Frankenduals: Their typology, structure, and significance

Daniel Harbour

Queen Mary University of London

d.harbour@qmul.ac.uk

Department of Linguistics (SLLF)

Queen Mary University of London

London E1 4NS, United Kingdom

Title: Frankenduals

Subtitle: Their typology, structure, and significance

Abstract

Frankenduals, that is, duals composed (as in Hopi) of a 'singular' and a 'plural' morpheme, display a consistent asymmetry. A new typological study shows that the element closer to the nominal is sensitive to singularity, whereas the one sensitive to plurality is more peripheral. This pattern impacts on the theory of 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, not copied and partially deleted). The resulting account instantiates Hale's (1986) idea that features are semantically broad, ontologically flexible, and category independent.*

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

1. INTRODUCTION. 1 + 3 ≠ 2. Yet in Hopi, grammar and arithmetic come apart. Hale (1997:74) shows that the language achieves reference to 'two' by combining a verb from the singular with a pronoun from the plural, as per 1–3:[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, as in standard English **They runs* (but see Belfast English 21–23).

Frankenduals—as I will term these duals stitched together from morphemes also used for singular and plural—have long been appreciated across a range of frameworks (e.g., Voegelin & Voegelin 1957, Jeanne 1978, Noyer 1992, Hale 1997, Plank 1997, Corbett 2000, Harley & 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 is that dual is not a semantic primitive (Jeanne 1978:74). Rather, it is composed of more basic features (Hale 1973, Silverstein 1976), as shown abstractly in 4:

(4) singular $F' \; \underline{\underline{G}}$

dual $\underline{F} \; \underline{\underline{G}}$

plural $\underline{F} \; G'$

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. This leads to the feature-exponent isomorphism in table 1 (anticipating the features adopted below; throughout the article, elements of the dual shared with plural are single underlined, those shared with singular, double underlined).

[TABLE 1 about here.]

The field has been far from united on what F and G are. The authors mentioned above disagree on valence, on feature definitions and semantic types, and on the nature of the syntax-morphology and syntax-semantics interfaces. I contend that Frankenduals are actually decisive on these issues.

The starting point is the fullest typology of the phenomenon to date (section 2). It shows that Frankenduals vary greatly but conform to a unifying generalization:[2]

(5) FRANKENDUAL GENERALIZATION

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

This asymmetry has an analogue in Harbour's (2014) formalization of Noyer's (1992) definition of Hale's (1973) features (section 3). The features ±atomic and ±minimal generate the number system singular-dual-plural only if N composes with ±atomic and ±minimal composes with the result. Given that ±atomic distinguishes singular from nonsingular (table 1), this is precisely the asymmetry of 5. (So, single-underlining reflects first composition, double-underlining, second.)

Deriving the Frankendual generalization requires four factors to work in consort (section 4). Two, already mentioned, are a feature inventory with the right natural classes and a feature semantics with a compositional asymmetry. Additionally, we need the right feature syntax: the two number features must be merged in different locations, not collocated, copied, then differentially silenced. And last, we require a transparent syntax-semantic interface: too loose a connection scuppers the Frankendual generalization, even if the other conditions are met.

This analysis leads to a deeper question (section 5): 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 1–3 show two different categorial behaviours of ±minimal at once, the verbal distribution typical of its aspectual use with the nominal interpretation typical of numerical use. This is the converse of classic cases where the noun (via number) restricts interpretation of the verb (via aspect).

Properly understood, then, Frankenduals are not typological oddments, but ruly 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 typologies (e.g., Corbett 2000, Veselinova 2006, 2013), grammars, and articles, plus some serendipity, has yielded 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' terms

(Cysouw & Wohlgemuth 2010). However, statistically minor patterns can still be theoretical significant if diverse with respect to geography, genetics, and grammar (Harbour 2016). The typology here is robust in that sense, as I will now show with particular reference to Chamorro and Hiw.[4]

[TABLE 2 about here.]

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 Yatıì, 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*.), several Uto-Aztecan languages (Hopi, *etc*.), and, curiously, three further isolates (Tonkawa, Yuchi, Zuni).

Despite this diversity and distance, borrowing and inheritance scenarios are possibilities. McLaughlin (2018) entertains borrowing in Uto-Aztecan, from Numic to Hopi. This might extend to Zuni, as Bunzel's texts (1933, 1933–1938) suggest close contact with Hopis, including ritual salt gathering. However, even if borrowed, Frankenduals have developed distinctly enough in Hopi and Zuni to count as separate.

Even for related languages, genetic distance can be substantial. Hiw is buried deep within the diversification of the Oceanic branch of Eastern Malayo-Polynesian, whilst Chamorro is its own branch of the higher grouping, Central-Eastern Malayo-Polynesian (Hammarström et al. 2017). Similarly, where Hopi is its own branch of Northern Uto-Aztecan, Kawaiisu and Southern Paiute (note 3) belong to the southern subgroup of the Numic branch (*ibid.*).

The grammatical diversity of Frankenduals underlines the last two paragraphs. Hiw and Chamorro illustrate how grammatical extent and means of expression vary even between related languages. Hiw (François 2009, 2019, p.c.) registers (non)plurality via suppletion, like Hopi 1–3. In 6–8, the object pronouns (singular–dual–plural) *e–se–se* crosscut with *not–not–r̄ot'* (< *r̄ote*) '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 r̄ot' i- se.
ART ghost hit.PL OBJ-3NSG
'The ghost killed them$_{3+}$.'

Chamorro uses affixation instead.[5] Illustrating the indefinite object antipassive, 9–11 crosscut first exclusive *yo'–ham–ham* with the verbal affix Ø–Ø–*man*.

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

(10) Ø- 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 do the means available to Frankenduals differ in these languages, but so does their pervasiveness. In Hiw, they are limited to objects of transitives.[6] In Chamorro, they occur for subjects of indefinite object antipassives 9–11 and 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.’

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.'

(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 with these constructions again show variation. Nonplural marking is null in 9–10, 15–16, but infixal for 12–13 *-um-* and 18–19 *-in-*. Plural marking is prefixal in all four constructions, but varies between *man-* 11/14, *fan-* 17, and *ma-* 20.

Productivity is a further dimension of variartion. In Hiw, Frankenduals are confined to objects of verbs that supplete. Although Hiw is rich in suppletive pairs (François 2009 lists about 30), the construction is marginal compared to Chamorro, where it is fed by productive inflectional morphology in a range of argument roles.

Given these differences of grammatical resources, constructions, pervasiveness, and productivity, I count Hiw and Chamorro as separate data points. (Chamorro is further distanced by broad-scale relexification from Spanish.) Similar diversity within Dene, Uto-Aztecan, or Yam would expand the typology.

The differences between Chamorro and Hiw far from exhaust the grammatical variety with which Frankenduals present. As a brief foretaste, inflectional versus suppletive patterns are not mutually exclusive but cooccur in Hopi, Ngkolmpu, and Zuni. Nor is Hiw the most marginal end of the spectrum. In Yuchi and some Dene languages, the phenomenon depends on small stocks of suppletive verbs but is additionally confined to particular persons—in Yuchi, just to the inclusive.

Finally, the phenomenon does not require collaboration of nouns and verbs, but can arise between other categories or within single ones. Hopi is particularly rich in this regard (section 5). This language-internal diversification is consistent with Frankenduals being a longstanding property of Hopi grammar. This again contrasts with other members of the typology. Belfast English 21–23 appear to be an innovation of a few speakers (Henry 2005:1610–1):

(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 all couple proximity to the noun with sensitivity to singularity. So, I now turn to the derivation of that generalization.

3. FEATURES. I now define the features ±atomic and ±minimal and establish the specifications of singular, dual, and plural in table 3 (section 3.1). An important byproduct of the presentation will be the following lemma (section 3.2):

[TABLE 3 about here.]

(24) LEMMA

A nominal N has the numbers singular-dual-plural only if ±atomic composes with N first and ±minimal composes with the result.

That is, the order of composition is $[\![\pm\text{minimal}]\!]([\![\pm\text{atomic}]\!][\![\text{N}]\!])$. Importantly, then, the asymmetry in sensitivities within Frankenduals has a parallel asymmetry in the order of composition of number features. Section 4 uses 24 to derive 5.

3.1. SINGULAR, DUAL, AND PLURAL. I take a (pro)noun, N, to denote the power set minus the empty set (a semilattice) of atoms that satisfy N, the predicate corresponding to N. Semiformally:

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

$= \{\text{singletons, dyads, triads, tetrads, } \dots\}$

Number features pick out subsets of this set. ±atomic confines the denotation to atoms (+atomic) or to nonatoms (−atomic). (Negation is present only for minus.)

(26) $[\![\pm\text{atomic}]\!] = \lambda x \,.\, (\neg)\, \text{atom}(x)$

±minimal is more complex. It asserts minimality with respect to a predicate P, hence the extra lambda term, and it contains a presupposition.

(27) $[\![\pm\text{minimal}]\!] = \lambda P \,.\, \lambda x \,.\, \dfrac{(\neg)\,\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}$ ← assertion / ← presupposition

Both values presuppose that x satisfies P. Plus picks out x's such that $\neg\exists y\,(P(y) \wedge y \sqsubset x)$, that is, minimal x's, no subset of which satisfies P. Minus, by contrast, picks out those nonminimal x's for which such subset y's do exist. I assume that D transforms the resulting expressions of type $\langle e, t\rangle$ into individual-denoting ones (the def feature of Kratzer 2009:221).[7] ±atomic and $[\![\text{N}]\!]$ have type $\langle e, t\rangle$, and so compose via predicate modification (Heim & Kratzer 1998), returning type $\langle e, t\rangle$;

±minimal, of type $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$, composes with $[\![\pm\text{atomic}]\!][\![\text{N}]\!]$ by function application (*op. cit.*).

Derivation of table 3 will make these definitions clearer. For singular, informally, +atomic applied to 25 returns {singletons}, to which +minimal then applies redundantly, as all singletons are also minimal. Formally:

(28) $[\![_{\text{NumP}}\ \text{+minimal +atomic}\ [_{\text{NP}}\,\text{N}]]\!]$

$$= [\![\text{+minimal}]\!]\big([\![\text{+atomic}]\!][\![\text{N}]\!]\big)$$

$$= [\![\text{+minimal}]\!](\lambda x\,.\,N(x) \wedge \text{atom}(x)) \qquad \text{by predicate modification}$$

$$= \lambda P\,.\,\lambda x\,.\,\frac{\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x\,.\,N(x) \wedge \text{atom}(x))$$

$$= \lambda x\,.\,\frac{\neg\exists y\,(N(y) \wedge \text{atom}(y) \wedge y \sqsubset x)}{N(x) \wedge \text{atom}(x)} \qquad \text{by function application}$$

x's satisfying this function are atomic and satisfy N (the presuppositions) and do not contain any smaller elements that are also atoms of N (the nucleus). (The redundancy of +minimal is evident in the nuclear clause: if x is atomic, then no smaller y in x is also atomic.) Such x's are the set of elements of cardinality 1 that satisfy $N(x)$:

(29) $[\![\text{+minimal +atomic}]\!][\![\text{N}]\!](x) = 1$ iff $x \in \{|x| = 1 \,:\, N(x)\}$

Complementarily, −minimal applied to +atomic is contradictory. There are no nonminimal elements in a set of singletons. So, 30 delivers no number at all.

