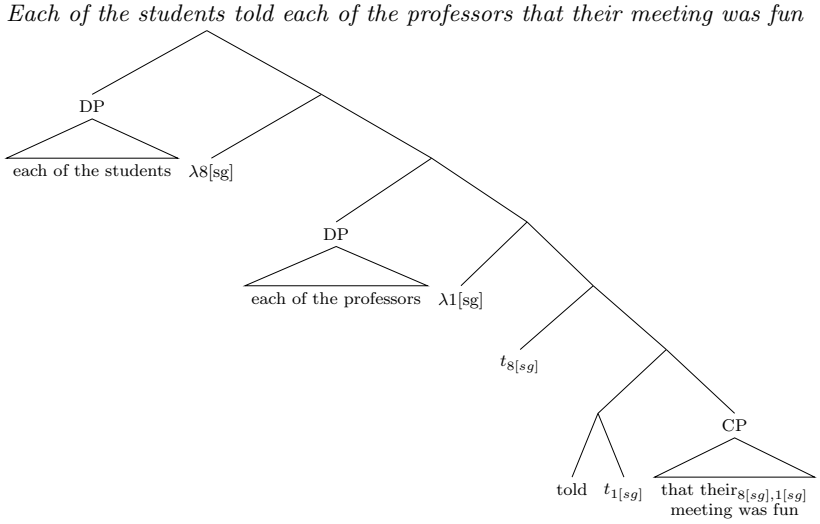
(35) {Each of the students}$_i$ told {each of the professors}$_j$ that their$_{i+j}$ meeting was fun.

(Sudo, 2012:178)

The relevant interpretation of (35) is the one in which the pronoun *their* has two (singular) antecedents, *each of the students* and *each of the professors*. In this type of partial binding, the plural number on the pronoun reflects the singular features on two syntactically distinct antecedents. That is, precisely as with local effects and Resolved Agreement, the features of two (syntactically distinct) arguments may be morphologically reflected in one place.

Sudo argues that indices can be "enriched" with featural information, and so when a binder passes its index to the pronoun, the phi-features come with it. A sketch of the idea behind this approach is represented in (36), taken from Sudo (2012), employing standard analyses for variable binding (cf. Heim and Kratzer 1998).

(36) *Each of the students told each of the professors that their meeting was fun*



In (36), both of the binders contribute their phi-featural information to the pronoun *their*, which then reflects the sum total of the features. But note that there is no plural feature associated with the pronoun. Under a view in which number features are specified as, say, [±plural], neither argument provides a [+plural] feature, making the plural morphology on the bound pronoun mysterious.

The problem goes away immediately once all the [sg] features in (36) are switched to [Ind]. In this case, *their* will bear two Ind features, and be correctly realized as plural. The empirical facts are derived without further comment.

9 Typology and acquisition

One clear objection to the proposed system of number features concerns typology. Most of the proposed features systems have bene developed by taking into consideration the range of number categories that are found cross-linguistically. For instance, feature systems have tried to *derive* the fact that there is no language with anything over a "quadral" number — and even this is exceedingly rare (Corbett, 2000; Cysouw, 2011). The natural response given this typological upper-limit is to suggests a limited number of number features, such that all possible combinations of features exhausts the space of typologically possible number categories (Cysouw, 2011; Harbour, 2003a, 2006).

Clearly, the proposal in this paper will fall short on this metric. There is nothing built into the system to prevent a hypothetical language which maps, say, seven Ind features to an exponent, i.e., a "septal" number. I suggest the response should lie within the innate limits on cognition. It has been recognized for some time that children are born with the innate ability to compute small sets, containing one, two, or three elements (Wynn, 1992; Dehaene, 1997; Wynn et al., 2002).

> "While young children's numerical abilities are real, they are strictly limited to the most elementary of arithmetic. In the first place, their abilities for exact calculations do not seem to extend beyond the numbers 1, 2, 3,

> and perhaps 4. Whenever experiments involve sets of two or three objects, infants are found to discriminate them. However, only occasionally are they shown to differentiate three versus four. And never can a group of babies under one year of age distinguish four dots from five or even from six. Apparently, babies only have an accurate knowledge of the first few numbers." (Dehaene, 1997:56-57)

With respect to number morphology, a child could potentially be able to handle mapping a group of group two or three IND features to a phonological form, but because a set containing seven or ten IND features is outside the cognitive limits of the child-learner, no language will ever develop a septal or decal system.

Precisely such an approach has been implemented in Ramscar et al. (2011) *et seq*, which models the learning of number words in acquisition as an associative process. Moreover, a similar approach derives number Markedness (at least morphologically) quite naturally. As shown in Malouf et al. (2015), an associative computational model based on semantic information (i.e., sets) and real-world frequency information about number can derive Greenberg's Universal 34, which states that there is no language with a plural without a singular, and no language with a dual without a plural, etc. Such an explanation goes beyond merely stipulating that UG contains a certain set of features, which any given language may or may not make use of.

10 Conclusion

The present study has argued for a reanalysis of the featural representation of morphological number. Focusing on a subset of languages within the empirical domain of local contexts, it was shown that a surface (1st person) plural agreement marker used in local contexts is the result of realizing the phi-featural content of both arguments. A theory of featural representation was proposed to account for the plural morphology in these contexts. The argument was that even though no plural entity was merged in the syntax, plural morphology can be expressed due to the fact that plural exponence does not rely on the availability of a dedicated plural features, rather it relies on the presence of more than one atomic IND feature. Data from a number of languages was provided to support the claim, including languages which exhibit inclusive and exclusive distinctions. The arguments were extended to other empirical domains, and it was shown that the approach here correctly accounts for phenomena outside of local contexts, such as agreement with coordinated subjects, and split-antecedent bound pronouns.

The proposed theory is in line with the Minimalist Program in that it reduces the language faculty to contain only those items which are essential for the computation of language, and nothing else. The same representation underlies both morphology and semantics. Note that this reduction in features does not entail an increase in computational complexity. Morphological spell-out functions precisely as before, with bundles of features being associated with phonological form. In this way, the decompositional view of number morphology is theoretically superior in that it merges semantic and morphological (and syntactic) theories.

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