Frankenduals:
Their typology, structure, and significance*

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Abstract. Frankenduals, that is, duals composed (as in Hopi) of a nonsingular and a nonplural morpheme, display a consistent asymmetry. The first typological study of its kind shows that the element closer to the nominal is sensitive to (non)singularity, whereas the one sensitive to (non)plurality is more peripheral. This pattern impacts on morphology (dual featurally crosscuts singular and plural), morphosemantics (number features are sensitive to order of composition), and syntax and its interfaces (the features are interpreted and pronounced where they are merged). The resulting account builds on Hale's (1986) idea that features are semantically broad, ontologically flexible, and category independent.

Keywords: composed dual, features, Hopi, number, typology.

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1. Introduction

$1+3 \neq 2$. Yet in Hopi, grammar and arithmetic come apart. The language achieves reference to 'two' (2) by combining a verb from the singular (1) with a pronoun from the plural (3) (Hale 1997: 74).[1]

(1) *Pam* *wari.*
that.SG run.NPL
'(S)he ran.'

(2) *Puma* *wari.*
that.NSG run.NPL
'They$_2$ ran.'

(3) *Puma* *yùutu.*
that.NSG run.PL
'They$_{3+}$ ran.'

Most languages simply lack dual where they lack dual-specific morphemes and treat analogues of (2) as ungrammatical. In standard English, for instance, **They runs* is ungrammatical (cp, (21)–(23) in Belfast English).

Frankenduals—as I will term these duals stitched together from morphemes used for singular and plural in the absence of dedicated dual morphology—have long been appreciated across a range of linguistic disciplines, endeavours, and frameworks (*e.g.*, Voegelin and Voegelin 1957, Jeanne 1978, Noyer 1992, Hale 1997, Plank 1997, Corbett 2000, Harley and Ritter 2002, Adger 2003, Bliss 2005, Cowper 2005, Nevins 2011, Sadler 2011, Arka 2012a, Dalrymple 2012, Harbour 2014). The main conclusion that theoreticians have drawn from the phenomenon, as first formulated by Jeanne (*op. cit.*: 74), is that dual is not a semantic primitive. Rather, it is composed of more basic features (Hale 1973, Silverstein 1976), as shown abstractly in (4):

(4)

singular	F′	G
dual	F	G
plural	F	G′

[1]The Leipzig glossing conventions are followed, with the following additions: AREAL, so-called areal agreement (Tlicho); CONV.PNVT, so-called conversive causative punctiliar (Zuni); FSP, feminine speaker (Yuchi); GRPL, greater plural (Mokilese); INCR, so-called root increment, *k* (Hopi); PVB, preverb (Tlicho); RECIP, reciprocal (Tlicho). Where necessary, subscripted numerals disambiguate English translations (*e.g.*, you$_2$, 'you two'; you$_{2+}$, 'you two or more'). Original orthographies have been retained (hence the differences between examples in Hopi and Zuni).

	Pronoun	Verb	Features
Singular	*pam*	$\left\{\underline{\underline{\textit{wari}}}\right\}$	+atomic $\left\{\underline{\underline{+\text{minimal}}}\right\}$
Dual	$\left\{\underline{\textit{puma}}\right\}$		$\left\{\underline{-\text{atomic}}\right\}$
Plural		*yùutu*	−minimal

Table 1: Hopi: shared morphemes, shared features

The dual shares F with plural, capturing the occurrence of *puma* in (2)–(3), as opposed to *pam* (F′) in singular (1), and dual further shares G with singular, capturing the occurrence of *wari* in (1)–(2), as opposed to *yùutu* (G′) in plural (3). Anticipating the features adopted below, this leads to the feature-exponent isomorphism illustrated in table 1. (In what follows, dual exponents shared with plural are single underlined, those shared with singular, double underlined, as in (4).)

The field has been decidedly less united on what these F's and G's are. The above-cited authors disagree on valence, on the viability of cardinality-based definitions, on the adequacy of first-order predicates, and on the nature of the syntax-semantics interface. This paper contends that Frankenduals are actually decisive on these issues.

The starting point for this case is the fullest typology of the phenomenon gathered to date (section 2). It shows that, though Frankenduals vary considerably, they are subject to a unifying generalisation:[2]

(5) *Frankendual Generalisation*
For N, a nominal with Frankendual, the morpheme closer to N registers (non)singularity, the one further away registers (non)plurality.

This generalisation follows straightforwardly from Harbour's (2014) formalisation of Noyer's (1992) definition of Hale's (1973) features (section 3). The number system singular-dual-plural arises from two features, as per table 1. However, these three numbers result only if ±atomic composes with N and ±minimal subsequently composes with their output. (So, single-underlined exponents reflect features that compose first, double-underlined exponents, those that compose second.) This asymmetry is precisely what the Frankendual Generalisation reports.

[2]Bliss (2005, 11) briefly makes the same generalisation for the languages discussed in Corbett 2000, Hopi, Kawaiisu, and Zuni (see footnote 22 for discussion). More passing reference occurs in Harley and Ritter 2002, 493, note 11, and Cowper 2005, 443, note 3.

Adopting the feature system above is not by itself enough to derive (5). A total of four specific assumptions are necessary (section 4). Two of these have already been mentioned: the right feature inventory, one where dual shares both with singular and with plural, and the right feature semantics, one that embeds a compositional asymmetry in the form of sensitivity to order between the features that generate singular-dual-plural. Additionally, we need the right feature syntax: the two number features must be merged in different locations, not collocated, copied, then differentially ignored in each locus. And last, we require a transparent syntax-semantic interface: if the connection between syntax and semantics is too loose (as on some LFG approaches), then the Frankendual Generalisation remains underived, even if the three preceding conditions are met.

This analysis leads to a deeper question (section 5.1): what is a feature for nominal number doing in the verbal domain? Supporting Hale's (1986) case for ontologically flexible, category-independent features, Harbour 2014 argues that ±minimal is not simply a "number feature" but is logically equivalent to core concepts of aspect/telicity. Frankenduals like Hopi (1)–(3), which distribute number features between noun and verb, offer, then, a simultaneous glimpse of a two different categorial behaviours of a single feature: they show ±minimal with the verbal distribution typical of its aspectual use but with the nominal interpretation typical of numerical use. These data, then, are the converse of classic cases where nominal number imposes restrictions on verbal aspect. Continuing in this vein, section 5.2 analyses Frankenduals that do not involve both nominal and verbal elements and argues that the mechanisms underlying the Frankendual Generalisation might be detectable in a greater range grammatical structures.

Properly understood, then, Frankenduals are not typological freaks, but well behaved creatures that fill in a gap in our map of nominal-verbal interactions and deliver concrete insights into the inventory, definitions, and distributions of features and the morphosyntactic and semanticosyntactic interfaces that they traverse.

2. Typology

Frankenduals are a rare phenomenon. Extensive searching of potentially pertinent typologies (*e.g.*, Corbett 2000, Veselinova 2006, 2013) and of grammars and theoretical articles, together with not negligible serendipity, has brought to light the typology in table 2. Its exact size depends on how one counts related languages. I argue below that the Malayo-Polynesian languages should be taken as separate data points, but I have not analysed Dene, Uto-Aztecan, and Yam similarly and so

treat them, conservatively, as single data points (cf, Bobaljik 2012).[3]

This certainly makes the phenomenon a *rarum* or *rarissimum* on various typologists' views (Cysouw and Wohlgemuth 2010). However, rarity does not entail irrelevance. Following Harbour 2016 (on patterns of morphological compositionality in person), I regard statistically minor patterns as being nonetheless of likely theoretical significance if they are diverse with respect to geography, genetics, and grammar. The typology here is robust in that sense, as I will now show, with particular reference to Chamorro and Hiw.[4]

Geographically, table 2 spans five regions: the Island of Ireland, eastern Russia, the western Pacific, the southern border area of Indonesian Papua and Papua New Guinea, and North America. Secondarily, there is considerable geographic distance within these regions. Some 4000km separate both Chamorro from Hiw and, say, Tlicho (a.k.a. Tłı̨chǫ Yatìì, Dogrib) from Zuni.

These five geographic regions are mutually genetically distinct. Moreover, there is genetic diversity internal to two of the three regions with multiple languages. In Western Papua and Papua New Guinea, we find an isolate (Marori) and members of the Yam family (Ngkolmpu, *etc*.). Similarly, in North America, the pattern occurs in numerous Dene languages (Tlicho, *etc*.), two Uto-Aztecan languages (Hopi, Kawaiisu), and three further isolates (Tonkawa, Yuchi, Zuni).[5]

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[3]Such analysis, though beyond the bounds of this paper, should be possible and productive for Dene, which is distributed discontinuously over the Northwest Territories in Canada and California, Oklahoma, and the Southwest in the United States. As more documentation of Yam languages and their neighbours becomes available, these questions could be addressed there too. Information on Kawaiisu is too scant for the issue to be fully addressed in Uto-Aztecan. Zigmond, Booth, and Munro (1990, 76) write only that "[a]lthough there are no lexically dual verbs, a dual subject is expressed by using a morphologically plural subject noun phrases … with a singular intransitive verb stem" and provide the example below (cf, *ibid.*, 67):

(i) *Si?imɨ wɨnɨ- dɨ- mɨ.*
they stand.SG-NMZ-PL
'They$_2$ are standing.'

[4]Given the typology's size, I have folded most data exposition into the flow of the argument. Yuchi and Zuni and their complications are discussed in appendix A. The remaining languages are found as follows: Belfast English (21)–(23); Chamorro (9)–(20); Hiw (6)–(8), footnote 7; Hopi (1)–(3), (45)–(47), (64)–(76), (96)–(98), footnote 17 (on Kawaiisu, see footnote 3); Koryak (92)–(94); Marori (83)–(91), footnote 14; Mi'gmaq (95), table 6; Ngkolmpu (77)–(82), footnote 11; Tlicho (55)–(60), (105)–(107), footnote 13; Tonkawa (99), table 7.

[5]The occurrence of so many isolates in this sample is rather curious. Plank 1997 (and p.c.) indicates that Wilhelm Geuder had data from case patterns in Irish Gaelic that also might constitute Frankenduals, but I have not been able to find them. If so, the Island of Ireland would be a second

Language	Family	Location
Belfast English	Indo-European	Island of Ireland
Koryak	Chukotko-Kamchatkan	Kamchtka, Russia
Chamorro	Malayo-Polynesian	Guam
Hiw	Malayo-Polynesian	Vanuatu
Marori	Isolate	Papua, Indonesia
Ngkolmpu, ...	Yam (Morehead-Maro)	Papua, Indonesia
Hopi, ...	Uto-Aztecan	Arizona, USA
Mi'gmaq	Eastern Algonquian	New Brunswick, Canada
Tlicho, ...	Dene	Northwest Territories, Canada
Tonkawa	Isolate	Texas, USA
Yuchi	Isolate	Oklahoma, USA
Zuni	Isolate	New Mexico, USA

Table 2: Frankenduals crosslinguistically

Despite this genetic diversity and the distances involved, borrowing or inheritance scenarios are still not impossible. However, at least two factors minimise this concern. First, it is not clear what borrowing scenario could account for the full range of North American cases. Bunzel's Zuni texts (1933, 1933–1938) mention several encounters with Hopi, including a joint ritual salt gathering, which might possibly be a vehicle for transmitting Frankenduals; but beyond this, I do not see much scope for other borrowings (except perhaps between the Dene language Kiowa Apache and Yuchi, if, indeed, Kiowa Apache has or had the phenomenon). Second, even amongst some of the related languages, the genetic distance is quite substantial. Hiw, for instance, is buried deep within the diversification of Oceanic branch of Eastern Malayo-Polynesian, whilst Chamorro forms its own branch of the higher grouping, Central-Eastern Malayo-Polynesian (Hammarström, Forkel, and Haspelmath 2017). Similarly, where Hopi is its own branch of Northern Uto-Aztecan, Kawaiisu belongs to Southern Numic, that is, the southern group of a separate branch (*ibid.*).