(30) $[\![_{\text{NumP}}\ \text{−minimal +atomic}\ [_{\text{NP}}\,\text{N}]]\!]$

$$= \lambda P\,.\,\lambda x\,.\,\frac{\neg\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x\,.\,N(x) \wedge \text{atom}(x))$$

$$= \lambda P\,.\,\lambda x\,.\,\frac{\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x\,.\,N(x) \wedge \text{atom}(x))$$

$$= \lambda x\,.\,\frac{\exists y\,(N(y) \wedge \text{atom}(y) \wedge y \sqsubset x)}{N(x) \wedge \text{atom}(x)}$$

This function is true of x's that have atomic subelements (nucleus) but which are themselves atomic (presupposition). These properties contradict, which, I assume, makes the feature combination unusable (cf, Gajewski 2002, 2008). So, −minimal +atomic is absent from table 3 because 30 does not characterize any x satisfying $N(x)$.

Dual and plural require −atomic. Informally, this picks out the complement to +atomic in 25: {dyads, triads, tetrads, ...}. From this, +minimal picks out the smallest elements, the dyads, and −minimal, larger ones. Formally, for the former:

(31) $[\![_{\text{NumP}}\ \text{+minimal}\ \text{−atomic}\ [_{\text{NP}}\,\text{N}]]\!]$

$$= [\![\text{+minimal}]\!]\big([\![\text{−atomic}]\!][\![\text{N}]\!]\big)$$

$$= [\![\text{+minimal}]\!](\lambda x\,.\,N(x) \wedge \neg\text{atom}(x))$$

$$= \lambda P\,.\,\lambda x\,.\,\frac{\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x\,.\,N(x) \wedge \neg\text{atom}(x))$$

$$= \lambda x\,.\,\frac{\neg\exists y\,(N(y) \wedge \neg\text{atom}(y) \wedge y \sqsubset x)}{N(x) \wedge \neg\text{atom}(x)}$$

This function holds of x's that are nonatomic and satisfy N (presupposition) and that do not contain subelements that are also nonatoms of N (nucleus). Concretely, consider dyadic and triadic x. Both are nonatomic, but only dyads satisfy the nuclear requirement that x lack subelements y satisfying $\neg\text{atom}(y)$. Any triadic $x = a \sqcup b \sqcup c$ has the subelement $y = a \sqcup b$ which satisfies $\neg\text{atom}(y)$. So, 31 picks out all and only the dyads and so is the dual.

(32) $[\![\text{+minimal}\ \text{−atomic}]\!][\![\text{N}]\!](x) = 1$ iff $x \in \{|x| = 2 : N(x)\}$

The characterization of the plural follows from what has just been said.

(33) $[\![_{\text{NumP}}\ \text{−minimal}\ \text{−atomic}\ [_{\text{NP}}\,\text{N}]]\!]$

$$= \lambda P\,.\,\lambda x\,.\,\frac{\neg\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x\,.\,N(x) \wedge \neg\text{atom}(x))$$

$$= \lambda x\,.\,\frac{\exists y\,(N(y)\ \wedge\ \neg\text{atom}(y)\ \wedge\ y \sqsubset x)}{N(x)\ \wedge\ \neg\text{atom}(x)}$$

Unlike dual, this formula demands that x have nonatomic subelements. By the reasoning above, this excludes dyadic x but admits anything triadic or larger. Hence:

(34) $[\![-\text{minimal} -\text{atomic}]\!][\![\text{N}]\!](x) = 1$ iff $x \in \{|x| \geq 3 : N(x)\}$

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

3.2. ORDER. Given that the features show the same sharing relationships with respect to singular and plural as Hopi pronouns and verbs (table 1), we can write these exponents:

(35) HOPI

[+atomic 3] $\mapsto$ *pam*

[−atomic 3] $\mapsto$ *puma*

[+minimal $\sqrt{\text{RUN}}$] $\mapsto$ *wari*

[−minimal $\sqrt{\text{RUN}}$] $\mapsto$ *yùutu*

±atomic encodes sensitivity of the pronoun to singularity as does ±minimal, for sensitivity of the verb root to plurality. (The exponents can read or rephrased as fused exponents, spans, or number-sensitive suppletion).

This is descriptively adequate. However, we could equally well imagine exponents with the features, and hence sensitivities, swapped:

(36) ANTI-HOPI

[±minimal 3] $\mapsto$ *pam* / *puma*

$$[\pm\text{atomic}\ \sqrt{\text{RUN}}] \mapsto \textit{wari} \,/\, \textit{yùutu}$$

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

However, in the current system, there is more to singular-dual-plural than the feature inventory. The features must compose in the right order. For minimal-before-atomic, both opposite-value specifications pose irreconcilable demands. Applied to 25, +minimal picks out just the singletons, as these are the most minimal (37a). Yet these are atoms, so applying −atomic returns nothing (37b):

(37) a. $[\![+\text{minimal}]\!]\left([\![\text{N}]\!]\right)$

$$= \lambda P \,.\, \lambda x \,.\, \frac{\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)}\,(\lambda x \,.\, N(x))$$

$$= \lambda x \,.\, \frac{\neg\exists y\,(N(y) \wedge y \sqsubset x)}{N(x)}$$

b. $[\![-\text{atomic}]\!][\![+\text{minimal}[\text{N}]]\!]$

$$= \lambda x \,.\, \neg\text{atom}(x) \wedge \frac{\neg\exists y\,(N(y) \wedge y \sqsubset x)}{N(x)}$$

The x's in 37 are nonatomic (first conjunct) and satisfy N (presupposition) but have no subelements satisfying N (nucleus of second conjunct). By parity of reasoning with 30, 37 is unusable.

Similarly, applying −minimal to 25 picks out the nonsingletons, all of which are nonatomic. So, applying +atomic after −minimal again yields nothing:

(38) $[\![+\text{atomic}]\!][\![-\text{minimal}]\!]\left([\![\text{N}]\!]\right)$

$$= \lambda x \,.\, \text{atom}(x) \wedge \frac{\exists y\,(N(y) \wedge y \sqsubset x)}{N(x)}$$

No x can be atomic but have subelements ($y \sqsubset x$).

With two of four feature-value combinations delivering nothing, this order of composition cannot yield three numbers. This establishes lemma 24. Empirically, the Anti-Hopi exponents would generate just two number values (plus-plus and minus-minus) and, so, none of the crosscutting that defines Frankenduals.

3.3. PAUCALS. The result above applies only to duals. Foreshadowing a seeming exception to 5, singular-paucal-plural systems present no parallel asymmetry. Paucal arises via ±additive (Harbour 2014). Applied to 25, it cuts ⟦N⟧ into a subset closed under union (+additive, plural) and another containing smaller elements (−additive, paucal). A verb with ±atomic or ±minimal can partition the paucal into atoms (+atomic/+minimal) versus nonatoms. But the reverse order is equally valid: −atomic, say, can pick out nonatoms, which ±additive can partition into paucal and plural. Either way, singular-paucal-plural results.

Ainu is a language of the second sort. Number in verbal roots diverges from argument-dependent singular-plural agreement in several ways (Shibatani 1990:50–4). One is that paucal numerals (up to three or four) occur with 'singular' roots, higher numbers with plural (Veselinova 2013, citing Tamura 1988:40):

(39) tu okkaypo ek

two youth come.PC

'Two youths came.'

(40) tupesaniw ka arki ruwe ne

eight even come.PL NMLZ COP

'Eight people came.'

Zuni common nouns appear to violate the Frankendual generalization, but in fact have a paucal-plural sensitivity, the reverse of Ainu (appendix A.3).

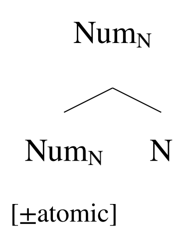
4. DERIVATION AND ITS REQUISITES. We are now close to deriving the Frankendual generalization. By table 3, ±atomic contrasts singular with nonsingular, and ±minimal, nonplural with plural. By lemma 24, ±atomic is compositionally closer to the nominal than ±minimal. Thus, the element responsible for singular sensitivity is closer to the nominal than source of plural sensitivity. This is in essence the Frankendual generalization.

A complete derivation requires that order of composition and locus of exponence correspond. That is, feature positions reflect semantic scope (cf, Baker 1985, Rice 2000). In a syntax-centred model (Chomsky 1995), this equates to transparent interfaces, with the features located where they are pronounced and interpreted where they are located. Section 4.1 lays out such an account.

Sections 4.2–4.4 examine alternative definitions and less transparent interfaces. All lose the explanation of the Frankendual generalization. Consequently, Frankenduals tell us about feature semantics and syntactic interfaces, as much as they do about feature inventories.

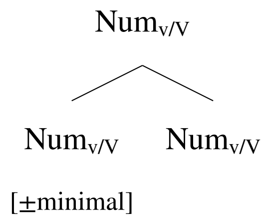
4.1. IMPLEMENTATION. Consider again Hopi 1–3. A transparent mapping from syntax to morphology means that (non)singular morphemes on the noun realize ±atomic in the nominal extended projection (many accounts posit a low number head for precisely such features; Ritter 1993, Borer 2005, Harbour 2007, Acquaviva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

(41)



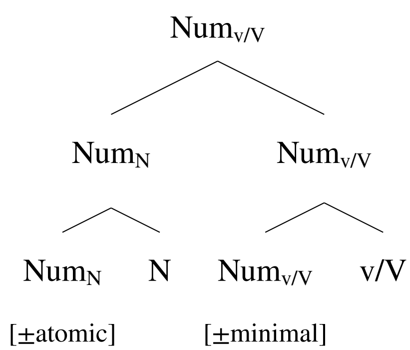
Similarly, transparency means that (non)plural morphemes on the verb realize ±minimal in the verbal projection. For this, I posit a second number head (to which we return in section 5.1) and distinguish it from nominal number by a different subscript. For subject versus object Frankenduals, verbal number must be able to project above both v and V:

(42)



I further assume that the subject/object arguments merge Num$_{v/V}$ to Num$_N$:

(43)



The idea that the functional structure of DP arguments is distributed between the nominal and verbal projections and assembled in the syntax has substantial precedent (Williams 1986, Johnson 2000, Lin 2002, Sportiche 2005, Svenonius 2005). This work leaves open how number should be treated, as it focuses on severing D from N (in languages with just a singular-plural contrast), but there is no obvious tension between that work and the current partitioning of number. In fact, positing multiple positions for verbal number is paralleled in the multiple D positions posited above V and v for object and subject. Although languages like Hiw exploit only one of these, others, like Hopi, use both and can do so simultaneously (table 4).

[TABLE 4 about here.]

For semantic composition, verbal ±minimal must have a different type from its nominal counterpart. If the verb has type $\langle e, t\rangle$, then it will compose directly with Num$_V$ and the wrong thing will be minimal. Instead, we require the definition:[8]

(44) $[\![_{\text{v/V}} \pm\text{minimal}]\!] = \lambda Q \lambda P \lambda x \,.\, Q(x) \wedge \dfrac{(\neg)\, \neg\exists y\, (P(y) \ \wedge \ y \sqsubset x)}{P(x)}$

Composed with $[\![\text{V}]\!] = \lambda x \,.\, V(x)$, for instance, we have:

(45) $[\![_{\text{v/V}} \pm\text{minimal [V]}]\!] = \lambda P \lambda x \,.\, V(x) \wedge \dfrac{(\neg)\, \neg\exists y\, (P(y) \ \wedge \ y \sqsubset x)}{P(x)}$

Other compositional details then remain as per section 3:

(46) $[\![_{\text{v/V}} \pm\text{minimal [V]}]\!] \left([\![\pm\text{atomic [N]}]\!]\right)$
$= \lambda x \,.\, V(x) \wedge \dfrac{(\neg)\, \neg\exists y\, (N(y) \wedge (\neg)\text{atom}(y) \ \wedge \ y \sqsubset x)}{N(x) \wedge (\neg)\text{atom}(x)}$

An analogous type change for ±atomic does not provide a way around lemma 24. 47, for instance, simply simulates the effect of predicate modification:

(47) $[\![_{\text{v/V}} \pm\text{atomic}]\!] = \lambda Q \,.\, \lambda x \,.\, Q(x) \wedge (\neg)\text{atom}(x)$

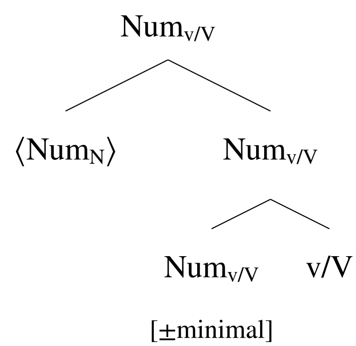
The two number projections will then also combine via predicate modification:

(48) $[\![_{\text{v/V}} \pm\text{atomic [V]}]\!][\![\pm\text{minimal [N]}]\!]$
$= \lambda x \,.\, V(x) \wedge (\neg)\text{atom}(x) \wedge \dfrac{(\neg)\neg\exists y(N(y) \wedge y \sqsubset x)}{N(x)}$

The crux here is syntax. Locality of Num_{N} to N means that ±minimal will composes with $[\![\text{N}]\!]$ before ±atomic does, irrespective of the latter's type. This is insufficient to produce singular-dual-plural.

Obviously, the conceptual core of ±minimal is constant across categories. Its type here has an effect comparable to that of argument introducing heads (Kratzer 1996, Pylkkänen 2008), conjoining conditions on arguments to the denotation of the verb. This suggests that ±minimal is properly integrated into the extended verbal project, on a par with other heads. Consistent with such integration, movement of NP affects only Num_{N} and leaves $\text{Num}_{\text{v/V}}$ in situ (giving, e.g., Hopi 1–3, with a free pronoun at some remove from the verb):

(49)



With regard to pronunciation, the system is flexible, allowing for the wide range of presentations found in Hopi (and Chamorro, *etc.*). Number can coalesce with a suppletive root 35 or with a grammatical affix, as in possessives (Kalectaca 1978:82–6). Or it can be an independent morpheme, whether a reduplicant (*tɨwa* ‘see.NPL’, *tɨtwa* ‘see.PL’), infix (*coʔomti* ‘jump.NPL’, *coʔom⟨to⟩ti* ‘jump.PL’), or suffix (*hohonaqa* ‘play.NPL’, *hohonaq-ya* ‘play.PL’) (Jeanne 1978:86–8). The possessive and suffixal strategies are shown below (Kalectaca 1978:85, *pace* a change in person; Hale et al. 1991:258):

(50) Nu’ tsoongo-’ta.
1SG pipe- POSS.NPL
‘I have a pipe.’

Nu’ hohonaqa-Ø.
1SG play- NPL
‘I play.’

(51) Uma tsoongo-’ta.
2NSG pipe- POSS.NPL
‘You$_2$ have a pipe.’

’Itam hohonaqa-Ø.
1NSG play- NPL
‘We$_2$ play.’

(52) 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 35 for the suppletive case, see 55 for Hale *et al*.'s examples.[9]

So the compositional semantics and variable exponence of Hopi (and other) Frankenduals can be implemented in a standard theory of syntax and its interfaces. Nonetheless, derivation of the Frankendual generalization is a delicate result. The remainder of this section shows that it is lost under different feature definitions, a different feature syntax, or different mapping to morphology or semantics.

4.2. REQUISITE I: FEATURE SEMANTICS. Treating Frankenduals, Cowper (2005) and Arka (2012a; see also Sadler 2011) posit features different from those given above. Cowper's are privative, with plural more endowed than dual, whereas Arka's are bivalent and specified in equal measure for all numbers. Both are defined in terms of cardinality. This is reflected directly in Cowper's feature names, '> 1', '> 2' (see also Bliss 2005). Arka (2012a:17) defines his similarly: −SG as 'two or more' and +PL as 'three or more' (with opposite signs defined complementarily, e.g., −PL 'either one or two'). Because of its similarity to Hale's system, I focus on Arka's proposals, but the comments apply generally to this class of approaches.

Arka's features are isomorphic mine. Though ±minimal and ±PL take opposite values, the systems capture Jeanne's and Hale's two natural classes (table 5).[10] However, the two systems are not equivalent more broadly.

[TABLE 5 about here.]

The issue is that sets of cardinality features are interpreted via conjunction, which is symmetric (Harbour 2016, chh. 7, 9). Consider dual, −SG −PL. −SG, has-cardinality-two-or-more(x), restricts a variable over singletons, dyads, triads, and so on, to everything but singletons. Similarly, −PL, has-cardinality-one-or-two(x), confines 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). Hence:

(53) $[\![-\textsc{sg}]\!][\![-\textsc{pl}]\!]$

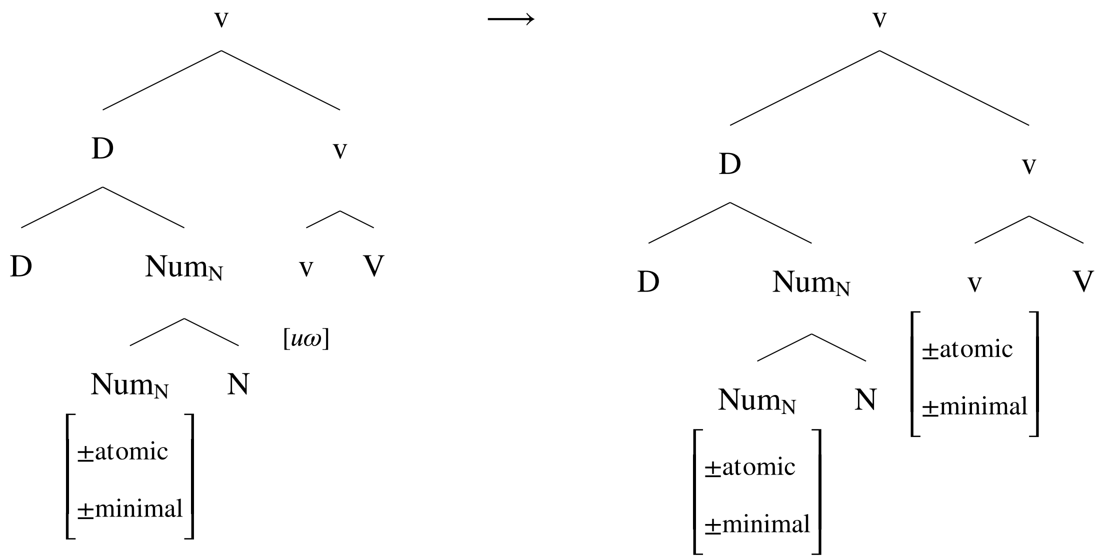
$$= \lambda x\,.\,\text{has-cardinality-two-or-more}(x) \;\wedge\; \text{has-cardinality-one-or-two}(x)$$
$$= \lambda x\,.\,\text{has-cardinality-one-or-two}(x) \;\wedge\; \text{has-cardinality-two-or-more}(x)$$
$$= [\![-\textsc{pl}]\!][\![-\textsc{sg}]\!]$$

With conjunction at its core, function application is symmetrical and order, immaterial.

Syntactic locus thus does not matter to these features. With ±SG on Num_N and ±PL on Num_V, or vice versa, the same semantics results. Thus, feature sharing between dual and singular/plural is not enough for the Frankendual generalization. The feature semantics must be right too. Conjunctive features do not impose an order of composition and so do not drive one feature closer to the noun.

4.3. REQUISITE II: FEATURE SYNTAX AND THE SYNTAX-MORPHOLOGY INTERFACE. Properties of nouns encoded on verbs are commonly handled via feature copying from a fully specified noun. 54 shows ±atomic and ±minimal on Num_N, which values uninterpretable number ($u\omega$) on a verbal head (possibly as part of case licensing; other φ features and transmission via D are omitted):

(54)



Nevins (2008:361) suggests this approach, with the singularity-sensitive pronoun and plurality-sensitive verb in Hopi as head and tail of a single agreement chain.

The approach is clearly descriptively adequate. The exponents in 55 applied to the Num_N-v agreement agreement chain in 54 produce 'I/we play' 50–52.

(55) HOPI

[±atomic 1] ↦ *nu'*/*'itam*

[±minimal v] ↦ Ø/*ya*

[$\sqrt{\text{PLAY}}$] ↦ *hohonaq*(*a*)

Agreement and Frankenduals can cooccur (see Ngkolmpu 80–82). However, agreement plus partial exponence, even if the correct analysis of other phenomena, is too unconstrained for Frankenduals.