Related to the last set of concerns is the grammatical diversity of how Frankenduals present. Their grammatical extent and means of expression vary between languages. Hiw (François 2009, p.c.) registers the plural-nonplural sensitivity via

region, like Malayo-Polynesia, with multiple, not closely related languages, from the Celtic and Germanic branches of Indo-European.

suppletion, like Hopi (1)–(3). In (6)–(8), the object pronouns (singular–dual–plural) *e–se–se* crosscut with *not–not–rōt'* (< *rōte*) 'hit'.

(6) *Ne temët not i- e.*
ART ghost hit.NPL OBJ-3SG
'The ghost hit him/her.'

(7) *Ne temët not i- se.*
ART ghost hit.NPL OBJ-3NSG
'The ghost killed them$_2$.'

(8) *Ne temët rōt' i- se.*
ART ghost hit.PL OBJ-3NSG
'The ghost killed them$_{3+}$.'

Chamorro uses affixation instead.[6] Illustrating the indefinite object antipassive, (9)–(11) crosscut first exclusive *yo'–ham–ham* with the verbal affix ∅–∅–*man*.

(9) ∅- *Man- li'e' yo' guma'.*
NPL-DETR-see 1SG house
'I saw a house.'

(10) ∅- *Man- li'e' ham guma'.*
NPL-DETR-see 1EX.NSG house
'We.EX$_2$ saw a house.'

(11) *Man-man- li'e' ham guma'.*
PL- DETR-see 1EX.NSG house
'We.EX$_{3+}$ saw a house.'

Not only are the means available to Frankenduals different in these related languages, but so is their pervasiveness. In Hiw, the construction is limited to object of transitives.[7] In Chamorro, by contrast, Frankenduals occur, not only for subjects

[6]My exposition of Chamorro follows Plank 1997, which relies on more than 20 studies of aspects of the language. In all cases, both in Chamorro and beyond, when an overt morpheme contrasts with an absence of material, I insert "∅" into the gloss line. This is for clarity only and is not meant to claim that an actual zero morpheme is present.

[7]For subjects, including subjects of intransitives, a specialised morpheme, *-rē*, is added to the nonsingular pronouns, *kimi* in (ii)–(iii), for a morphologically dedicated dual (François 2009):

(i) *Ike sō.*
2SG fall.NPL
'You$_1$ fall.'

of indefinite object antipassives, but for arguments of three further constructions, namely, subjects of intransitives:

(12) *H⟨um⟩anao gue' para Saipan.*
⟨NPL⟩go 3SG to Saipan
'(S)he went to Saipan.'

(13) *H⟨um⟩anao siha para Saipan.*
⟨NPL⟩go 3NSG to Saipan
'They$_2$ went to Saipan.'

(14) *Man-hanao siha para Saipan.*
PL- go 3NSG to Saipan
'They$_{3+}$ went to Saipan.'

as well as nonthird persons in the future tense:

(15) *Para un saga giya Yigo.*
FUT 2SG stay in Yigo
'You$_1$ will stay in Yigo.'

(16) *Para en saga giya Yigo.*
FUT 2NSG stay in Yigo
'You$_2$ will stay in Yigo.'

(17) *Para en fañaga giya Yigo.* *fañaga < fan-saga*
FUT 2NSG PL.stay in Yigo PL- stay
'You$_{3+}$ will stay in Yigo.'

and nonfocused agents of object-focused verbs:

(18) *L⟨in⟩i'e' i ma'estro ni patgon.*
⟨NPL$_S$.FOC$_O$⟩see DEF teacher DEF.NFOC child.SG
'The child saw the *teacher*.'

(ii) *Kimi- rē sō.*
2NSG-DU fall.NPL
'You$_2$ fall.'

(iii) *Kimi iw.*
2NSG fall.PL
'You$_{3+}$ fall.'

(19) *L⟨in⟩i'e'* *i* *ma'estro* *ni* *famagu'on.*
⟨NPL$_S$.FOC$_O$⟩see DEF teacher DEF.NFOC child.NSG
'The children$_2$ saw the *teacher*.'

(20) *Ma-* *li'e'* *i* *ma'estro* *ni* *famagu'on.*
PL$_S$.FOC$_O$-see DEF teacher DEF.NFOC child.NSG
'The children$_{3+}$ saw the *teacher*.'

Internal to Chamorro, the grammatical resources that each of these constructions uses again show variation. In the indefinite object antipassive and the future, nonplural verbal marking is null (9)–(10), (15)–(16). By contrast, intransitive subjects and nonfocused agents of object-focused verbs use infixes for nonplural, (12)–(13) *-um-* and (18)–(19) *-in-*. Plural marking is prefixal in all four constructions, but varies between (11)/(14) *man-*, (17) *fan-*, and (20) *ma-*.

Chamorro Frankenduals are, moreover, more productive than in Hiw. Because Hiw's are confined to objects and depend on suppletion, the phenomenon is restricted by the set of verbs that so supplete. Although the language has, by crosslinguistic standards, many suppletive pairs (about 30; François 2009), the construction is far more restricted than in Chamorro, where it relies on productive inflectional morphology and affects a range of argument roles.

Given their difference in point of grammatical resources, constructions affected, and language-internal pervasiveness, I count Hiw and Chamorro as separate data points. That Chamorro has undergone broad-scale relexification from Spanish might be considered a further distancing factor between it and Hiw. Thus, genetic relatedness still leaves scope for variation significant enough for languages to be counted separately (and, to repeat, I treat Dene, Uto-Aztecan, and Yam as single data points not because they demonstrably lack such internal variation, but because the matter requires enquiry beyond current confines).

The degree of difference between Chamorro and Hiw far from exhausts the grammatical variety from which Frankenduals are assembled, as we will see as the discussion progressions. As a brief foretaste, the inflectional versus suppletive patterns of Chamorro and Hiw are not mutually exclusive. Hopi, for instance, displays both, as do Ngkolmpu and Zuni. Nor does Hiw represent the most marginal end of the spectrum. In Yuchi and some Dene languages, the phenomenon is again dependent on the small stock of suppletive verbs, but, additionally, it is confined to particular persons—in Yuchi, just to the inclusive.

Finally, the phenomenon does not require a collaboration between nouns and verbs, but can arise between other categories or within single ones. Hopi is particularly rich in the range of ways that Frankenduals present (section 5). This

	±atomic	±minimal
Singular	+atomic	+minimal
Dual	+atomic	−minimal
Plural	−atomic	−minimal

Table 3: Features of singular, dual, plural

language-internal grammatical diversification is consistent with Frankenduals being a longstanding property of Hopi grammar. In this, they again contrast with other members of the typology. In Belfast English (Henry 2005, 1610–1611), for instance, the pattern in (21)–(23), while analogous with Hopi (1)–(3), appears to have arisen as an innovation of a few speakers:

(21) The man is talking.

(22) The (two) men is talking.

(23) The (more than two) men are talking.

Given these geographic, genetic, and grammatical differences, it is striking that all the languages in table 2 should obey the same generalisation linking (non)proximity to the noun (in)sensitivity to singularity. So, I now turn to the derivation of that generalisation.

3. Features

Table 3 presents the feature system on which the derivation of the Frankendual Generalisation rests. It gives the specifications of singular, dual, and plural in terms of ±atomic and ±minimal. As stated in the introduction, these are Hale's (1973) features, as reworked in Noyer 1992 and formalised in Harbour 2014. This section justifies the table in informal terms.

An important byproduct of this exposition will be the following lemma:

(24) *Lemma*
A nominal N has the number contrast singular-dual-plural only if ±atomic composes with N and then ±minimal composes with their output, and not the reverse.

That is, ±minimal(±atomic(N)), not ±atomic(±minimal(N)), is the order of

composition. The explanatory appeal of this result should be immediately apparent. The asymmetry in sensitivities within Frankenduals finds a parallel asymmetry in the order of composition of number features. The next section will build this into an explanation of the generalisation. For now, we concentrate on table 3 and the lemma.

I take these features to apply to the power set minus the empty set (*i.e.*, the join-complete atomic semilattice) of elements that satisfy the corresponding nominal predicate, that is:[8]

(25) $[\![\text{noun}]\!] = \lambda x \in D_e \,.\, \text{noun}(x)$

So, for example, *cat* denotes $\lambda x \in D_e \,.\, \text{cat}(x)$, the set of cat individuals, cat pairs, cat triples, and so on. Numbers like singular, dual, and plural restrict the variable x to particular parts of the *cat* lattice.

Informally, we can represent the noun as denoting a set of singletons, dyads, and larger elements (built out of the atomic instances of the noun):

(26) $[\![\text{noun}]\!] = \{\text{singletons, dyads, triads, tetrads, } \dots\}$

Applying +atomic to (26) picks out just the singletons:

(27) $[\![+\text{atomic(noun)}]\!] = \{\text{singletons}\}$

Because atoms are, by definition, minimal, the feature +minimal acts redundantly on (27), yielding the same set as +atomic alone:

(28) $[\![+\text{minimal}(+\text{atomic}(\text{noun}))]\!]$
$= [\![+\text{minimal}]\!](\{\text{singletons}\})$
$= \{\text{singletons}\}$

This justifies the specification of singular as plus-plus.

Complementarily, −minimal is contradictory when applied to +atomic: there are, by definition, no nonminimal elements in a set of singletons. So, this specification delivers no number at all.

(29) $[\![-\text{minimal}(+\text{atomic}(\text{noun}))]\!] = [\![-\text{minimal}]\!](\{\text{singletons}\}) = \varnothing$

This justifies the absence of −minimal +atomic from table 3.

[8] Although I represent this denotation as coming directly from the root, it is more likely the combined denotation of the root and the functional material that intervenes between it and the number features (see Borer 2005 amongst others).

For the nonsingulars, we apply −atomic. This feature picks out the complement to (28), that is, everything except the singletons:

(30) $[\![-\text{atomic(noun)}]\!] = \{\text{dyads, triads, tetrads, } \dots\}$

From this, +minimal picks out the smallest elements, which are the dyads:

(31) $[\![+\text{minimal}(-\text{atomic(noun)})]\!] = \{\text{dyads}\}$

So, +minimal(−atomic(noun)) delivers the dual. Switching from plus to minus again yields the complement, so −minimal applied to (30) yields the plural:

(32) $[\![-\text{minimal}(-\text{atomic(noun)})]\!] = \{\text{triads, tetrads, } \dots\}$

This completes the justification of table 3 and shows that, when ±atomic composes before ±minimal, the features deliver only singular, dual, and plural.

Given that these features are in exactly the same sharing relationships with respect to singular and plural as Hopi pronouns and verbs are (table 1), we can write the following vocabulary entries (abstracting away from the person features; see Harbour 2016 for a proposal):

(33) *Hopi*
$[+\text{atomic } 3] \mapsto$ *pam*
$[-\text{atomic } 3] \mapsto$ *puma*

This directly encodes the sensitivity of the pronoun to (non)singularity via the feature ±atomic. Likewise, for the verb root $\sqrt{\text{RUN}}$, we can encode the sensitivity to (non)plurality via the feature ±minimal (either as fused exponents, as shown below, or as number-sensitive root allomorphs):

(34) *Hopi*
$[+\text{minimal } \sqrt{\text{RUN}}] \mapsto$ *wari*
$[-\text{minimal } \sqrt{\text{RUN}}] \mapsto$ *yùutu*

This is descriptively adequate, but not explanatory. We could just as easily write entries with the features swapped to generate "Anti-Hopi", a language with a complementary distribution of features:

(35) *Anti-Hopi*
$[\pm\text{minimal } 3] \mapsto$ *pam* / *puma*
$[\pm\text{atomic } \sqrt{\text{RUN}}] \mapsto$ *wari* / *yùutu*

This apparently models a language in which the pronoun is sensitive to (non)plurality and the verb, to (non)singularity, contradicting the Frankendual Generalization.

However, in the current feature system, there is more to generating singular-dual-plural than having the right features. The features need to compose in the right order: atomic-before-minimal is crucial.