The issue is that the number features, being everywhere, are equally accessible to noun and verb. This makes exponents with the reverse sensitivities possible:

(56) ANTI-HOPI

[±atomic v] ↦ Ø/*ya*

[±minimal 1] ↦ *nu'*/*'itam*

In contrast to 36, feature semantics cannot block this version of Anti-Hopi. Number is computed within Num_N which contains both features. Pronunciation is independent of this.

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 invoke impoverishment (Bonet 1991, Halle 1997) here. Insensitivity to specific features can be forced by selective deletion. Bobaljik (2002) handles metasyncretism in this way. 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:

(57) Hopi 'impoverishment'

±atomic ↦ Ø / V

±minimal ↦ Ø / N

(58) Anti-hopi 'impoverishment'

±minimal ↦ Ø / V

±atomic ↦ Ø / N

57 gets the results we want and 58 does not, but I am not aware of general constraints that permit one but prevent the other. (The same holds for other morphological approaches, like fission of

±atomic—but not ±minimal—from the verb into subject position; Nevins 2008:361.) Language-specific morphological operations cannot be the root of the crosslinguistic pattern.

Markedness is sometimes called on to make impoverishment 'natural' (e.g., Noyer 1998, Nevins 2011), but it is not obviously helpful here. Noyer and Nevins's markedness concerns particular feature-value combinations in the context of others (cf, 117). 57–58 require markedness of whole features, irrespective of values, in the context of particular categories, and the implicit markedness statements for the 'correct' choice 57 are not empirically motivated.

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

Second, verbs are often sensitive to ±atomic. Most obvious is singular/plural agreement, as in English or, alongside Frankenduals, Ngkolmpu 80–82. Equally relevant are languages with suppletion for number. Amongst these, suppletion for singularity is well attested and languages can display a variety of patterns simultaneously (table 6).[12]

[TABLE 6 about here.]

Frankenduals can even present with verbs that are sensitive to singularity on top of their more usual plural sensitivity. Tlicho is one of several Dene languages that illustrate this. Regular Frankenduals in the language are structured as follows (Jaker et al. 2013:173, Nicholas Welch, p.c.):

(59)	sǫnà-ne- wo	sǫnà-Ø- wo
	play- 2SG-do.NPL	play- 3SG-do.NPL
	'you$_1$ play'	'he/she plays'

(60) sǫnà-ah- who — sǫnà-ge- wo

play- 2NSG-do.NPL — play- 3NSG-do.NPL

'you$_2$ play' — 'they$_2$ play'

(61) sǫnà-ah- dè — sǫnà-ge- dè

play- 2NSG-do.PL — play- 3NSG-do.PL

'you$_{3+}$ play' — 'they$_{3+}$ play'

However, for a few verbs, like 'sit', the nonplural forms are additionally show sensitive to singularity (Ackroyd 1982:72, Jaker et al. 2013:186):[13]

(62) whe- ne- da

STAT-2SG-sit.SG

'you$_1$ sit'

(63) wh- ah- ke

STAT-2NSG-sit.DU

'you$_2$ sit'

(64) wh- ah- kw'e

STAT-2NSG-sit.PL

'you$_{3+}$ sit'

Exponents for 'sit', then, include allomorphy for ±atomic in the nonplural root:

(65) $[+\text{minimal}\ \sqrt{\text{SIT}}] \mapsto \begin{cases} \textit{da} \ /\ +\text{atomic} \\ \textit{ke} \ /\ -\text{atomic} \end{cases}$

$[-\text{minimal}\ \sqrt{\text{SIT}}] \mapsto \textit{kw'e}$

These diverse phenomena make a markedness constraint on ±atomic in the verbal domain or on ±minimal in the nominal problematic. Transcategoriality (section 5.1) underscores this point. As a result, markedness does not motivate 57.

So, having the right feature sharing relations and the right feature semantics is still not enough. The features must be sparse, so that only nominals have primary access to ±atomic, and only verbs, to ±minimal. When verbs have access to ±atomic (62–65, 80–82), or nouns, to ±minimal (section 5.1, 114–116), these are enrichments of the more spartan distribution that underlies Frankenduals.

4.4. REQUISITE III: THE SYNTAX-SEMANTICS INTERFACE (AND PRESUPPOSITIONALITY). Frankenduals have received generous attention in Lexical Functional Grammar (LFG; Bresnan 2001, Dalrymple 2001): Arka 2011, Sadler 2011, Arka 2012a, 2012b, Dalrymple 2012, Arka & Dalrymple 2016. Besides feature semantics (section 4.2), these accounts differ from the current one at the syntax-semantics interface, or, in LFG terminology, in how feature structure relates to constituent structure, in a way that undoes the Frankendual generalization. A similar problem arises for purely presuppositional accounts of number (e.g., Sauerland 2003).

A major point of agreement between LFG approaches and the current one concerns feature syntax. Dalrymple (2012:9) presents figure 1, a schematic constituent structure (left) of the Hopi sentence 2 with (right) feature structures corresponding to each of the boxed constituents. As per section 4.3, there is one feature on each of the noun (top feature structure) and the verb (middle).

[FIGURE 1 about here.]

If (footnote 10) we read −atomic for +PL in feature structure for *puma* and +minimal for +SG in that for *wari*, then the features are in the correct configuration for 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 subsidiary number specifications. Arka notates this as set union, an operation that recreates the problem of section 4.2: like conjunction, union is commutative ($A \cup B = B \cup A$) and so, unlike Frankenduals, symmetric. The same sentential matrix would result with ±atomic and ±minimal (±SG, ±PL) swapped.

Pooling is also problematic for purely presuppositional implementations of number features (Chris Kennedy, p.c.; cf, Kratzer 2009:221). If cast as distinct, noninteracting presuppositions, +minimal restricts its predicate to atoms and −atomic restricts the argument denotation to nonatoms. Instead of delivering dual, these conflicting demands deliver no number at all. (−minimal and +atomic also deliver nothing, recreating double blank problem of 37–38.) This arises whether or not the features are in the correct loci. So, where LFG overgenerates syntactic possibilities, the presuppositional approach undergenerates semantic ones.

The pooling problem arises from too loose a syntax-semantics interface. With greater articulation, LFG or a presuppositional theory might escape it. Yet, untreated, it overrides the effects of an asymmetric feature syntax, making Frankenduals and their reverse equally (im)possible.

5. FEATURE FLEXIBILITY. The foregoing shows that asymmetry of composition explains the Frankendual generalization only in a syntax with sufficiently transparent interfaces to morphology and semantics. This transparency is of course language particular. Feature displacement, via agreement, is very common (Corbett 2012)—which may help to explain the rarity of Frankenduals. Nonetheless, transparency raises an obvious question: what is a feature for nominal number doing in the verbal domain? Answering this pushes Frankenduals' theoretical import yet further.

A feature's being used for number does not make it a number feature, nor does its modifying nouns make it essentially nominal. Hale (1986) argues that feature definitions should be ontologically flexible (covering, for instance, aspect and obliques) and, correspondingly, syntactically flexible. Frankenduals are a case study in the feature flexibility that Hale envisaged. They show that a feature that can be either interpretatively and distributionally nominal or interpretatively and distributionally verbal can crosscut these behaviours and present with the distribution of one use and the interpretation of the other. Three empirical sources support this view (section 5.1): Hopi postpositions, Hopi (and Dene) non-Franken-duals, and, most strikingly, Ngkolmpu event enumeration.

A logical consequence of categorial flexibility is the existence of intracategorial Frankenduals (section 5.2). These are more common in verbs than 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. The proximity of ±atomic to person (lemma 24) provides an obvious account of this.

5.1. TRANSCATEGORIAL FEATURES. The account of Frankenduals relies on there being a nominal and a verbal version of ±minimal. This is more than expedient. The underlying concept leads a second life in the verbal domain. A logically equivalent paraphrase of strict cumulativity (developed to explain cooccurrence patterns between (a)telic predicates and *in*/*for* temporal adverbials; Krifka 1992) incorporates nonminimality (with $P(x)$ nonpresuppositional; Harbour 2014):

$$(66)\quad \underbrace{\exists x(P(x) \wedge \exists y(P(y) \wedge y \sqsubset x))}_{-\text{minimal}} \;\wedge\; \underbrace{\forall x \forall y((P(x) \wedge P(y)) \rightarrow P(x \sqcup y))}_{+\text{additive}}$$

Given that strict cumulativity is a property of events, 66 shows that it is inaccurate to regard ±minimal as nominal. It is at home in extended projections of both nouns and verbs. Further supporting this, the other half of 66 also exists as a number feature (±additive; sections 3.3, A.3).

This is the kind of semantically general and ontologically (hence syntactically) flexible 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. First, Hopi Frankenduals arise with other categories. Second, in Hopi and Tlicho, ±minimal can occur either on the verb (for a Frankendual) or on the noun (for a nominal dual). The complementarity of these duals follows from their being different uses of the same means. Third, in a further gradation of nominal and verbal uses of ±minimal, Ngkolmpu use its morphological resources for counting verbal entities (events), as well as nominal ones—a use that requires ±atomic in the verbal domain.

A variety of research (e.g., Hale 1986, Koopman 2000, Svenonius 2007, Zwarts 2008) points to a close relationship between verbal and adpositional structures. In this vein, Hopi exhibits Frankenduals composed from case on animate nouns and number on postpositions (Jeanne 1978:98):

(67) nɨˀ ˀi- t maana-t ˀa-Ø- mɨm tɨmalaˀyta
1SG this.SG-OBL.SG girl- OBL.SG 3- NPL-with work
‘I work with this girl.’

(68) nɨˀ ˀimɨ- y maana-tɨ- y ˀa-Ø- mɨm tɨmalaˀyta
1SG this.NSG-OBL.NSG girl- NSG-OBL.NSG 3- NPL-with work
‘I work with these$_2$ girls.’

(69) nɨˀ ˀimɨ- y ma-man-tɨ- y ˀa-mɨ-mɨm tɨmalaˀyta
1SG this.NSG-OBL.NSG PL- girl- NSG-OBL.NSG 3- PL-with work
‘I work with these$_{3+}$ girls.’

Mɨm ‘with’ assigns oblique case to ‘this/these girl(s)’. The exponents of case, both on the demonstrative and on the noun, display a singular-nonsingular pattern, *t–y–y*, like the demonstratives, singular *ˀi* and nonsingular *ˀimɨ*. Number marking on the postposition itself displays a nonplural-plural contrast, Ø–Ø–*mɨ*.