To see this, consider a common noun. Under the order of composition minimal-before-atomic, the two opposite-value specifications constitute irreconcilable demands. Applied to the denotation of the noun, +minimal picks out just the singletons, as these are, by definition, the most minimal.

(36) $[\![+\text{minimal}(\text{noun})]\!] = \{\text{singletons}\}$

Everything in this set is +atomic. So, applying −atomic yields nothing:

(37) $[\![-\text{atomic}(+\text{minimal}(\text{noun}))]\!] = \varnothing$

Similarly, applying −minimal to the noun picks out just the nonsingletons, the complement of (36):

(38) $[\![-\text{minimal}(\text{noun})]\!] = \{\text{dyads, triads, } \dots\}$

Everything in this set is −atomic. So, applying +atomic again yields nothing:

(39) $[\![+\text{atomic}(-\text{minimal}(\text{noun}))]\!] = \varnothing$

With two out of four feature-value combinations delivering nothing (as opposed to just one such zero in the reverse order), this order of composition cannot generate a three-member number system.

This establishes Lemma (24), that only one order of composition delivers the number system singular-dual-plural. Empirically, it entails that, if Anti-Hopi exists, it will not deliver a tripartite system, with the reverse sensitivities as Hopi. Instead, with ±minimal as part of the nominal and, so, composing before ±atomic, a bipartite number systems will result. So, we leave this system aside and continue with trying to explain the structural sensitivities of Frankenduals.

4. Derivation

At this point, derivation of the Frankendual Generalization is quite simple. By table 3, ±atomic is the feature that contrasts singular with nonsingular, whereas ±minimal contrasts nonplural with plural. Lemma (24) states that, in order of

composition, ±atomic must be closer to the nominal than ±minimal. Thus, we have that the element responsible for (non)singular sensitivity must be closer to the nominal than the element responsible for (non)plurality. This is essential the content of the Frankendual Generalisation.

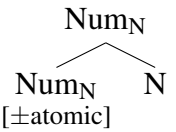
As phrased, this derivation assumes transparent correspondences between order of composition in the semantics and the locus of exponence in the morphology. It requires morpheme order to reflect semantic scope (cf, Baker 1985, Rice 2000). In terms of the syntacticocentric Y-model of grammar (Chomsky 1995), this equates to transparent interfaces, such that the features are located where they are pronounced and are interpreted where they are located. Section 4.1 shows that the tools already exist for ensuring this transparency whilst nonetheless permitting the diversely distributed number features to combine semantically.

The system as a whole is further justified in sections 4.2–4.4. These examine extant proposals for alternative feature definitions and less transparent syntax-morphology and syntax-semantics interfaces. All lose the explanation of the Frankendual Generalisation just given. This therefore establishes the claim made in the introduction that Frankenduals do not just tell us about the inventory of features, but also about the semantics of the features and the interfaces that they traverse.

4.1. Implementation

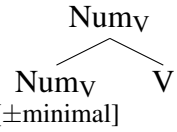
Consider again Hopi (1)–(3). A transparent mapping from syntax to morphology means that (non)singular morphemes on the noun realize ±atomic in the nominal extended projection (many accounts posit a low number head for precisely such features; Ritter 1993, Borer 2005, Harbour 2007, Acquaviva 2008, i.a.):

(40)



Similarly, (non)plural morphemes on the verb realize ±minimal in the verbal projection. For convenience, I posit a second number head (the nature of which we return to in section 5.1) and distinguish it from the nominal version by subscripts:

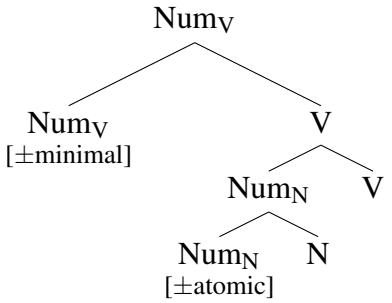
(41)



This much is straightforward and simply spells out the explanation at the opening of section 4. However, ultimately, both number features must come, in the semantics, to modify the noun. How they come to do that, given the syntactic distance between them, presents a challenge. However, syntactic theory is already equipped with mechanisms to faciliate this.

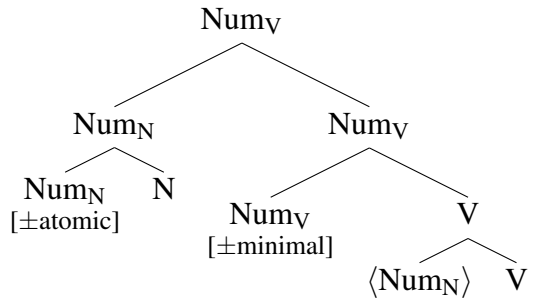
The essential idea is (Williams 2003, Sportiche 2005) is that DP arguments of the verb can be constructed by accretive movement of an initially smaller nominal up the verbal spine. I will assume that the nominal bearing ±atomic (40) is merged as the argument of V in (41), before the verbal Number head projects:

(42)



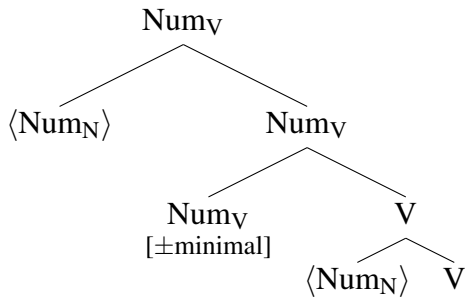
The noun and its number projection move into the specifier of the verbal number projection, as shown in (43). This, I will assume (but see immediately below), establishes sufficient proximity for ±minimal to apply to ±atomic(N).

(43)



Further movement (landing site not shown) can then target the noun and its number while leaving verbal number containing ±minimal in situ:

(44)



The assumption that semantic composition is enabled by movement of Num_N through Num_V is a simplistic one, and more sophisticated alternatives have been proposed. The compositional semantics of accretively constructed DPs have been well explored (see, e.g., Svenonius 2005 on idioms, Johnson 2012 on *wh*-elements and quantifiers). Specifics aside, the movements, just as in the current account, allow for things like ±minimal to apply to elements like the number head that hosts ±atomic adjoined via Move (secondary Merge) rather than first Merge. As desired, then, ±minimal comes to apply to the noun, but not without ±atomic, which is nearer, applying first.

With regard to pronunciation, the system is flexible. The exponents for 'run' in (34) are suppletive, but nothing forces this (a necessity if we are to capture the use of verbal inflection in Chamorro; section 2). In Hopi, the means of expression in the verb are very varied. Instead of coalescing with the root, number can be fused with a grammatical affix, as in possessives (Kalectaca 1978, 82–86). Or plurality can be expressed as an independent morpheme, via reduplication (*ti̶wa* 'see.NPL', *ti̶twa* 'see.PL'), infixation (*co'omti* 'jump.NPL', *co'om⟨to⟩ti* 'jump.PL'), or suffixation (*hohonaqa* 'play.NPL', *hohonaq-ya* 'play.PL') (Jeanne 1978, 86–88). The first and last of these four options are illustrated below (Kalectaca 1978, 85, modulo a change in person; Hale, Jeanne, and Pranka 1991, 258):

(45)
Nu' tsoongo-'ta̲.
1SG pipe- POSS.NPL
'I have a pipe.'

Nu' hohonaqa-∅̲.
1SG play- NPL
'I play.'

(46)
Uma tsoongo-'ta̲.
2NSG pipe- POSS.NPL
'You$_2$ have a pipe.'

'Itam hohonaqa-∅̲.
1NSG play- NPL
'We$_2$ play.'

(47)
Uma tsoongo-'yungwa.
2NSG pipe- POSS.PL
'You$_{3+}$ have a pipe.'

'Itam hohonaq-ya.
1NSG play- PL
'We$_{3+}$ play.'

Writing exponents for the above is straightforward. In addition to (33)–(34) for the suppletive case, see (51) for Hale *et al*.'s examples.[9]

So the compositional semantics and variable exponence of Hopi (and other) Frankenduals can be easily implemented in a quite standard theory of syntax and its interfaces. No assumptions without independent motivation are called for. But that is not to say the result is trivial. The remainder of this section shows that the derivation of the Frankendual Generalization is lost if one assumes different feature definitions, a different feature syntax and mapping to morphology, or a different mapping to semantics.

4.2. Requisite I: Feature semantics

In their treatments of Frankenduals, Cowper (2005) and Arka (2012a; see also Sadler 2011) posit quite different features, both from each other and from those given above. Cowper's are privative, with plural more heavily endowed than dual, whereas Arka's are bivalent and specified in equal measure for all numbers. Despite these differences, a property that they share is definition in terms of cardinality. This reflected directly in Cowper's feature names (see also Bliss 2005): ">1", ">2". Arka (2012a:17), though he uses abbreviated versions of Hale's feature names, defines his similarly: $-$SG as "two or more" and $+$PL as "three or more" (the opposite signs are defined complementarily, e.g., $-$PL "either one or two"). Because of its similarity to Hale's system (and hence mine), I focus on Arka's proposals, but the comments apply generally to this class of approaches.

The first thing to note is that Arka's features are isomorphic to those in section 3. Though $\pm$minimal and $\pm$PL take opposite values, the systems as wholes replicate Jeanne's and Hale's original results in defining the same pair of natural classes with dual at their intersection (table 4).[10] So, one might expect the two

[9]The variable realization of $\pm$minimal is a matter of syntax as much as one of exponence. Jeanne (1978, 92) observes that suppletive verbs that take the (apparently meaningless) verbal increment *k* before other suffixes may mark plurality twice, for some speakers. Hence, alongside *yɨʔtɨ* 'run.PL', there exists *yɨʔtɨ-k-ya* 'run.PL-INCR-PL'. This alone does not prove that there are the two syntactic loci of $-$minimal: the one realised as *ya* might be the real one and $\sqrt{\text{RUN}}$ might merely register its presence (in which case, the feature conditions allomorphy of the root). However, the two can be proven to be separate, by dint of tracking different arguments. For example, if its subject is singular, 'kill' takes the form *niina* for a singular object and *qöya* for a plural one. Subject plurality is marked separately and additionally, by suffixation in the former case, *niina-ya* kill.NPL$_{\text{O}}$-PL$_{\text{S}}$, and by reduplication in the latter, *qö⟨q⟩ya* ⟨PL$_{\text{S}}$⟩kill.PL$_{\text{O}}$ (Jeanne 1978, 93–94). I leave these issues aside, as they belong to an investigation of the featural syntax of Hopi.

[10]Sadler (2011) uses the same notation as Arka but posits $+$SG $+$PL for dual. Her features are

	Current system	Arka's system
Singular	+atomic +minimal	+SG −PL
Dual	−atomic +minimal	−SG −PL
Plural	−atomic −minimal	−SG +PL

Table 4: Isomorphic systems of nonequivalent features

systems to be equivalent for current purposes. They are not.

The nub of the issue is that multiple cardinality-based features are interpreted as conjunctions and conjunction is symmetric (an issue discussed more generally in Harbour 2016, chapters 7 and 9). Consider dual, −SG −PL. The feature −SG denotes a predicate, has-cardinality-two-or-more(x), which restricts a variable over singletons, dyads, triads, and so on, to everything but singletons. Similarly, the denotation of −PL, has-cardinality-one-or-two(x), confines a variable, x, over singletons, dyads, triads, tetrads, and larger, to just singletons and dyads, excluding everything triadic and larger. The conjunction of these two conditions yields the dual, the set of x satisfying has-cardinality-one-or-two(x) $\wedge$ has-cardinality-two-or-more(x).

On this way of thinking, there is no question of which feature applies first and which applies to the output of the other, as there was with ±atomic and ±minimal. The features apply to each other (function modification, Heim and Kratzer 1998):

(48) If $[\![\mathrm{F}]\!] = \lambda x.\mathrm{F}(x)$ and $[\![\mathrm{G}]\!] = \lambda x.\mathrm{G}(x)$, then $[\![\mathrm{F\ G}]\!] = \lambda x.\mathrm{F}(x) \wedge \mathrm{G}(x)$.