The head noun 'girl(s)' is omissible here (Kenneth Hill, p.c.), leading to a Frankendual between the demonstratives and case, and the postposition:

(70) ˀi- t ˀa-Ø- mɨm
this.SG-OBL.SG 3- NPL-with
'with this (one)'

(71) ˀimɨ- y ˀa-Ø- mɨm
this.NSG-OBL.NSG 3- NPL-with
'with these$_2$ (two)'

(72) ˀimɨ- y ˀa-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 duals in Hopi further support the transcategoriality of ±minimal. Number systems vary within languages by person, animacy, and so on (Corbett 2000). So, purely nominal duals for Hopi animates (and dual agreement for Tlicho first person 114–116) are unsurprising. Subsystems of number are easily captured if number dominates, and can be conditioned by, person and nouns (Harbour 2016). But the interaction of these duals with suppletion needs to be captured.

The key question is whether singular-dual-plural nouns should permit a greater range of numbers when combined with number-differentiated verbs. Consider a +minimal verb, like *niina* ‘kill.NPL’, with plural *taatapt* ‘cottontails$_{3+}$’. One might reason that this should denote a killing of exactly three cottontails, as a minimal killing of three or more is a killing of three (cf, the derivation of trial in Harbour 2014). It does not and the combination is ungrammatical (Jeanne 1978:100):

(73)*taa-tap- tɨ- y niina
PL- cottontail-NSG-OBL.PL kill.NPL
‘killed [some number of] cottontails’

Only three options are permitted (Jeanne 1978:93; 75 is constructed):

(74) nɨˀ taavo- t niina
1SG cottontail-OBL.SG kill.NPL
‘I killed a cottontail.’

(75) nɨˀ taavo- tɨ- y niina
1SG cottontail-NSG-OBL.NSG kill.NPL
‘I killed cottontails$_2$.’

(76) nɨˀ taa-tap- tɨ- y qöya
1SG PL- cottontail-NSG-OBL.NSG kill.PL
‘I killed cottontails$_{3+}$.’

These show the same pattern of suppletion as Frankenduals 1–3.

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

This ‘feature trading’ has a precedent. Analysing the Person Case Constraint, Adger & Harbour (2007) propose that the applicative head requires an argument specified for ±participant.

If first or second person, the argument bears the feature inherently, as part of its meaning, 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 (−participant).

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/these girl(s) entered' is a three-way number contrast on the noun (*maana* 'girl', *maanat* 'girls$_2$', *mamant* 'girls$_{3+}$') sandwiched between a Frankendual of demonstrative and suppletive verb (Jeanne 1978:73):

(77) Miˀ maana paki.
that.SG girl enter.NPL
'That girl entered.'

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

(79) Mima ma-man-t yɨŋʸa.
that.NSG PL- girl- NSG enter.PL
'Those girls$_{3+}$ entered.'

In 78, for example, Num_N is −atomic +minimal. This forces the demonstrative, sensitive to ±atomic, into its nonsingular form, *mima*, and the verb, sensitive to ±minimal, into +minimal, *paki*. The complementary distribution of semantically contentful ±minimal on the noun and semantically contentful ±minimal on the verb follows if they are different locations of the same thing.

Ngkolmpu (Carroll 2014) provides a different and striking illustration of categorial flexibility. The language is not only rich in morphological resources for Frankenduals (over half its verbs encode number), but the same verbal forms serve two distinct semantic purposes (*ibid.*:10–1). The first is nominal number. For instance, the singular-nonsingular first person pronoun, *ngko–ni–ni*, and a plural-nonplural verb, like 'return', *ntek–ntek–nent*, overlap in a Frankendual 81:

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

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

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

Second, the same distribution of verb roots is found for repetitions of the same event. Homecomings of one, two, or three (or more) people, 80–82, and one person's returning home once, twice, or thrice, 83–85, both use *ntek–ntek–nent*:

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

(84) ngko yempokampr kr⟨ntek⟩nt mwa- ngke
1SG twice FUT⟨return.NPL⟩ house-ALL
'I will return home twice.'

(85) ngko yuowmpr kr⟨nent⟩nt mwa- ngke
1SG thrice FUT⟨return.PL⟩ 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 & Dalrymple 2016:97–8).

Enumeration of events is an important example of intermediate behaviour for a feature that can be either verbal, used for aspect, or nominal, used for counting. First, event enumeration is, simply, counting in the verbal domain (for which, instantiating ontological flexibility, the features must be retyped to handle events, not individuals). Second, the morphological resources that Ngkolmpu draws on are bound up with aspectual distinctions: the so-called 'extended stem' is used both as 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, supports the current approach.

Ngkolmpu shows that categorial flexibility extends to ±atomic (Jeff Lidz, p.c.). As per section 3, ±minimal can distinguish two events from more only if ±atomic first distinguishes one from many. The locus of the enumerated event must therefore host ±atomic (cf, Koasati, appendix A.1). The feature may be silent, but covert ±atomic is independently attested within Ngkolmpu Frankenduals (footnote 11). Consequently, categorial flexibility extends to both features explored here.[14]

Three lines of evidence thus support the claim that ±minimal is transcategorial. In Hopi, not only verbs, but postpositions (and nouns) can host it. Again in Hopi, but shared with Tlicho, nominal and verbal ±minimal are in complementary distribution, emphasising their unity. Finally, in Ngkolmpu, resources for aspect and nominal counting serve also to count events. This further gradates the flexibility of ±minimal and shows that ±atomic too is categorially flexible.

5.2. INTRACATEGORIAL FRANKENDUALS. Flexibility predicts intracategorial Frankenduals. If nouns can host ±minimal and verbs, ±atomic, then these components can cooccur in an extended projection. Yet, if they are located on separate heads, semantic restrictions on which feature is syntactically nearer the noun or person will still apply. Pure nominal and verbal Frankenduals have featured 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 isolated oddments, but form a network of superficially divergent phenomena anchored in the same 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 singularity-sensitive nominal and a plurality-sensitive verb, and verbal sensitivity may be registered either by suppletion (Arka 2011:7, p.c.):

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

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

(88) 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 (Arka 2011:7, p.c.):

(89) 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.'

(90) 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.'

(91) 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, the nominal is dispensible and some verbs agree in person and number. When these cooccur, verb-internal Frankenduals result (Arka 2011:8):[15]

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

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

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

Tlicho 59–61 and Ngkolmpu 80–82 above are also verb-internal cases.

In 92–94, number is nonzero only for plural. This results in a dual, *kesneme*, which is a substring of the plural, *kesnemem*. Zero for singular and dual are not infrequent (Chamorro 9–10, 15–16, Hopi 50–51). 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. The hortative/imperative/jussive gives this simple triple (Zhukova 1972:313):

(95) my- lle- Ø- gi

1SG-take-NPL-2SG
'let me take you$_1$'

(96) my- lle- Ø- tyk

1SG-take-NPL-2NSG
'let me take you$_2$'

(97) my- lla- la- tyk

1SG-take-PL-2NSG
'let me take you$_{3+}$'

Plural increments dual by *la*. So, dual *my-lle-tyk* a discontinuous substring of plural *my-lla-la-tyk* (modulo vowel harmony). Clear as such examples are, a full analysis of this complex system (with more complete data) would be welcome.

Mi'gmaq Frankenduals occur only in intransitives. Table 7 gives the present indicative of *teluis*(*i*) 'be named' (Little 2018:245, citing Francis & Hewson 1990:46). It shows a typical Frankendual, but without overt number common to singular and dual. Dual is, thus, again a discontinuous substring of the plural, as in second person *teluisi-oq* and *teluis-ulti-oq* (modulo the root-final vowel).[16]

[TABLE 7 about here.]

Morphemes interpreted as dual in intransitives are nonsingular in the transitive (Coon & Bale 2014:92, 97):

(98) Mu nem-u'ln- u- oq.

NEG see- 2OBJ-NEG-2PL
'I don't see you$_{2+}$.'

The dual-plural distinction is an Eastern Algonquian innovation and analogues of the intransitive dual in related languages are again nonsingular (Little 2018:246). The current analysis handles *oq* and the like straightforwardly, as person plus −atomic. This covers dual and plural when ±minimal is absent. Elsewhere, −minimal *ulti* confines plain *oq* (*etc*.) to −atomic +minimal, making it dual.

Intracategorial Frankenduals are attested beyond the verb. Sentences 73–76 and 77–79 illustrate the noun-internal Frankenduals of Hopi.[17] Underlining the constituent morphemes (Jeanne 1978:60, 77, 83, 98; cf, Hale 1997), we have:

(99) Ø- taavo- Ø   Ø- maana-Ø
NPL-cottontail-SG   NPL-girl- SG
‘cottontail’   ‘girl’

(100) Ø- taavo- t   Ø- maana-t
NPL-cottontail-NSG   NPL-girl- NSG
‘cottontails$_2$’   ‘girls$_2$’

(101) taa-tap- t   ma-man-t
PL- cottontail-NSG   PL- girl- NSG
‘cottontails$_{3+}$’   ‘girls$_{3+}$’

As in Koryak and Mi’gmaq, nonplural is covert, but plural reduplication (root-final apocope, vowel shortening, consonant ablaut) masks the substring effect here.

Hopi nominal Frankenduals are intracategorial. But without further argument, they are irrelevant the current theory (cf, note 15). Prefixal *taa-*/*ma-* and suffixal *-t* do not show whether −minimal or −atomic is nearer the root.

[TABLE 8 about here.]

Theoretically relevant purely nominal Frankenduals are to be found in Tonkawa pronouns. Table 8 (Hoijer 1933–1938:122–3) presents all persons, but only third person is immediately relevant. These combine *’a* with two suffixes. The near-root suffix *ye·–we·–we·* is sensitive to singularity, final *la–la–ga*, to plurality. This is as generalization 5 predicts. I take person to be more deeply embedded than number Harbour (2016). So, their interpretation, 102, conforms to lemma 24:

(102) ⟦ *’a-ye·/we·-la/ga* ⟧

$$= [\![[[\underbrace{\textit{'a}}_{\pi}]\ \underbrace{\textit{ye}\cdot/\textit{we}\cdot}_{\pm\text{atomic}}]\ \underbrace{\textit{la/ga}}_{\pm\text{minimal}}]]\!]$$

$$= [\![\pm\text{minimal}]\!]([\![\pm\text{atomic}]\!][\![3]\!])$$

Unless one argues that Tonkawa first and second person pronouns arise by ad hoc linearization of 102, they are, like Hopi nouns, intracategorial but otherwise irrelevant, as number flanks person (cf, note 16). In contrast to verbs, then, nouns present very slim grounds for testing the Frankendual generalization. Given the propensity for both number features to occur under a single nominal number head (e.g., Noyer 1992, Harbour 2011b, Nevins 2011), this is to be expected.[18]

However, the mechanisms that underlie the Frankendual generalization are detectable in a common template for pronoun systems. Consider the emphatic pronouns of Mokilese (table 9; Harrison 1976:89). All nonsingulars share common bases: inclusive *kisa*, exclusive *kama*, second person *kamwa*, and third person *ara*/*ira*. These are, in fact, the dual forms, from which plural and greater plural derive by affixation. The singulars by contrast are morphologically distinct: *ngoah* vs *kama*, *koah* vs *kamwa*, *ih* vs *ara*/*ira* (cf, Arka 2011:10 on Manam).

[TABLE 9 about here.]

Having one base for nonsingular numbers and another for singular is a common template for pronoun systems crosslinguistically. Almost half (29/62) of the singular-dual-plural systems in Smith 2011 exhibit this to some extent.[19]

The account of the Frankendual generalization above makes this a natural pattern. Lemma 24 states that singular-dual-plural requires ±atomic to compose with person first, a result that generalizes to more complex systems like Mokilese (Harbour 2014). Singular-nonsingular is thus the primary cut of the number space and all nonsingular numbers are refinements of it. Mokilese-type systems reflect this. Their fundamental morphological division tracks the first semantic cut and additional semantic cuts correspond to additional morphological exponents. The rarity of nominal and pronominal Frankenduals matters less if the same mechanisms are widely detectable elsewhere.[20]

6. CONCLUSION AND CONSEQUENCES. Four theoretical properties are crucial to accounting for the Frankendual generalization. As long recognized (following Hale 1973, 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 singular-dual-plural (Noyer 1992, Harbour 2014). Finally, these features must be embedded by two transparent interfaces. A transparent syntax-morphology interface means that the features are where heard, 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 nominal they modify.

[TABLE 10 about here.]

Linguists have taken Frankenduals to tell us chiefly about the shape of feature inventories, and their typology has largely been ignored. The conditions summarized in table 10 show that an explanation of the nature of Frankenduals makes demands across morphology, semantics, syntax and their interfaces. They further reveal that features are fundamentally flexible. This suggests a program of inquiry into features that achieves depth through generality of definition and breadth by applying those definitions across diverse ontologies and categories.

A. DATA. Koasati, Yuchi and Zuni Frankenduals present complications that would have disturbed the flow of argument in the main text. Their details are laid out below.

A.1. KOASATI. Koasati Frankenduals lie under several layers of allomorphy embedded in a complex system of verbal number. The components are a nominal number system without dual (general, singular-plural, or singular-paucal-plural) and verbal number expressed via prefixes, infixes, suffixes, reduplicants, and allomorphy.

Verbal number is singular-plural and enumerates events as much as nominals. Allomorphy of verbal 'formatives' counts events in *łicoffin*/*łico:lin* 'to chip once/multiply' (*f*~*:*, Kimball 1991:315, 318, 333) but objects in *atiní:lin*/*atínnin* 'to burn one/several' (*:*~Ø, *ibid*.:316–7, 447). Similarly, Kimball characterizes suppletive *bátaplin*/*bóklin* as eventive, 'hit once/multiply', but *í:sin*/*píhlin* as nominal, 'pick up one/several' (*ibid*.:323, 333). This again shows (cf, Ngkolmpu, section 5.1) that ±atomic is categorially flexible and active in the verbal domain, both for nominals and events.

Against this backdrop, Koasati duals stand out, as the only case where verbal number counts higher than singular-plural and the only ones where Kimball gives only nominal, not eventive, translations. Structurally, they are Frankenduals, but not self-evidently so. They arise via suppletion and two kinds of person marking.[21]

First or second person Frankenduals (Kimball 1993:474, my glossing) are:

(103) o⟨cí⟩nti- n

come.NPL⟨2SG$_{\text{IIc}}$⟩-SW

‘you_1 come’

(104) o⟨hací⟩nti- n

come.NPL⟨2NSG$_{IIc}$⟩-SW
‘you_2 come’

(105) ilmá:- háska- n

come.PL-2NSG$_{IIIa}$-SW
‘you_{3+} come’

Singular and dual share the nonplural root *óntin*, but are distinguished by singular and nonsingular infixes -*cí*- and -*hací*-. In contrast to the Frankenduals above, no exponent unites dual and plural. This is because *ilmá:kan*, the plural root, and *óntin* belong to conjugation classes (IIc and IIIb, Kimball 1991) that condition different agreement allomorphs, a difference irrelevant to the analysis. If present, second person pronouns (*isnó* ‘you_1’, *hasnó* ‘you_{2+}’) would unite the nonsingulars.

Third person agreement in Koasati is usually numberless. However, a few motion verbs encode nonsingular via the suffix -*ci*. A handful of these also supplete, furnishing Frankenduals. An example is ‘go about’ (Kimball 1991:446):

(106) okipófka-k o:w- á:y

whale- NOM LOC-go about.NPL
‘A whale is swimming about.’

(107) okipófka-k o:w- á:yá- :c

whale- NOM LOC-go about.NPL-3NSG
‘Two whales are swimming about.’

(108) okipófka-k o:- yomáhl

whale- NOM LOC-go about.PL

‘There are some whales swimming about.’

The Frankendual 107 is verb internal, as the noun has general number. It comprises the nonplural root *áyan* and the nonsingular suffix *-ci*. The relationship between dual 107 and plural 108 is again opaque, as the plural of the suppletive pair, *yómahlin*, does not belong to the set that takes *-ci*. Plural use of *-ci*, and clearer comparison to 107, occurs in *ilá:c̲in* ‘they$_{2+}$ arrive here’ (*ibid.*:328).

With distractors controlled for, the empirical relevance of Koasati is clear.

A.2. YUCHI. Yuchi presents a standard singular-plural clusive system, as illustrated by the pronoun and the intransitive verb in table 11 (Linn 2000:133, 198; of the elaborate third person system, the female-speaker, nonfemale-referent forms are chosen). The two sets are nearly identical.

[TABLE 11 about here.]

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 is 109 (Linn 2000:235):

(109) ke- ’õ̲- wi

PVB-1IN.NSG-pass by.NPL
‘we$_2$ (you$_1$ and I) pass by’

(110) ke- ’õ̲- yã

PVB-1IN.NSG-pass by.PL
‘we$_{3+}$ (you$_{2+}$ and I) pass by’

The usual triple 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 lies 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):

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

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

Dual combining a nonplural root 111 with nonsingular person 112 is absent:[22]

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

Nothing in the theory leads us to expect this. Elsewhere, non-Frankendual persons have dual-specific morphology, as in Tlicho first person (Jaker et al. 2013:173, Nicholas Welch, p.c.):

(114) sǫnà-h- who
play- 1SG-do.NPL
'I play'

(115) sǫnà-wì- gwo

play- 1DU-do.NPL
'we$_2$ play'

(116) sǫnà-ts'e-de

play- 1PL-do.PL
'we$_{3+}$ play'

Suppletion in 114–116 patterns identically to other Tlicho persons (59–61), whereas suppletion is precisely what sets the inclusive in Yuchi apart.

One way to hobble Yuchi Frankenduals is in the morphology. If dual (−atomic +minimal) becomes plural (−atomic −minimal) postsyntactically, in all persons but inclusive, then, by construction, only inclusive will distinguish dual from plural. 117 does this (following Harbour 2016, inclusive is +author +participant and all other persons have at least one negative specification):

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

If this rule seems 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 Nevins (2011:421), that + is the marked value of ±minimal in the context of −atomic, making 117 markedness reducing.

Noun-verb feature trading (section 5.1) presents an alternative without morphological rules. It requires, though, taking Yuchi number to be, not singular-plural (±atomic), but minimal-augmented (±minimal), making the inclusive dyad (me and you) featurally distinct from larger inclusives. This shifts the explanatory load from why noninclusive suppletion lacks dual and to why inclusive agreement does. If inclusive is unspecified for ±minimal, feature trading delivers the right result. Persons with ±minimal impose that specification on the verb. So, for exclusive, second person, and third, the verb root is +minimal if and only if agreement is. This derives 111–112, where suppletion mirrors agreement. Where person lacks ±minimal, the verb imposes a value. This generates 109–110, where suppletion differentiates minimal (dual) from augmented (plural) inclusive.

Only under the first analysis is Yuchi relevant to this investigation (a language without ±atomic does not tell us about that feature's locus). I am unaware of any language that has been argued to be minimal-augmented on the basis of as marginal a number distinction as suppletion in the inclusive. So, the first analysis is preferrable, in which case, Yuchi does properly belong to the typology.

A.3. ZUNI. Zuni is one of the languages where Frankenduals are more widely discussed (Corbett 2000, Bliss 2005, Cowper 2005, Nevins 2011). A near minimal triple (Bunzel 1933–1938:421, 427, Corbett 2000:170 reporting Lynn Nichols, p.c.) is:[23]

(118) ho' akc Ø- a·- k̯ä.
1SG along NPL-go-PST
'I went along.'

(119) hon Ø- ʔa·-kya.
1NSG NPL-go- PST
'We$_2$ went.'

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

Given its use of inflectional morphology (as well as suppletives, Newman 1965:32, 55, Nichols

1997:231–2; see 133 below), this is a productive system like Chamorro and Hopi. It provides for intransitives 118–120 and for transitives. Objects are treated like 118–120 (Newman 1965:60, 70):

(121) tom ho' Ø- ˀutte-nna

2SG.ACC 1SG NPL$_O$-bite- FUT
'I will bite you$_1$.'

(122) to'na' ho' Ø- ˀilˀa·nuwa

2NSG.ACC 1SG NPL$_O$-take with.IRR
'I will take you$_2$ with me.'

(123) to'na' ho' ˀa·- ˀilˀa·nuwa

2NSG.ACC 1SG PL$_O$-take with.IRR
'I will take you$_{3+}$ with me.'

Agents, by contrast, are encoded suffixally (Newman 1965:60, Nichols 1997:40):

(124) tom ho' šema-Ø- kya

2SG.ACC 1SG call- NPL$_S$-PST
'I called you$_1$'

(125) hom šema-Ø- ka

1NSG call- NPL$_S$-PST
'we$_2$ called him'

(126) hom šema-nap-ka

1NSG call- PL$_S$-PST
'we$_{3+}$ called him'

This variation is easily accommodable via V- versus v-level number heads, as in 42.

The apparent problem of Zuni is that it permits a 'singular' noun with a nonsingular verb to be interpreted as dual. This would contradict the Frankendual generalization, which only permits dual from the reverse configuration of a nonsingular nominal with a ‘singular’ verb. I review the data before arguing that the problem is illusory as the two constructions use different features.

Newman’s only illustration of his statement is the following singular-dual contrast (1965:74). No plural is supplied.