The following equivalence lays out the symmetry of the number features:

(49)
$$\begin{aligned}
&[\![-\mathrm{SG}]\!]\,([\![-\mathrm{PL}]\!]) \\
&= [\lambda x.\text{has-cardinality-two-or-more}(x)]\,(\lambda x.\text{has-cardinality-one-or-two}(x)) \\
&= \lambda x.\text{has-cardinality-two-or-more}(x) \wedge \text{has-cardinality-one-or-two}(x) \\
&= [\lambda x.\text{has-cardinality-one-or-two}(x)]\,(\lambda x.\text{has-cardinality-two-or-more}(x)) \\
&= [\![-\mathrm{PL}]\!]\,([\![-\mathrm{SG}]\!])
\end{aligned}$$

Because conjunction ("$\wedge$") is the semantic glue that binds the two feature denotations together, function application is inherently symmetrical (cats and dogs are dogs and cats). Both "orders" result in the same conjunction, making order of composition is immaterial.

Translating this result into the syntax, it does not matter which number feature

not defined, but presumably her α_{SG} is Arka's $-\alpha_{\mathrm{PL}}$, and her α_{PL}, his $-\alpha_{\mathrm{SG}}$.

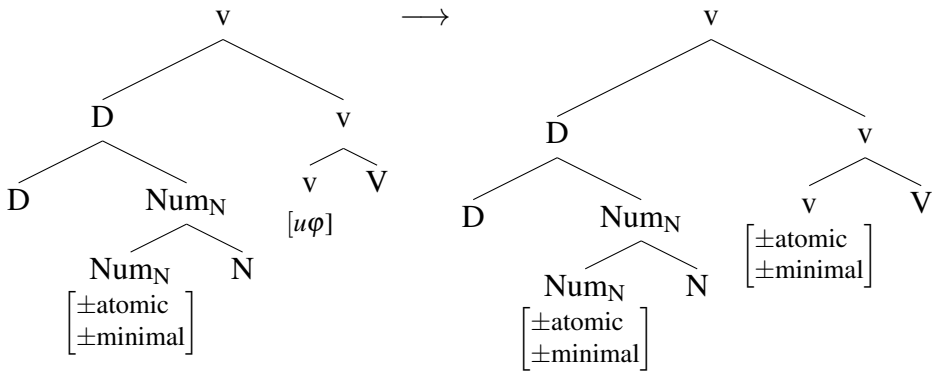
goes where. The same conjunction will result. So, we can take the syntax from the previous section and put ±SG on the nominal and ±PL on the verb or vice versa and without any semantic difference.

Thus, the right pattern of feature sharing between singular and dual and between dual and plural is not enough to explain the Frankendual Generalisation. Explanation requires the right feature semantics as well. With a purely first order semantics, there is no asymmetry in order of composition and so nothing that forces one feature to be closer to the nominal than the other. Since this asymmetry drives the Frankendual Generalisation, its explanation vanishes without it.

4.3. Requisite II: Feature syntax and the syntax-morphology interface

It is common to treat properties of nouns that are encoded on verbs as the result of feature copying from a fully specified noun. On this approach, the nominal number head would bear both ±atomic and ±minimal. This dispenses with the accretive approach to DP structure. Instead, we posit a full DP argument which agrees with uninterpretable phi features ($u\varphi$) on v, presumably as part of a case licensing process (person features and transmission via D are ignored):

(50)



An example of this approach is Nevins' (2008, 361) suggestion the singularity-sensitive pronoun and plurality-sensitive verb might be head and tail of a single agreement chain.

The approach is clearly descriptively adequate. The exponents in (51) for the singularity-sensitive nominal and the plurality-sensitive verb can be applied to the agreement Num$_N$-v agreement chain in (50) to produce 'I/we play' (45)–(47).

(51) *Hopi*
[±atomic 1] ↦ *nu'*/*'itam*

$[\pm\text{minimal v}] \mapsto \emptyset/ya$
$[\sqrt{\text{PLAY}}] \mapsto hohonaq(a)$

Singular-sensitivity is absent from the verb, and plurality-sensitivity from the noun, because no verbal exponents mention ±atomic nor any nominal exponents ±minimal.

The issue with this approach is obvious, given the previous subsection. Once number features are everywhere, they are equally accessible to noun and verb. So, it is just as easy to write vocabulary entries with the reverse sensitivities to (51):

(52) *Anti-Hopi*
$[\pm\text{atomic}] \mapsto \emptyset/ya$
$[\pm\text{minimal 1}] \mapsto nu'/'itam$

In contrast to the previous example of Anti-Hopi (35), the feature semantics cannot prevent violation of the Frankendual Generalisation. All the number semantics takes place within the number head, which contains both features. (Previously, they were both placed in number heads, but in different locations and had, therefore, to be assembled in the only order that syntactic movement could contrive.) Pronunciation is entirely autonomous from this, and so can expose or ignore the features wherever it chooses.

Of course, features do go unpronounced at times. But where they are systematically silent, positing them is questionable. Sadler (2011, 411) urges that we posit "only those distinctions in the paradigm space which are overtly evidenced by realization": when "we have no morphological evidence for postulating [a] distinction, … it should be eliminated from the morphological paradigm space for that category". For Frankenduals, Sadler's view is more than a heuristic. Its violation generates unattested grammars.[11]

A morphologist might attempt to save the current alternative by appealing to impoverishment, that is, selective feature deletion (Bonet 1991, Halle 1997). Es-

[11] This is not to rule out zero morphemes. They are crucial for the treatment of Ngkolmpu. There, first and second person show a singular-nonsingular contrast and lead to transparent Frankenduals ((77)–(79), footnote 11), but third person is *pi* for all numbers. If number is posited as present but silent, the verb will still distinguish plural (−minimal) from singular-dual (+minimal), even if exponence fails to reflect the semantic distinction between singular (+atomic) and dual-plural (−atomic). This correctly captures the attenuated Frankendual pattern in (i) and (ii):

(i) *Markus-u pi su- merk*
Markus-ERG.SG DEM SG:3.REC-follow
'Markus followed him/them$_2$.'

sentially, insensitivity to specific features can be forced by stripping them out. This kind of approached is pursued in Bobaljik 2002 for metasyncretism. In the current context, it is not explanatory, though, for the reasons for which Béjar (2003) criticizes partial exponence accounts of subject/object agreement competition. One can just as easily write one set of impoverishment rules as the opposite:

(53) *Hopi "impoverishment"*
$\pm$atomic $\mapsto \emptyset$ / V
$\pm$minimal $\mapsto \emptyset$ / N

(54) *Anti-Hopi "impoverishment"*
$\pm$minimal $\mapsto \emptyset$ / V
$\pm$atomic $\mapsto \emptyset$ / N

Clearly, (53) gets the results we want and (54) does not, but why should grammars reliably choose the former over the latter? (Similar questions arise for other morphological approaches, such as Nevins' (2008, 361) suggestion that the Hopi pattern might arise from fission of $\pm$atomic from the verb into subject position.)

A common move for sorting natural impoverishments from unnatural ones is appeal to markedness (*e.g.*, Noyer 1998, Nevins 2011). However, I do not see any explanation in such a move here. Noyer and Nevins argue for the markedness of particular feature-value combinations in the context of others (cf, (108)), but the current case requires markedness of whole features, irrespective of values, in the context of particular categories. Even in the case of (53), which is meant to derive a real language, this does not look crosslinguistically plausible.

First, $\pm$minimal is a perfectly acceptable nominal feature. It regularly cooccurs with $\pm$singular in languages that have singular, dual, and plural in the nominal domain (*e.g.*, Jeanne 1978, Noyer 1992, Hale 1997, Harbour 2007). Moreover, in the many languages with minimal-augmented number and the few with minimal, unit augmented, and augmented (Corbett 2000, Cysouw 2003), it is the only nominal number feature (Noyer 1992, Harbour 2011a). So, a markedness constraint affecting $\pm$minimal on N, with or without $\pm$atomic, is dubious.

Second, verbs are perfectly capable of sensitivity to $\pm$singular. This is obvious in the many languages that display verb agreement for the number, as in standard English. More relevant here, though, are languages with suppletion for number.

(ii) *Markus-u pi su- merk- ntn*
Markus-ERG.SG DEM SG:3.REC-follow-PL
'Markus followed them$_{3+}$.'

	SG	DL	PL	
Western Shoshoni	*wene"*	*tsatsakkih*	*topo'ih*	'stand'
	nukki	*nunukki*	*nutaan*	'run'
	nemi	*yeyenka*	*yenka*	'travel, live'
	pite	*pippite*	———	'arrive' (NDL–DL)
	uttuh	*himi*		'give' (SG–NSG)
Koasati	*á:tan*	*áswan*	*í:san*	'dwell'
	acapílkan	*askáhlin*		'release' (SG–NSG)
	íllin		*hápkan*	'die' (NPL–PL)
Kiowa	*êl*	*bîn*		'big' (SG–NSG)
	tsél		*sául*	'be set' (NPL–PL)

Table 5: Suppletive variation in three North American languages

Amongst these, suppletion for (non)singularity is well attested and languages can display a variety of patterns simultaneously (table 5).[12]

Even more relevant here are Frankenduals with verbs that display sensitivity to (non)singularity on top of their more usual (non)plurality sensitivity. Tlicho is one of several Dene languages that illustrate this. Regular Frankenduals in the language are structured as follows (Jaker, Sangris, and Sundberg 2013, 173, Nicholas Welch p.c.):

(55) *sǫnà-ne- wo*
play- 2SG-do.NPL
'you$_1$ play'

sǫnà-∅- wo
play- 3SG-do.NPL
'he/she plays'

(56) *sǫnà-ah- who*
play- 2NSG-do.NPL
'you$_2$ play'

sǫnà-ge- wo
play- 3NSG-do.NPL
'they$_2$ play'

(57) *sǫnà-ah- dè*
play- 2NSG-do.PL
'you$_{3+}$ play'

sǫnà-ge- dè
play- 3NSG-do.PL
'they$_{3+}$ play'

[12]Between them, Western Shoshoni (Crum and Dayley 1993), Koasati (Kimball 1991), and Kiowa (Watkins 1984) show all four possible suppletive patterns. Multiple examples of three-way contrasts in Western Shoshoni are given to illustrate full suppletion ('stand'; cf, Koasati 'dwell') versus suppletion plus reduplication with different numbers serving as the reduplicative base (singular for 'run', plural for 'travel, live'). The two-way suppletive examples use both these means.

However, in a small clutch of verbs, the nonplural forms additionally show sensitivity for (non)singularity. For instance, 'sit' shows a three-way contrast (Ackroyd 1982, 72, Jaker, Sangris, and Sundberg 2013, 186):[13]

(58) *whe- ne- da*
STAT-2SG-sit.SG
'you$_1$ sit'

(59) *wh- ah- ke*
STAT-2NSG-sit.DU
'you$_2$ sit'

(60) *wh- ah- kw'e*
STAT-2NSG-sit.PL
'you$_{3+}$ sit'

The relevant exponents for Tlicho 'sit', then, include allomorphic sensitivity to the presence of ±atomic for the nonplural root.

(61) $[+\text{minimal } \sqrt{\text{SIT}}] \mapsto \begin{cases} da \;/\; +\text{atomic} \\ ke \;/\; -\text{atomic} \end{cases}$
$[-\text{minimal } \sqrt{\text{SIT}}] \mapsto kw'e$

[13]Tlicho verbs can show a three-way number contrast by other means too. On first person, see section 5.1 and (105)–(107). A wholly different pattern arises with, for instance, 'dance' (Jaker, Sangris, and Sundberg 2013, 48). Although the root itself is equipped to deliver a Frankendual (it suppletes as *tłǫ* for nonplural, *who* for plural), its preverbs distinguish between nonplurals via a reciprocal, *łe*, in the dual, and "areal agreement", *go*, in the plural. The latter is not a plural marker *per se*, but an indicator of spatial distribution and/or abstractness (Nicholas Welch, p.c.). Featural analysis of these morphemes lies beyond current bounds (and beyond my current expertise).

(i) *da- ∅- tłǫ*
PVB-3SG-dance.NPL
'he/she dances'

(ii) *da- **łe**- ge- tłǫ*
PVB-RECIP-3NSG-dance.NPL
'they$_2$ dance'

(iii) *da- **go**- ge- who*
PVB-AREAL-3NSG-dance.PL
'they$_{3+}$ dance'

The range of these phenomena call into question the plausibility of a markedness constraint on ±atomic in the verbal domain or on ±minimal in the nominal. As a result, appeals to markedness cannot make impoverishment rules like (53) any more explanatory.

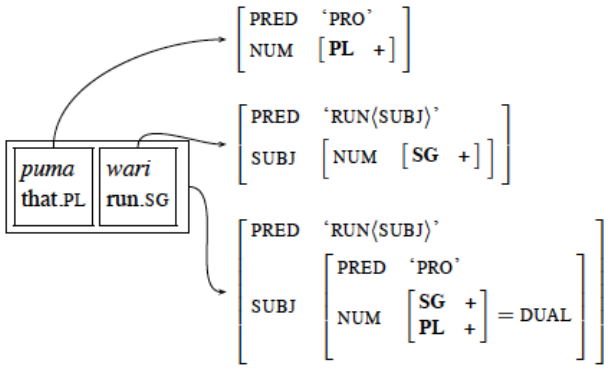
In sum, having the right feature sharing relations and the right feature semantics is not enough. These features need to be sparingly distributed, so that only nominals have primary access to ±atomic, and only verbs, to ±minimal. When languages permit the verb access to ±atomic, as in (58)–(61) or the noun, to ±minimal (section 5.1, (105)–(107)), these arise as enrichments of the more spartan distribution that underlies Frankenduals.

4.4. Requisite III: The syntax-semantics interface

Frankenduals have received generous attention in a number of approximately contemporaneous works in Lexical Functional Grammar (LFG; Bresnan 2001, Dalrymple 2001): Arka 2011, Sadler 2011, Arka 2012a, 2012b, Dalrymple 2012, Arka and Dalrymple 2016. These accounts differ from the current one in terms of the syntax-semantics interface they posit, or, in LFG terminology, how feature structure is related to constituent structure (as well as in their feature semantics, section 4.2). This undoes the explanation of the Frankendual Generalization.

A major point of agreement between the LFG approach and the current one concerns feature syntax. Dalrymple (2012, 9) presents (62), a schematic constituent structure (left) of the Hopi sentence (2) with feature structures corresponding to each of the boxed constituents on the right. As per section 4.3, there is one feature on each of the noun (top feature structure) and the verb (middle).

(62)



Moreover, if, as per footnote 10, we read −atomic for +PL in feature structure connected to *puma* and +minimal for +SG in that for *wari*, then the features are

in the correct configuration to derive the Frankendual Generalization: ±atomic on the nominal, ±minimal on the verb.

However, the mapping between constituent and feature structures does not force this correlation. The feature structure for the whole sentence (bottom right) simply pools the number specifications of the previous two. So, the same sentential matrix would result if the locations of ±atomic and ±minimal (or ±SG and ±PL) were reversed. Arka's notation is clear on this point. He uses set theoretic union ($\cup$) to represent feature pooling. This leads to the same formal problem as using conjunction to combine feature denotations (section 4.2). Like conjunction, set union is commutative ($A \cup B = B \cup A$).

This problem of the syntax-semantics arises irrespective of the feature definitions assumed. That is, even if conjunction-based first-order features are replaced with the order-sensitive features of section 3, the symmetric pooling mechanism overwrites asymmetric syntactic distribution: Frankenduals and their reverse become equally easily generable.

5. Feature flexibility

The foregoing discussion shows that asymmetry of order of composition, Lemma (24), explains the Frankendual Generalisation provided it is embedded in a syntax with sufficiently transparent interfaces to morphology and semantics. An obvious question, though, arises from this explanation: what is a feature for nominal number doing in the verbal domain?

This section argues that this question rests on a misconception. A feature's being used for number does not make it is a number feature, nor does its modifying nouns, or occurring on them, make it nominal. Since at least Hale 1986, there have been arguments features definitions should be ontologically flexible (covering, for instance, aspect and obliques) and, correspondingly, syntactically flexible (occurring in the verbal and nominal domains). Frankenduals' theoretical import is not confined to what they show about the order of composition of number features. They also show that features can be flexible in the way that Hale envisaged.

Section 5.1 argues that Frankenduals reinforce an independent argument for the flexibility of ±minimal. They show a feature that can be either nominal and verbal in interpretation and distribution with the distribution of one use and the interpretation of the other. This claim finds further support in three empirical arguments, from Hopi postpositions, Hopi (and Dene) nominal duals, and, most strikingly, from the event enumeration use of Ngkolmpu suppletion.

Section 5.2 pursues a logical consequence of categorial flexibility, namely, the existence of intracategorial Frankenduals. These are more common in verbals than within nouns, but, in the latter, they are plausibly connected to a common design template for pronoun systems with three or more numbers. Singular pronouns are frequently morphologically unrelated to nonsingulars, which, instead, share a suppletive root. The proximity of ±atomic to person, which drives the derivation of Generalization (5) provides an obvious account of this.

5.1. Transcategorial features

Contrary to what one might expect of a feature used to created nominal duals, ±minimal is not a nominal feature. To be sure, it is occurs on nominals. See, for instance, Harbour 2007, 2011b for extensive discussion of its use both for number and noun class within the nominal functional sequence. However, the concept underlying the feature leads a second life in the verbal domain. As shown in Harbour 2014, a logically equivalent paraphrase of Krifka's (1992) condition of strict cumulativity in fact contains nonminimality as a subclause:

(63) $$\underbrace{\exists x(\mathrm{P}(x) \wedge \exists y(\mathrm{P}(y) \wedge y \sqsubset x))}_{-\text{minimal}} \wedge \underbrace{\forall x \forall y((\mathrm{P}(x) \wedge \mathrm{P}(y)) \rightarrow \mathrm{P}(x \sqcup y))}_{+\text{additive}}$$

I have not attempted a feature-based recasting of Krifka's account (or of more recent accounts that inherit the same ideas). However, given that strict cumulativity is a property of events and hence verbal, the equivalence in (63) is sufficient to show that it is overly narrow to label ±minimal as nominal. It is equally at home in extended projections of both nouns and verbs. Further supporting this view, the other half of Krifka's strict cumulativity condition also corresponds to a feature, ±additive used for other nominal numbers, approximatives like paucal and greater plural.

This is, I believe, the kind of semantically general, ontologically flexible, and, hence, syntactically diverse feature that Hale envisaged in his (1986) investigation of ±central-coincidence in Warlpiri. Frankenduals, then, capture a single feature in two different guises: nominal in interpretation, verbal in distribution. Three lines of argumentation support the flexibility of ±minimal. In Hopi, Frankenduals are not limited to nouns and verbs but extend to postpositions and case. Also in Hopi (but shared with Tlicho), ±minimal can occur either on the noun (for a nominal dual) or on the verb (for a Frankendual). These possibilities are in complementary distribution, however, which follows naturally if they represent different

use of the same means. And illustrating yet another gradation between nominal and verbal uses of ±minimal, languages like Ngkolmpu use their morphological resources for counting verbal entities (*i.e.*, events), as well as nominal ones.

A variety of research (*e.g.*, Koopman 2000, Svenonius 2007, Zwarts 2008) has pointed to a close relationship between verbal and adpositional structures (and Hale 1986 argued for featural commonality between verbs and adposition-like cases). In this vein, Hopi exhibits Frankenduals composed from case on animate nouns and number on postpositions Jeanne (1978, 98):

(64) *nɨʔ ʔi- t maana-t ʔa-∅̲- mɨm tɨmalaʔyta*
1SG this.SG-OBL.SG girl- OBL.SG 3- NPL-with work
'I work with this girl.'

(65) *nɨʔ ʔimɨ̲- y̲ maana-tɨ̲- y̲ ʔa-∅̲- mɨm tɨmalaʔyta*
1SG this.NSG-OBL.NSG girl- NSG-OBL.NSG 3- NPL-with work
'I work with these$_2$ girls.'

(66) *nɨʔ ʔimɨ̲- y̲ ma-man-tɨ̲- y̲ ʔa-mɨ-mɨm tɨmalaʔyta*
1SG this.NSG-OBL.NSG PL- girl- NSG-OBL.NSG 3- PL-with work
'I work with these$_{3+}$ girls.'

The postposition 'with' assigns oblique case to its complement, 'this girl', 'these girls'. The exponents of case, expressed both on the demonstrative and on the noun, display a singular-nonsingular pattern, *t–y–y*, like the demonstratives, singular *ʔi* and nonsingular *ʔimɨ*. Number marking on the postposition itself displays a nonplural-plural contrast, ∅–∅–*mɨ*.

In fact, the head noun 'girl(s)' is omissible from the postpositional phrase (Kenneth Hill, p.c.), leading to a Frankendual between the demonstratives and case, on the one hand, and number marking on the postposition, on the other:

(67) *ʔi- t ʔa-∅̲- mɨm*
this.SG-OBL.SG 3- NPL-with
'with this (one)'

(68) *ʔimɨ̲- y̲ ʔa-∅̲- mɨm*
this.NSG-OBL.NSG 3- NPL-with
'with these$_2$ (two)'

(69) *ʔimɨ̲- y̲ ʔa-mɨ-mɨm*
this.NSG-OBL.NSG 3- PL-with
'with these$_{3+}$ (ones)'

These facts fit neatly with the transcategorial view. If one and the same feature can be located in verbal and nominal projections, then there is no prima facie reason to suppose it will not be found in other projections, like adpositions.

Purely nominal dual in Hopi offer a second supporting argument for the transcategorial view of ±minimal. It is empirically well established that number systems can vary language internally, depending on person or noun type (Corbett 2000). So, purely nominal duals for Hopi animates (exemplifed below; and for dual-specific agreement for Tlicho first person (105)–(107)) are not surprising. The existence of subsystems of number is easily captured by a functional sequence where NumberP dominates both person and nouns (*e.g.*, Harbour 2016). But the interaction of these duals with the suppletion system needs to be captured.

The key question is whether nominals that distinguish between nonsingulars should permit a greater range of numbers when combined with number-differentiated verbs. Concretely, consider a +minimal verb, like *niina* 'kill' with the plural noun *taatapt* 'cottontails$_{3+}$'. One might reason that this should denote a killing of exactly three cottontails, as the most minimal killing of three or more is a killing of three (cf, the derivation of trial in Harbour 2014). It does not. The combination is simply ungrammatical (Jeanne 1978, 100):

(70) **taa-tap-* *ti-* *y* *niina*
PL- cottontail-NSG-OBL.PL kill.NPL
'killed [some number of] cottontails'

Only three options are permitted (Jeanne 1978, 93, Kenneth Hill, p.c.):

(71) *ni?* *taavo-* *t* *niina*
1SG cottontail-OBL.SG kill.NPL
'I killed a cottontail.'

(72) *ni?* *taavo-* *ti-* *y* *niina*
1SG cottontail-NSG-OBL.NSG kill.NPL
'I killed cottontails$_2$.'

(73) *ni?* *taa-tap-* *ti-* *y* *qöya*
1SG PL- cottontail-NSG-OBL.NSG kill.PL
'I killed cottontails$_{3+}$.'

These show the same the same (non)plural pattern of suppletion as examples without nominal duals (1)–(3):

Described in theoretical terms, then, ±minimal on the verb contributes to nominal number only if the noun itself is unspecified for that feature. If, conversely, the noun is specified, then the verb does not add anything but takes its own value from noun.

Such "feature trading" has been argued for in a different domain. Analysing the Person Case Constraint, Adger and Harbour (2007) propose that the applicative head demands that its argument bear the person feature ±participant. If the applicative argument is first or second person, then it bears the feature inherently (without it, it would not mean first or second person) and values the applicative head accordingly. Matters are reversed for third persons. These need have no inherent specification for ±participant, so the applicative endows them with one.