(127) pasi- n Ø- kˀapa
sleeve-SG NPL-wide
‘The sleeve is wide’

(128) pasi- n ˀa·-kˀapa
sleeve-SG PL- wide
‘The sleeves$_2$ are wide’

Granberry’s empirically laconic formal work gives a minimal triple (1967:60, 72):

(129) ’acce šema-Ø- ka
boy call- NPL-PST
‘The boy called.’

(130) ’acce šema-p- ka
boy call- PL-PST
‘The boys$_2$ called.’

(131) ’aaw-acce šema-p- ka
NSG- boy call- PL-PST
‘The boys$_{3+}$ called.’

This composed number is mercurial. Detailed reading (Bunzel 1933–1938, Walker 1964, Newman 1965, Walker 1966, Granberry 1967, Nichols 1997) finds that the Frankendual pattern for pronouns is exceptionless. The reverse pattern on nouns is not. In 132, *tuna·* ‘eyes’ presents a Frankendual (Newman 1965:52):

(132) tuna-· łupcˀi- nna- ˀka
eye- PL yellow-STAT-PST
‘(his) eyes were yellow’

In 133, both it and the suppletive verb are nonsingular (Newman 1965:44):

(133) tom tuna-· ˀi- łuwa- ha- nna
2SG eye- PL REFL-be standing.PL-CONV.PNCT-FUT
‘your eyes will run about’

These examples differ both from each other and from 128. By my count, common noun exceptions to 127–128 outnumber instances of it by more than two to one.

This variability suggests a number feature that induces cuts of variable size, unlike ±atomic or ±minimal. The feature ±additive, for approximative numbers, has precisely this property (Harbour 2014, section 3.3). Paucals are −additive, but the feature leaves to linguistic and social context what the upper bound of a paucity is. This allows for what we see in *tuna·* ‘eyes’: two is variably treated as plural 133 or not 132. Two lines of argument suggest that this is the right view of the facts.

First, descriptively, two studies by Walker characterize Zuni nouns as having paucal-nonsingular, rather than singular-nonsingular, number. 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 note 3) adds:

> 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.

Notably, ‘is’ in the first sentence versus ‘may’ in the second recalls the variability in Newman’s examples. Interestingly, Walker’s article carries an addendum by Newman, endorsing its contents. It is plausible to read this endorsement as including the claimed paucal-nonsingular system, given that it is mentioned twice on the opening page and references Newman’s own work.

Second, analytically, the reverse Frankendual follows if ±additive is on the noun and ±minimal, on the verb. This makes the noun either paucal (−additive) or nonpaucal (+additive). If we represent the paucal as {singletons, dyads, (triads, (tetrads, (. . . , (heptads). . .)))}, that is, as a set that may go up to things of size seven or that may stop as low as two, 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 for plural.

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 12 highlights, this yields an isomorphism between the morphemes in the minimal triple 129–131 and the features just discussed.[24] Where common nouns follow the Frankendual pattern of a nonsingular noun and a nonplural verb 132, the nominal feature is presumably simply ±atomic.

[TABLE 12 about here.]

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

REFERENCES.

ACKROYD, LYNDA. 1982. Dogrib grammar. Ms, no address.

ACQUAVIVA, PAOLO. 2008. *Lexical plurals: A morphosemantic approach*. Oxford: Oxford University Press.

ADGER, DAVID. 2003. *Core syntax*. Oxford: Oxford University Press.

ADGER, DAVID, and DANIEL HARBOUR. 2007. Syntax and syncretisms of the Person Case Constraint. *Syntax* 10.2–37.

ARKA, I WAYAN. 2011. Constructive number systems in Marori and beyond. *Proceedings of the LFG11 conference*, ed. by Miriam Butt and Tracy Holloway King. Stanford, CA: CSLI Publications. Online: http://web.stanford.edu/group/cslipublications/cslipublications/LFG/16/papers/lfg11arka.pdf.

ARKA, I WAYAN. 2012a. Projecting morphology and agreement in Marori, an isolate of southern New Guinea. Language Documentation and Conservation Special Publication 5, *Melanesian languages on the edge of Asia: Challenges for the 21st century*, ed. by Nicholas Evans and Marian Klamer, 150–173. Honolulu, HI: University of Hawai‘i Press.

ARKA, I WAYAN. 2012b. Verbal number, argument number and plural events in Marori. *Proceedings of the LFG12 conference*, ed. by Miriam Butt and Tracy Holloway King. Stanford, CA: CSLI Publications. Online: http://web.stanford.edu/group/cslipublications/cslipublications/LFG/17/papers/lfg12arka.pdf.

ARKA, I WAYAN, and MARY DALRYMPLE. 2016. Number and plural semantics: Empirical evidence from Marori. *NUSA: Linguistic studies of languages in and around Indonesia* 60.89–106.

BAKER, MARK. 1985. The Mirror Principle and morphosyntactic explanation. *Linguistic Inquiry* 16.373–415.

BÉJAR, SUSANA. 2003. *Phi-syntax: A theory of agreement*. University of Toronto dissertation.

BLISS, HEATHER. 2005. Constructing dual number in Hopi. *Actes du congrès annuel de l'Association canadienne de linguistique 2004 / Proceedings of the 2004 Canadian Linguistics Association annual conference*, ed. by Marie-Odile Junker, Martha McGinnis, and Yves Roberge. ACL/CLA. Online: http://www.chass.utoronto.ca/ cla-acl/actes2004/Bliss-CLA-2004.pdf.

BOBALJIK, JONATHAN. 2002. Syncretism without paradigms: Remarks on Williams 1981, 1984. *Yearbook of morphology 2001*, ed. by Geert Booij and Jaap van Marle, 53–86. Dordrecht: Kluwer.

BOBALJIK, JONATHAN. 2012. *Universals in comparative morphology: Suppletion, superlatives, and the structure of words*. Cambridge, MA: MIT Press.

BONET, EULÀLIA. 1991. *Morphology after syntax: Pronominal clitics in Romance*. Cambridge MA: MIT dissertation.

BORER, HAGIT. 2005. *In name only*. Oxford: Oxford University Press.

BRESNAN, JOAN. 2001. *Lexical-functional syntax*. Oxford: Blackwell.

BUNZEL, RUTH L. 1933. *Zuni texts*. New York, NY: G. E. Stechert & Co.

BUNZEL, RUTH L. 1933–1938. Zuni. *Handbook of American Indian languages*, ed. by Franz Boas, 385–514. New York, NY: Columbia University Press.

CARROLL, MATTHEW J. 2014. Verbal number and aspect in Ngkolmpu. Ms, Australian National University.

CHOMSKY, NOAM. 1995. *The Minimalist Program.* Cambridge, MA: MIT Press.

COON, JESSICA, and ALAN BALE. 2014. The interaction of person and number in Mi'gmaq. *Nordlyd*, Special issue on Features, edited by Martin Krämer, Sandra-Iulia Ronai and Peter Svenonius, 40.85–101.

CORBETT, GREVILLE. 2000. *Number.* Cambridge: Cambridge University Press.

CORBETT, GREVILLE. 2012. *Features.* Cambridge: Cambridge University Press.

COWPER, ELIZABETH. 2005. A note on number. *Linguistic Inquiry* 36.441–55.

CRUM, BEVERLY, and JON DAYLEY. 1993. *Western Shoshoni grammar.* Boise, ID: Department of Anthropology, Boise State University.

CYSOUW, MICHAEL. 2003. *The paradigmatic structure of person marking.* Oxford: Oxford University Press.

CYSOUW, MICHAEL, and JAN WOHLGEMUTH. 2010. The other end of universals: Theory and typology of *rara*. *Rethinking universals: How rarities affect linguistic theory*, ed. by Michael Cysouw and Jan Wohlgemuth, 1–10. Berlin: De Gruyter Mouton.

DALRYMPLE, MARY. 2001. *Lexical functional grammar.* New York, NY: Academic Press.

DALRYMPLE, MARY. 2012. Number marking: An LFG overview. *Proceedings of the LFG12 Conference*, ed. by Miriam Butt and Tracy Holloway King. Stanford, CA: CSLI Publications. Online: http://csli-publications.stanford.edu.

FRANÇOIS, ALEXANDRE. 2009. Verbal number and suppletion in Hiw. Paper presented at Eleventh International Conference on Austronesian Linguistics, Aussois, June 2009.

FRANÇOIS, ALEXANDRE. 2019. Verbal number in Lo-Toga and Hiw: An emergent paradigm in the lexicon. *Transactions of the Philological Society* 177.forthcoming, special issue, *The life-cycle of suppletion*, ed. by Frans Plank and Nigel Vincent.

FRANCIS, BERNIE, and JOHN HEWSON. 1990. Ed., trans., *The Micmac grammar of Father Pacifique*. Sydney, NS: Cape Breton University Press.

GAJEWSKI, JON. 2002. On analyticity in natural language. Ms MIT.

GALLISTEL, C. RANSOM. 2008. NPI *any* and connected exceptive phrases. *Natural Language Semantics* 16.69–110.

GRANBERRY, JULIAN. 1967. *Zuni syntax*. State University of New York at Buffalo dissertation.

HALE, KENNETH. 1973. Person marking in Walbiri. *A festschrift for Morris Halle*, ed. by Stephen R. Anderson and Paul Kiparsky, 308–44. New York, NY: Holt, Rinehart, and Winston.

HALE, KENNETH. 1986. Notes on world view and semantic categories: Some Warlpiri examples. *Features and projections*, ed. by Pieter Muysken and Henk van Riemsdijk, 233–56. Dordrecht: Foris.

HALE, KENNETH. 1997. Some observations on the contribution of local languages to linguistic science. *Lingua* 100.71–89.

HALE, KENNETH; LAVERNE JEANNE; and PAULA PRANKA. 1991. On suppletion, selection and agreement. *Interdisciplinary approaches to language: Essays in honor of S.-Y. Kuroda*, ed. by Carol Georgopoulos and Roberta Ishinara, 255–70. Dordrecht: Kluwer.

HALLE, MORRIS. 1997. Distributed Morphology: Impoverishment and Fission. *PF: Papers at the interface (MIT working papers in linguistics 30)*, ed. by Benjamin Bruening, Yoonjung Kang, and Martha McGinnis, 425–49. MIT. Reprinted in Jacqueline Lecarme and Jean

Lowenstamm and Ur Shlonsky, 2003, eds., *Research in Afroasiatic Grammar: Papers from the Third Conference on Afroasiatic Languages, Sophia Antipolis, France 1996*, 125–50, Amsterdam: Benjamins.

HAMMARSTRÖM, HARALD; ROBERT FORKEL; and MARTIN HASPELMATH (eds.) 2017. *Glottolog 3.0.* Jena: Max Planck Institute for the Science of Human History. Online: http://glottolog.org.