This reasoning carries over to languages with both inherent duals and Frankenduals. Nouns unspecified for ±minimal receive a specification from the verb, as argued above. Nouns specified for ±minimal enforce that specification on the verb. The result for 'this girl / these girls entered' is a three-way number contrast on the noun (*maana* 'girl', *maanat* 'girls$_2$', *mamant* 'girls$_{3+}$') sandwiched between a Frankendual demonstrative and suppletive verb (Jeanne 1978, 73):

(74) *Mi?* *maana* *paki.*
that.SG girl enter.NPL
'That girl entered.'

(75) *Mima* *maana-t* *paki.*
that.NSG girl- NSG enter.NPL
'Those girls$_2$ entered.'

(76) *Mima* *ma-man-t* *yi■ᵑa.* should be engma
that.NSG PL- girl- NSG enter.PL
'Those girls$_{3+}$ entered.'

Taking the dual (75), for example, the number specification on the noun is −atomic +minimal. This forces the demonstrative, which is sensitive to ±atomic, to occur in its nonsingular form, *mima*, and the verb, which is sensitive to ±minimal, to occur as +minimal, *paki*.

A different and striking illustration of the principle of categorial flexibility comes from Ngkolmpu (Carroll 2014, 10–11) and its neighbourhood. The language is not only rich in morphological resources for Frankenduals (with over half its verbs encoding number), but the same verbal forms serve two distinct semantic purposes. The first is nominal number, as in Frankenduals. The a singular-nonsingular distinction for, for instance, first person pronouns, *ngko* 'I' versus *ni*

'we', meets the plural-nonplural distinction in verbs like *ntek* versus *nent* 'return' to deliver the overlap of nonsingular *ni* and nonplural *ntek* in the dual (78):

(77) *ngko kr⟨ntek⟩nt mwa- ngke*
1SG FUT⟨return⟩ house-ALL
'I will return home.'

(78) *ni kr⟨ntek⟩nt i mwa- ngke*
1NSG FUT⟨return⟩ NSG house-ALL
'We$_2$ will return home.'

(79) *ni kr⟨nent⟩nt- i mwa- ngke*
1NSG FUT⟨return.PL⟩-NSG house-ALL
'We$_{3+}$ will return home.'

Beyond this, the same distribution of verb roots is found for repetitions of the same event. Homecomings of one, two, or three (or more) people (77)–(79) and one person's returning home once, twice, or thrice (80)–(82) both use *ntek* for the first two cases and *nent* for the last.

(80) *ngko kr⟨ntek⟩nt mwa- ngke*
1SG FUT⟨return⟩ house-ALL
'I will return home.'

(81) *ngko yempokampr kr⟨ntek⟩nt mwa- ngke*
1SG twice FUT⟨return⟩ house-ALL
"I will return home twice."

(82) *ngko yuowmpr kr⟨nent⟩nt mwa- ngke*
1SG thrice FUT⟨return⟩ house-ALL
"I will return home thrice."

Similar facts may hold areally, in Ranmo, another Yam language (Lee 2016, 202), and in the isolate Marori (Arka 2012b, 10, Arka and Dalrymple 2016, 97–98).

Enumeration of events is a particularly elegant example of intermediate behaviour for a feature that is, on the one hand, verbal, used for aspect, and, on the other, nominal, used for counting. First, event enumeration is, simply, counting in the verbal domain. Second, the morphological resources that Ngkolmpu draws on are bound up with aspectual distinctions: one and the same form of the verb root, the so-called "extended stem", is used both for plural verbal number of the kind illustrated above, and for imperfective aspect. Although Carroll is careful to disentangle aspect from event plurality, the substantial overlap between plurality

and imperfectivity, notions both tied to the feature −minimal, strongly supports the current approach.

This section began with the claim that it is natural for a feature for nominal number to be located in the verbal projection because that feature, ±minimal, is in fact transcategorial. Three kinds of support have been adduced for this position. Internal to Hopi, postpositions in addition to verbs can host ±minimal, providing a second host category. Again within Hopi is the trading relation between nominal number and verbal number. Not only does this provide a third host category for ±minimal, but it shows that the nominal and verbal loci of the feature are in complementary distribution. Finally, in Ngkolmpu, the morphological means for distinguishing between aspects and for nominal counting are used for the enumeration of events, that is, for the counting of core verbal entities.

5.2. Intracategorial Frankenduals

Categorial flexibility predicts intracategorial Frankenduals. If nouns can host ±minimal and verbs, ±atomic, then the ingredients for these duals can all occur in the same extended projection. Nonetheless, if they are located on separate heads, the semantic restrictions on which feature is syntactically nearer the noun or person will still apply. In fact, purely nominal and purely verbal Frankenduals have already occurred above. The verbal pattern is the more frequent, but the nominal one is plausibly manifest in a well attested morphological template for multinumber pronoun systems. This last connection again underlines that Frankenduals are not an isolated oddment, but form part of a network of superficially divergent phenomena with shared theoretical underpinnings.

Given its rich morphology, the isolate Marori is an instructive case to consider for verb-internal Frankenduals. The language permits intercategorial Frankenduals comprising a singular-sensitive nominal and a plural-sensitive verb, and verbal sensitivity may be registered either by suppletion (Arka 2011, 7, p.c.):

(83) *Efi tanamba Merauke-ke kuye*
3SG now Merauke-LOC sit.NPL
'He/she is now in Merauke.'

(84) *Emnde tanamba Merauke-ke kuye*
3NSG now Merauke-LOC sit.NPL
'They$_2$ are now in Merauke.'

(85) *Emnde tanamba Merauke-ke mingg-ri*
3NSG now Merauke-LOC sit.PL- PL

'They$_{3+}$ are now in Merauke.'

or by marking on an auxiliary supporting the main verb (Arka 2011, 7, p.c.):

(86) *Efi yewrifam na- n bosik eyew nda- m.*
3SG woman 1SG-for pig see AUX.F-2/3.NPL.PST
'She / the woman hunted a sow for me.'

(87) *Emnde* (*yanadu*) *na- n bosik eyew nda- m.*
3NSG two 1SG-for pig see AUX.F-2/3.NPL.PST
'They$_2$ hunted a sow for me.'

(88) *Emnde* (*usindu*) *fis na- n bosik eyew nd- im.*
3NSG all yesterday 1SG-for pig see AUX.F-2/3.PL.PST
'They$_{3+}$ hunted a sow for me yesterday.'

However, on the one hand, the nominal element is dispensible and, on the other, verbs can agree in person and number, given the right combination of person, tense, and aspect. When these cooccur, verb-internal Frankenduals result, as the following second person examples show (Arka 2011, 8):[14]

[14]When they agree, first persons do so more richly than second. In (i)–(iii) (slightly reanalysed from Arka and Dalrymple 2016, 97; Arka, p.c.), two sets of exponents are specific to first person: *u–en–en*, which displays a singular-nonsingular contrast, like the pronouns, *na–nie–nie*; and *d–d–m*, which is out of kilter with the pronouns and shows the nonplural-plural contrast of the predicate number morpheme for 'be', *mbo–mbo–re*.

(i) *Na tanamba tge to- mbo- d- u.*
1SG now strong be-NPL-1NPL-1SG.PRES
'I am now strong.'

(ii) *Nie* (*yanadu*) *tanamba tge to- mbo- d- en.*
1NSG two now strong be-NPL-1NPL-1NSG.PRES
'We$_2$ (two) are now strong.'

(iii) *Nie* (*usindu*) *tanamba tge te- re- m- en.*
1NSG all now strong be-PL-1PL-1NSG.PRES
'We$_{3+}$ are (all) now strong.'

Although the resulting word-internal Frankendual is relevant to a complete typology, it is not pertinent to the theory offered here. With two first person morphemes displaying different number sensitivities, the Frankendual Generalization, though not contradicted, does not apply: neither number feature closer to the locus of person in the verb. (Analogy with second person is not obviously helpful: second person ∅*–n–n* occupies a position before the auxiliary, not after it like first, and its number morphemes are not specifically second person.) Relevant first person Frankenduals occur in the absence of person agreement (Arka and Dalrymple 2016, 97):

(89) *ksw-∅- me- ∅* (*kesweme*)
hit- 2SG-AUX.M-2/3.NPL.IRR
'you$_1$ will hit him'

(90) *ksw-n- me- ∅* (*kesneme*)
hit- 2NSG-AUX.M-2/3.NPL.IRR
'you$_2$ will hit him'

(91) *ksw-n- me- m* (*kesnemem*)
hit- 2NSG-AUX.M-2/3.PL.IRR
'you$_{3+}$ will hit him'

Verb-internal Frankenduals are also found in Tlicho (55)–(57).

In the last triplet of Marori examples, number marking is nonzero only for plural. This results in a plural, *kesnemem*, which is a substring of the dual, *kesneme*. Zero forms for singular and dual are not infrequent. Besides Marori, we have seen them already in Chamorro (9)–(10), (15)–(16) and Hopi (45)–(46). Frankenduals in two further languages present only in this fashion.

Koryak Frankenduals are, like Marori, limited to specific combinations of person, role, tense, and mood. Nonetheless, examples are frequent and clear. A simple triplet, from the hortative/imperative/jussive (Zhukova 1972, 313), is:

(92) *my- lle- ∅- gi*
1SG-take-NPL-2SG
'let me take you$_1$'

(93) *my- lle- ∅- tyk*
1SG-take-NPL-2NSG
'let me take you$_2$'

(iv) *Na John-i kamaen pnde- ∅- ben*
1SG John-U hate 3SG.M.AUX-NPL-1REC
'I$_1$ hated John'

(v) *Nie yanadu John-i kamaen pnde- ∅- ben*
1NSG two John-U hate 3SG.M.AUX-NPL-1REC
'We$_2$ hated John'

(vi) *Nie usindu John-i kamaen pnde- fre-ben*
1NSG all John-U hate 3SG.M.AUX-PL-1REC
'We$_{3+}$ hated John'

	IN	EX	2	3
Singular	—	*teluisi-∅*	*teluisi-∅-n*	*teluisi-∅-t*
Dual	*teluisi-∅-'gw*	*teluisi-∅-eg*	*teluisi-∅-oq*	*teluisi-∅-j-ig*
Plural	*teluis-ulti-'gw*	*teluis-ulti-eg*	*teluis-ulti-oq*	*teluis-ulti-j-ig*

Table 6: Mi'gmaq animate intransitive Frankendual

(94) *my- lla- la- tyk*
1SG-take-PL-2NSG
'let me take you$_{3+}$'

Plural differs from dual in the addition of *la*. Thus, dual *my-lle-tyk* a discontinuous substring of the plural *my-lla-la-tyk* (modulo vowel harmony). Clear as such examples are, a full analysis of the language's complex verbal morphology (with access to data absent from Zhukova's paradigms) would be welcome.

Mi'gmaq Frankenduals are more tightly confined than those of Koryak, occurring only in intransitives. Table 6 gives the present indicate of *teluis*(*i*) 'be named' in all persons and numbers (Little in press, 4, citing Francis and Hewson 1990, 46). The underlining shows a typical Frankendual configuration, but with no overt number exponent common to singular and dual. So, again, dual is a (discontinuous) substring of the plural, as in second person, *teluisi-oq* and *teluis-ulti-oq* (modulo the root-final vowel).[15]

Coon and Bale (2014, 97) observe that morphemes interpreted as dual in intransitives are simply nonsingular in the transitive, as in (*ibid.*, 92).

(95) *Mu nem-u'ln- u- oq.*
NEG see- 2OBJ-NEG-2PL
'I don't see you$_{2+}$.'

In fact, the dual-plual distinction is an Eastern Algonquian innovation and analogues of the intransitive dual in related languages are simply nonsingular, as they are in the Mi'gmaq transitive (Little in press, 4). The current analysis affords *oq* and its ilk a constant featural identity. They are person plus −atomic. These cover dual and plural when ±minimal is absent. But, when present −minimal *ulti* con-

[15]The third person nonsingular has separate exponents for third person, *j*, and nonsingular, *ig*, such that person is flanked by number exponents: *ulti-j-ig* PL-3-NSG. These examples are therefore neutral with respect to the Frankendual Generalisation, pending language-internal or comparative evidence on the proximity of person to either number morpheme.

fines −atomic *oq* and the like to +minimal, that is, to dual.

Intracategorial Frankenduals are attested beyond the verb. Sentences (70)–(73) and (74)–(76) illustrate the noun-internal Frankenduals of Hopi. Underlining the constituent morphemes (Jeanne 1978, 60, 77, 83, 98; cf, Hale 1997), we have:[16]

(96) *∅-taavo-∅*
NPL-cottontail-SG
'cottontail'

∅-maana-∅
NPL-girl- SG
'girl'

(97) *∅-taavo-t*
NPL-cottontail-NSG
'cottontails$_2$'

∅-maana-t
NPL-girl- NSG
'girls$_2$'

(98) *taa-tap-t*
PL- cottontail-NSG
'cottontails$_{3+}$'

ma-man-t
PL- girl- NSG
'girls$_{3+}$'

Like the Koryak and Mi'gmaq examples just examined, singular and dual do not share any overt number, making dual again a substring of plural, though one rather hidden by regular morphophonology (plural reduplication cooccurs with root-final apocope, vowel shortening, and consonant ablaut).

Hopi nominal Frankenduals are relevant to this section, instantiating the construction intracategorially. However, without further argument, they are irrelevant the Frankendual Generalization. With the plural reduplicant (*taa-*, *ma-*) prefixal and the nonsingular marker (*-t*) suffixal, linear order does not reveal which of −minimal and −atomic is nearer the root. Like Marori first person agreement (footnote 14), the facts neither contradict nor support the generalization.[17]

[16] Second Mesa Hopi has a dual-specific suffix, *vit* (Jeanne 1978, 186 note 1; Kalectaca 1978).

[17] A few nouns (Jeanne 1978, 83) appear to contradict the generalization that singularity-sensitive suffixes should be nearer the noun. For 'deer' (i)–(iii), for instance, the plurality-sensitive suffix *w–w–∅* intervenes between the root and the (non)singular marker *∅–t–t* of (96)–(98).

(i) *∅-cöövi-w-∅*
NPL-deer- AUG.NPL-SG
'deer$_1$'

(ii) *∅-cöövi-w-t*
NPL-deer- AUG.NPL-NSG
'deer$_2$'

(iii) *cöö-cöp-∅-t*
PL- deer-AUG.PL-NSG

	1	2	3
SG	*ca·-ya*	*na·-ya*	*'a-ye·-la*
DL	*geu-ca·-ya*	*we-na·-ya*	*'a-we·-la*
PL	*geu-ca·-ga*	*we-na·-ga*	*'a-we·-ga*

Table 7: Tonkawa pronouns

Tonkawa, too, presents purely nominal Frankenduals, but in its pronouns. All three persons are laid out in table 7 (Hoijer 1933–1938, 122–123), but the immediate focus is on the third person forms. These combine a third person root *'a* with two suffixes. The one nearer the root, *ye·–we·–we·*, is sensitive to (non)singularity. The final suffix, *la–la–ga*, by contrast, is sensitive to (non)plurality. This is as Generalization (5) predicts. As per Harbour 2016, I take person to be more deeply embedded than number. So, their interpretation (99) conforms to Lemma (24):

(99) $[\![$ *'a-ye·/we·-la/ga* $]\!]$
$= [\![[[[\underbrace{\textit{'a}}_{\pi}]\underbrace{\textit{ye·/we·}}_{\pm\text{atomic}}]\underbrace{\textit{la/ga}}_{\pm\text{minimal}}]]\!]$
$= [\![\pm\text{minimal}]\!]([\![\pm\text{atomic}]\!]([\![3]\!]))$

The first and second person of Tonkawa, like Hopi nouns, illustrate intracategoriality, but are not relevant to the Frankendual Generalization, as the number morphemes flank person, unless one argues that they arise by *ad hoc* linearization of the structure in (99). This means that, in contrast to verbs, nouns present very slim grounds for testing the Generalization (5).

However, the signature of the mechanisms that underlie the explanation of the Frankendual Generalization might be detectable in a rather common template for multinumber pronoun systems. Consider the emphatic pronouns of Mokilese (table 8; Harrison 1976, 89). For each person, all three nonsingular numbers share a common base: inclusive *kisa*, exclusive *kama*, second person *kamwa*, and third person *ara/ira*. These bases are, in fact, the dual forms, and plural and greater

'deer$_{3+}$'

However, this does not falsify the generalization if we accept Jeanne's analysis. As per the glossing above, she labels the *w*-suffix an "augmentative"—an historical suffix (*ibid.*, 64). As such, the morpheme is not the primary exponent of number, but a nominal formative that is sensitive to number. This means that *w* does not mark the position in which ±minimal is interpreted, It simply shows (potentially long-distance) allomorphy for that feature.

	IN	EX	2	3
SG	—	*ngoah*	*koah*	*ih*
DL	*kisa*	*kama*	*kamwa*	*ara*/*ira*
PL	*kisa-i*	*kama-i*	*kamwa-i*	*ara-i*/*ira-i*
GRPL	*kisa-*^{i} (*kihs*)	*kama-*^{i} (*kimi*)	*kamwa-*^{i} (*kimwi*)	*ara-*^{i}/*ira-*^{i} (*ihr*)

Table 8: Mokilese emphatic pronouns

plural derive from them by affixation. In contrast, the singular forms neither derive from nor derive the nonsingulars. Compare *ngoah* with *kama*, *koah* with *kamwa*, and *ih* with *ara*/*ira* (cf, Arka 2011, 10 on Manam).

Having a common base for nonsingular numbers and different one for the singular is frequent template for pronoun systems crosslinguistically. As a crude measure, I calculate that almost half (29/62) of the singular-dual-plural systems in Smith 2011 exhibit this to some extent.[18]

The account of the Frankendual Generalisation above makes this a natural pattern. Lemma (24) states that the number system singular-dual-plural requires ±atomic be the first number feature to composed with person, and the result generalizes to more complex systems, like Mokilese (Harbour 2014). This means that singular-nonsingular is the primary cut of the number space and all nonsingular numbers are refinements of it. Mokilese and similar systems plausibly reflect this. There is a fundamental morphological division reflecting the first semantic cut and additional semantic cuts correspond to additional morphological exponents. If so, the rarity of nominal and pronominal Frankenduals does not entail that the underlying mechanisms have scant application in the nominal domain. Their mark may be detectable in a wide range of pronoun systems.[19]

[18]The measure is crude because a typologically balanced sample of singular-dual-plural systems is not the same thing as the singular-dual-plural subset of a typologically balanced sample. The former might contain 19 Austronesian languages out of a total of 620, but the latter might contain the same 19 languages out of a total of 62. A 62-member typology would not be so constructed.

[19]I do not expect the reverse design of pronoun system to be impossible, however. If the number features of a pronoun reside in a single Number head, then all will be equally close person. So, all can condition person allomorphy. Nothing would then rule out person exponents that are sensitive to ±minimal, rather than ±atomic—in contrast to Frankenduals, where the semantics does not work if the sensitivities are the wrong way around. The pattern in the main text is expected to be a tendency, not a surface universal.

Grammatical Domain	Requisite
Morphology	{SG, DL} and {DL, PL} are featurally natural classes
Morphosemantics	Singular-dual-plural requires fixed order of composition
Syntax-morphology	The features are merged where they are pronounced
Syntax-semantics	The features are interpreted where they are merged

Table 9: Theoretical requisites for explaining Frankenduals

6. Conclusion and consequences

Four theoretical properties are crucial to accounting for the Frankendual Generalization. As the field has long recognized (following the implementation of Hale 1973 in Jeanne 1978), dual must lie at the featural intersection of two natural classes, one with singular, the other with plural. Additionally, the features must be so defined that only one order of composition yields the number system singular-dual-plural (Noyer 1992, Harbour 2014). Finally, this system must be embedded by two transparent interfaces. A transparent syntax-morphology interface means that the features are where you hear them, with ±atomic on the nominal and ±minimal on the verb. They are not fully specified throughout the syntax and then only partially pronounced. And a transparent syntax-semantics interface means that the two features are interpreted in order of proximity to the noun they modify.

These conditions, summarized in table 9, show that an explanation of the nature of Frankenduals makes demands across distinct subparts of the grammar. Given that the field has, for the most part, taken Frankenduals to tell us only about the shape of feature inventories and has not fully explored their typology, it is fair to say that these constructions have been underappreciated. Properly understood, they hold consequences for morphology, syntax, semantics, and their interfaces and reveal the fundamental ontological and categorial flexibility of features.

A. Data

Two members of the typology in table 2, Yuchi and Zuni, present complications that would have disturbed the flow of argument in the main text. Their details are laid out in appendices A.1 and A.2, respectively.

Person	Singular	Nonsingular	Singular	Nonsingular
IN		*'õ-di*		*'õ-k'æ*
EX	*di*	*nõ-di*	*di-k'æ*	*nõ-k'æ*
2	*tse*	*'ã-dze*	*ne-k'æ*	*'ã-k'æ*
3(M).FSP	*s'e-di*	*'o-de*	*s'e-k'æ*	*'o-k'æ*

Table 10: Yuchi pronouns (left) and a nonsuppletive verb (laugh.PRES; right)

A.1. Yuchi

Yuchi presents a standard singular-plural clusive system, as illustrated by the pronoun and the intransitive verb in table 10 (Linn 2000, 133, 198; of the elaborate third persons system, the female-speaker, nonfemale-referent forms are used). The pronominal and verbal prefixes are nearly identical across these domains.

Yuchi Frankenduals are markedly marginal. Not only do they depend on a rather scant stock of suppletive roots (seven, by my count, well under a quarter of the number of Hiw and Hopi), but they are restricted to first person inclusive. An example of the inclusive is the following (Linn 2000, 235):

(100) *ke- 'õ- wi*
PVB-1IN.NSG-pass by.NPL
'we$_2$ (you$_1$ and I) pass by'

(101) *ke- 'õ- yã*
PVB-1IN.NSG-pass by.PL
'we$_{3+}$ (you$_{2+}$ and I) pass by'

The usual triplet of examples cannot be given here, because inclusives lack singulars. Nonetheless, the Frankendual Generalization can still be seen to apply. The locus of person in this verb-internal construction is *'õ*. It is nonsingular, like *'itam* in Hopi (2)–(3). Exponents further from person, in the verb root, supply the difference between nonsingulars, *wi* for the dual and *yã* for the plural. Deriving this via the account above is straightforward. Inclusive *'õ* carries −atomic. The verb introduces +minimal or −minimal and, respectively, delivers dual or plural.

The challenge arises in explaining why the other persons do not have Frankenduals. Instead, they have a simple singular-nonsingular distinction, using *wi* for singular and *yã* for dual-plural, as in the exclusive (Linn 2000, 235):

(102) *ke- di- wi*
PVB-1EX.SG-pass by.NPL
'I pass by'

(103) *ke- nõ- yã*
PVB-1EX.NSG-pass by.PL
'we.EX_{2+} pass by'

Dual combining a nonplural root (102) with nonsingular person (103) is absent:[20]

(104) **ke- nõ- wi*
PVB-1EX.NSG-pass by.NPL
'we.EX_2 pass by'

Nothing in the theory so far leads us to expect this. Moreover, the gap differs from other person restrictions mentioned above. The Tlicho first person, for instance, lacks a Frankendual because it has a dual of its own. That is, unlike the Yuchi inclusive, it makes more distinctions than other persons. And, dual-specific agreement aside, Tlicho first persons show the same pattern of suppletion as other persons (55)–(57) (Jaker, Sangris, and Sundberg 2013, 173, Nicholas Welch p.c.):

(105) *sǫnà-h- wo*
play- 1SG-do.NPL
'I play'

(106) *sǫnà-wì- gwo*
play- 1DU-do.NPL
'we_2 play'

(107) *sǫnà-ts'e-de*
play- 1PL-do.PL
'we_{3+} play'

In consequence, the means of section 5.1 do not explain the current case.

The only way that I can see to clip the wings of the generative mechanisms underpinning Frankenduals is in the morphology. If dual (−atomic +minimal) is changed to plural (−atomic −minimal) for all persons except inclusive, then, by construction, only inclusive will distinguish dual from plural. To do this, we can

[20]The starred example is mine, based on Linn's description and the following statement of Wagner's (1933–1938, 353): "A parallel formation of an exclusive dual by prefixation of *nǫ-* to the singular stem is apparently not possible."

write (108), using the person features of Harbour 2016, where inclusive is +author +participant and all other persons have at least one negative specification:

(108) $+\text{minimal} \mapsto -\text{minimal} \;/\; \text{V}\_\_\_ \begin{bmatrix} -\text{atomic} \\ -\text{au}/-\text{pt} \end{bmatrix}$

If this rule strikes the reader as rather arbitrary, that may be no bad thing, as the Yuchi person restriction seems equally so. Nonetheless, the rule is not unprecedented: Noyer 1998 and Harbour 2003 argue that unmarked values can replace marked ones, and, in a treatment of the relative markedness of dual and plural, Nevins 2011, 421 claims that + is the marked value of ±minimal in the context of −atomic, as per (108).

There is, though, a way to account for Yuchi without resort to morphological rules and using instead the mechanisms of section 5.1. The statement two paragraphs higher that these mechanisms cannot apply here is true so long as Yuchi is assumed to use ±atomic. An alternative is to assume that it is not a singular-plural system, but a minimal-augmented one, using the feature ±minimal.

On this approach, the special property of Yuchi will lie in the inclusive, rather than in the other persons. Minimal-augmented systems typically distinguish the speaker-hearer dyad ('you$_1$ and I') and larger inclusives. For Yuchi not to do this, one must suppose, unusually, that the inclusive is unspecified for ±minimal.

With this set up, the mechanisms of section 5.1 deliver the correct results. In cases where person is specified for ±minimal, that specification is imposed on the verb. Hence, for exclusive, second person, and third, the verb root will be +minimal if and only if agreement is. The root will, therefore, add no new number distinctions. This derives the pattern in (102)–(103). Conversely, where person lacks a specification, the verb imposes one. Thus, for inclusive, the verb imposes a number distinction that person lacks, generating the difference between dual and plural (or minimal and augmented) in (100)–(101).

A language without ±atomic does not tell us about the position of the feature. So, it is only under the first analysis that Yuchi counts as relevant to the theoretical concerns of the article. I am not aware of any language that has been argued to have a minimal-augmented system on the basis of a comparably marginal number distinction in the inclusive. So, the first analysis might be preferred, in which case, Yuchi does properly belong to the typology.

A.2. Zuni

Zuni is one of the languages more widely discussed in relation to Frankenduals (*e.g.*, Corbett 2000, Bliss 2005, Cowper 2005, Nevins 2011). The examples below comprise a near minimal triple (Bunzel 1933–1938, 421, 427, Corbett 2000, 170 reporting Lynn Nichols, p.c.):[21]

(109) *ho' akc* ∅- *a·-k̂ä.*
1SG along NPL-go-PST
'I went along.'

(110) *hon* ∅- *ʔa·-kya.*
1NSG NPL-go- PST
'We$_2$ went.'

(111) *hon* *ʔa·w-ʔa·-kya.*
1NSG PL- go- PST
'We$_{3+}$ went.'

Given its use of inflectional morphology (as well as the availability of suppletives, Newman 1965, 32, 55, Nichols 1997, 231–232; see (124) below), this is a productive system of Frankenduals along the lines of Chamorro and Hopi. Moreover, like Hopi, it provides not only for intransitives like (109)–(111), but for transitives too. This holds both for objects, which use the morphological means above, as in the following near minimal tiple (Newman 1965, 60, 70):

(112) *tom* *ho'* ∅- *ʔutte-nna*
2SG.ACC 1SG NPL$_O$-bite- FUT
'I will bite you$_1$.'

[21] For any person, duals may be marked by optionally adding *ʔa·či* (Nichols 2008, 117 note 5). Common nouns may also take *ʔāči*. Compare (i) (Corbett, *op. cit.*) with (110) and **??**.

(i) *hon* *ʔa·či* ∅- *ʔa·-kya* — 1NSG DU NPL-go- PST — 'We$_2$ went.'
ʔa·w-akcek *ʔa·či* *ʔa·-kya* — PL- boy DU go- PST — 'Boys$_2$ went.'

ʔA·či is distinct from the numeral 'two' (*kwili(·)i*, Bunzel 1933–1938, 411, 503) and can occur more than once in a one-argument sentence (Newman 1965, 48). So, I assume that is a nominal modifier, rather than an intrinsic part of nominal number.

(113) *to'na'* *ho'* *∅-* *ʔil ʔa·nuwa*
2NSG.ACC 1SG NPL$_O$-take with.IRR
'I will take you$_2$ with me.'

(114) *to'na'* *ho'* *ʔa·-* *ʔil ʔa·nuwa*
2NSG.ACC 1SG PL$_O$-take with.IRR
'I will take you$_{3+}$ with me.'

and, via different morphological means, for transitive subjects, as the following again near minimal triple shows (Newman 1965, 60, Nichols 1997, 40):

(115) *tom* *ho'* *šema-∅-* *kya*
2SG.ACC 1SG call- NPL$_S$-PST
'I called you$_1$'

(116) *hom* *šema-∅-* *ka*
1NSG call- NPL$_S$-PST
'we$_2$ called him'

(117) *hom* *šema-nap-ka*
1NSG call- PL$_S$-PST
'we$_{3+}$ called him'

This variation is all easily accommodable within the theory constructed above.

The apparent problem that Zuni raises is not as widely discussed as the (intransitive) data just laid out. It is that Zuni permits a "singular" noun with a nonsingular verb. In this setting, the noun is interpreted as dual. The result is, seemingly, a direct contradiction of the Frankendual Generalization, which only permits the dual from the reverse configuration, a nonsingular nominal with a "singular" verb.[22] I review the data before explaining why the problem is illusory, as the two constructions use different features.

Newman's only examples are the following singular-dual contrast (1965, 74). No plural is supplied.

(118) *pasi-* *n* *∅-* *kʔapa*
sleeve-SG NPL-wide
'The sleeve is wide'

[22] And I believe the facts are incompatible with Bliss's (2005) account. Though her paper cites Newman 1965, it asserts (*ibid.*, 11) that "no documented case of dual number" is constructed "from a singular DP and a plural verb". It goes on to claim that its "default valuation account … predicts"—or, more accurately, stipulates (*ibid.*, 10)—"that only verbs, but not nouns, could be singular in constructed duals".

(119) *pasi- n ʔa·-kʔapa*
sleeve-SG PL- wide
'The sleeves$_2$ are wide'

Granberry's more aphoristic formal work provides a minimal triple (1967, 60, 72):

(120) *'acce šema-∅- ka*
boy call- NPL-PST
'The boy called.'

(121) *'aa- 'acce šema-∅- ka*
NSG-boy call- NPL-PST
'The boys$_2$ called.'

(122) *'aa- 'acce šema-p- ka*
NSG-boy call- PL-PST
'The boys$_{3+}$ called.'

The status of this kind of composed number is clearly different from the Frankenduals illustrated above. First, it is not mentioned in Bunzel 1933–1938 at all, so far as I can see, though re grammar mentions and her texts illustrate numerous singulars, duals, and plurals that conform to Generalization (5).

Second, Newman (1965, 74) reports the Frankendual pattern for pronouns, and working in some detail through a range of research (Bunzel 1933–1938, Walker 1964, Newman 1965, Walker 1966, Granberry 1967, Nichols 1997) suggests that it is exceptionless. The reverse pattern is restricted to nouns and is, by contrast, far from exceptionless.

For example, *tuna·* 'eyes' departs from (119) in two different ways. In (123), it presents a regular Frankendual (Newman 1965, 52; cf, *ʔa·w-akcek ʔa·-kya*, PL-boy go-PST, 'two boys went', Corbett 2000, 170):

(123) *tuna-· łupcʔi- nna- ʔka*
eye- PL yellow-STAT-PST
'(his) eyes were yellow'

In (125), by contrast, both the noun and the suppletive verb are nonsingular (Newman 1965, 44):

(124) *tom tuna-· ʔi- łuwa- ha- nna*
2SG eye- PL REFL-be standing.PL-CONV.PNCT-FUT
'your eyes will run about'

In fact, if my count is correct, common noun exceptions to the pattern in (118)–(119) outnumber instances of it by more than two to one.

This variability suggests that a number feature different from ±atomic and ±minimal is involved, one that induce variable or nonexact semantic cuts. Harbour 2014 proposes precisely such a feature, ±additive, for approximative numbers. −Additive characterizes the paucal but leaves to linguistic and social context what the upper bound of a paucity is. This allows for what we see for *tuna·* 'eyes'. The same quantity, two, is sometimes treated as plural (124), sometimes not (123). Two lines of argument suggest that this is right reading of the facts.

First, descriptively, two studies by Walker characterize Zuni nouns as having a paucal-nonsingular, rather than singular-nonsingular, distinction. Paucal, here, includes singular and "refers to any number less than eight, but most often to one or two" (Walker 1964, 52). Walker (1966, 217) repeats the same characterization and adds (footnote 3):

> A noun with … paucal inflection is interpreted as singular when it occurs as the subject of a predicate inflected for singular subject. When it occurs as the subject of a predicate inflected for nonsingular subject, however, it may be interpreted as dual. See Newman, 1965, p. 74.

The variation between "is" in the first sentence and "may" in the second is noteworthy, as it is recalls the variability in Newman's examples. Interestingly, Walker's article carries an addendum by Newman, endorsing its contents. The article focuses on Zuni taxonomy, but, given the two mentions to number on the first page and references to his own work (as in the quote above), one might have expected some expression of dissent if there were any. So, it is plausible to read Newman as accepting that Zuni common nouns have a paucal-nonsingular system.

Second, analytically, the reverse Frankendual configuration falls out directly if we place ±additive on the noun and maintain ±minimal on the verb. The nominal feature divides the noun into paucal (−additive) and nonpaucal (+additive). If we represent the paucal as {singletons, dyads, (triads, (tetrads, (…, (heptads)…)))}, then +minimal picks out just the singletons, and −minimal picks out everything else. The result is +minimal −additive for singular, −minimal −additive for paucal, and −minimal +additive. This makes singular and paucal a natural class in virtue of the nominal feature −additive, and paucal and plural a natural class in virtue of the verbal feature −minimal. As table 11 highlights, this yields an isomorphism between the morphemes in the minimal triple (120)–(122) and the fea-

	Noun	Verb	Features
Singular	{ *'acce* }	*šemaka*	{ +additive } { +minimal }
Paucal	{ *'aawacce* }	{ *šemapka* }	{ −additive } { −minimal }
Plural			

Table 11: Zuni reverse paucal "Frankenduals"

tures just discussed.[23] Where common nouns follow the Frankendual pattern of a nonsingular noun and a nonplural verb (123), the nominal feature is presumably simply ±atomic.

Thus, despite its challenging appearance, Zuni, like Yuchi, falls well within the bounds of the theory of number that accommodates the explanation of Frankenduals' properties.

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[23] It is unclear to me from the available facts whether whether sentences like (119) allow for a typically paucal approximative interpretation, or whether they are restricted to dual. If the latter, then a sociosemantic convention must be posited confining the cut induced by ±additive strictly to dyads in this morphosyntactic context. Special restrictions on paucals are well known in counting and counting-like contexts (*e.g.*, Russian and Byak; Harbour 2014, 222, footnote 36) and are attested in Zuni too (Walker 1964, 52). A paucal confined to two is featurally still paucal, even if its interpretation mirrors a conventional dual. Further elucidation of these data would be welcome.

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