HARBOUR, DANIEL. 2003. The Kiowa case for feature insertion. *Natural Language and Linguistic Theory* 21.543–78.

HARBOUR, DANIEL. 2007. *Morphosemantic number: From Kiowa noun classes to UG number features*. Dordrecht: Springer.

HARBOUR, DANIEL. 2011a. Descriptive and explanatory markedness. *Morphology* 21.223–40.

HARBOUR, DANIEL. 2011b. Valence and atomic number. *Linguistic Inquiry* 42.561–94.

HARBOUR, DANIEL. 2014. Paucity, abundance, and the theory of number. *Language* 90.185–229.

HARBOUR, DANIEL. 2016. *Impossible persons*. Cambridge, MA: MIT Press.

HARLEY, HEIDI, and ELIZABETH RITTER. 2002. Person and number in pronouns: A feature-geometric analysis. *Language* 78.482–526.

HARRISON, SHELDON. 1976. *Mokilese reference grammar*. Honolulu, HI: University Press of Hawaii.

HEIM, IRENE, and ANGELIKA KRATZER. 1998. *Semantics in Generative Grammar*. Oxford: Blackwells.

HENRY, ALISON. 2005. Non-standard dialects and linguistic data. *Lingua* 115.1599–617.

HOIJER, HARRY. 1933–1938. Tonkawa. *Handbook of American Indian languages*, ed. by Franz Boas, 1–148. New York, NY: Columbia University Press.

JAKER, ALESSANDRO; FRED SANGRIS; and MARY ROSE SUNDBERG (eds.) 2013. *Wıìlıìdeh yatıì wet'à edàgot'į yatıì enįhtł'è: Weledeh language verb dictionary*. Yellowknife, NT: Goyatiko Language Society.

JEANNE, LAVERNE MASAYESVA. 1978. *Aspects of Hopi grammar*. MIT dissertation.

JOHNSON, KYLE. 2000. Few dogs eat Whiskas or cats Alpo. *UMOP 23: Issues in semantics and its interface*, ed. by Kiyomi Kusumoto and Elisabeth Villalta, 59–82. Amherst, MA: GLSA.

KALECTACA, MILO. 1978. *Lessons in Hopi*, ed. by Ronald W. Langacker. Tucson, AZ: University of Arizona Press.

KIMBALL, GEOFFREY D. 1991. *Koasati grammar*. Lincoln, NE: University of Nebraska Press.

KIMBALL, GEOFFREY D. 1993. Two hunters, two wives, two dogs, and two clawed witches: The use of the dual in a Koasati narrative. *International Journal of American Linguistics* 59.473–96.

KOOPMAN, HILDA. 2000. Prepositions, postpositions, circumpositions and particles. *The syntax of specifiers and heads*, ed. by Hilda Koopman, 204–60. London: Routledge.

KRATZER, ANGELIKA. 1996. Severing the external argument from its verb. *Phrase structure and the lexicon*, ed. by Johan Rooryck and Laurie Zaring, 109–38. Dordrecht: Kluwer.

KRATZER, ANGELIKA. 2009. Making a pronoun: Fake indexicals as windows into the properties of pronouns. *Linguistic Inquiry* 40.187–237.

KRIFKA, MANFRED. 1992. Thematic relations as links between nominal reference and temporal constitution. *Lexical matters*, ed. by Ivan Sag and Anna Szabolcsi, 29–53. Stanford, CA: CSLI.

LEE, JENNY. 2016. Root alternation and verbal plurality in Ranmo. *University of Pennsylvania Working Papers in Linguistics* 22.197–206.

LIN, VIVIAN I-WEN. 2002. *Coordination and sharing at the interfaces*. MIT dissertation.

LINN, MARY SARAH. 2000. *A grammar of Euchee (Yuchi)*. University of Melbourne dissertation.

LITTLE, CAROL-ROSE. 2018. A binary feature analysis of Mi'gmaq number agreement. *Proceedings of the 35th west coast conference on formal linguistics*, ed. by Wm. G. Bennett, Lindsay Hracs, and Dennis Ryan Storoshenko, 242–50. Somerville, MA: Cascadilla Proceedings Project.

MCLAUGHLIN, JOHN E. 2018. Expanding to the edges: Central Numic dual number. *International Journal of American Linguistics* 84.359–81.

NEVINS, ANDREW. 2008. Cross-modular parallels in the study of phon and phi. *Phi theory: Phi-features across interfaces and modules*, ed. by Daniel Harbour, David Adger, and Susana Béjar, 329–67. Oxford: Oxford University Press.

NEVINS, ANDREW. 2011. Marked targets versus marked triggers and impoverishment of the dual. *Linguistic Inquiry* 42.413–44.

NEWMAN, STANLEY. 1965. *Zuni grammar*. Albuquerque: The University of New Mexico Press.

NICHOLS, LYNN. 1997. *Topics in Zuni syntax*. Harvard University dissertation.

NICHOLS, LYNN. 2008. Zuni accusative intransitives. *International Journal of American Linguistics* 74.115–140.

NOYER, ROLF. 1992. *Features, positions and affixes in autonomous morphological structure*. MIT dissertation.

NOYER, ROLF. 1998. Impoverishment theory and morphosyntactic markedness. *Morphology and its relation to phonology and syntax*, ed. by Steven Lapointe, Diane Brentari, and Patrick Farrell, 264–85. Palo Alto, CA: CSLI.

PLANK, FRANS. 1997. Indirect duals [part I]. Ms Universität Konstanz.

PYLKKÄNEN, MARILIINA. 2008. *Introducing arguments*. Cambridge, MA: MIT Press.

RICE, KEREN. 2000. *Morpheme order and semantic scope*. Cambridge: Cambridge University Press.

RITTER, ELIZABETH. 1993. Where's gender? *Linguistic Inquiry* 24.795–803.

SADLER, LOUISA. 2011. Indeterminacy, complex features and underspecification. *Morphology* 21.379–417.

SAPIR, EDWARD. 1930. Southern Paiute, a Shoshonean language. *Proceedings of the American Academy of Arts and Sciences* 65.1–296.

SAUERLAND, ULI. 2003. A new semantics for number. *Proceedings from Semantics and Linguistic Theory XIII*, ed. by Robert B. Young and Yuping Zhou, 258–75. Ithaca, NY: Cornell University.

SHIBATANI, MASAYOSHI. 1990. *The languages of Japan*. Cambridge: Cambridge University Press.

SILVERSTEIN, MICHAEL. 1976. Hierarchy of features and ergativity. *Grammatical Categories in Australian Languages*, ed. by R.M.W. Dixon, 112–171. Canberra: Australian Institutes of Aboriginal Studies.

SMITH, NORVAL. 2011. Free personal pronoun system database. Online: http://languagelink.let.uu.nl/fpps/index.php.

SPORTICHE, DOMINIQUE. 2005. Division of labor between Merge and Move: Strict locality of selection and apparent reconstruction paradoxes. Online: http://linguistics.ucla.edu/general/Conf/LaBretesche/.

SVENONIUS, PETER. 2005. Extending the extension condition to discontinuous idioms. *The linguistic variation yearbook 5*, ed. by Pierre Pica, Johan Rooryck, and Jeroen van Craenenbroeck, 227–63. Amsterdam: John Benjamins.

SVENONIUS, PETER. 2007. Adpositions, particles, and the arguments they introduce. *Argument structure*, ed. by Eric Reuland, Tanmoy Bhattacharya, and Giorgos Spathas, 71–110. Amsterdam: John Benjamins.

TAMURA, SUZUKO. 1988. *The Ainu language*. Tokyo: Sanseido. Reprinted in 2000, translated from Japanese into English by Sanseido Co. Ltd.

VESELINOVA, LJUBA N. 2006. *Suppletion in verb paradigms: Bits and pieces of the puzzle*. Amsterdam: John Benjamins.

VESELINOVA, LJUBA N. 2013. Verbal number and suppletion. *The world atlas of language structures online*, ed. by Matthew S. Dryer and Martin Haspelmath. Leipzig: Max Planck Institute for Evolutionary Anthropology. Online: http://wals.info/chapter/80.

VOEGELIN, CHARLES F., and FLORENCE M. VOEGELIN. 1957. Hopi domains: A lexical approach to the problem of selection. *International Journal of American Linguistics* Supplement 23.(2).

WAGNER, GÜNTER. 1933–1938. Yuchi. *Handbook of American Indian languages*, ed. by Franz Boas, 293–384. New York, NY: Columbia University Press.

WALKER, WILLARD. 1964. *Reference, taxonomy, and inflection in Zuni*. Cornell University dissertation.

WALKER, WILLARD. 1966. Inflectional class and taxonomic structure in Zuni. *International Journal of American Linguistics* 32.217–27.

WATKINS, LAUREL J. 1984. *A grammar of Kiowa*. With the assistance of Parker McKenzie. Lincoln, NE: University of Nebraska Press.

WILLIAMS, EDWIN. 1986. A reassignment of the functions of LF. *Linguistic Inquiry* 17.265–99.

ZHUKOVA, ALEVTINA N. 1972. *Grammatika korjakskogo jazyka: Fonetika, morfologia* [*Grammar of the Koryak language: Phonetics, morphology*]. Leningrad: Nauka.

ZIGMOND, MAURICE L.; CURTIS G. BOOTH; and PAMELA MUNRO. 1990. *Kawaiisu: A grammar and dictionary with texts*. Berkeley and Los Angeles, CA: University of California Press.

ZWARTS, JOOST. 2008. Aspects of a typology of direction. *Theoretical and cross-linguistic approaches to the semantics of aspect*, ed. by Susan Rothstein, 79–105. Amsterdam: John Benjamins.

NOTES.

*My initial research on this topic was greatly aided by Oli Peatman, as part of an MA research practicum. I also gratefully acknowledge very varied input from Rafael Abramovitz, David Adger, I Wayan Arka, Theresa Biberauer, Hagen Blix, Hagit Borer, Matthew Carroll, Jessica Coon, Grev Corbett, Mary Dalrymple, Alexandre François, Wilhelm Geuder, Heidi Harley, Kenneth Hill, Kyle Johnson, Carol-Rose Little, John McLaughlin, Jeff Lidz, Pamela Munro, Lynn Nichols, Frans Plank, Omer Preminger, Conor Quinn, Gillian Ramchand, Keren Rice, Wolfgang Schellinger, Peter Svenonius, Coppe van Urk, Thomas Weir, and Nicholas Welch, as well as audiences at Roots IV (New York University), London Semantics Day 2015 (Queen Mary University of London), and CamCOS 7 (University of Cambridge), and the universities of Maryland, Oxford, and Toronto. Lastly, I am very grateful for thoughtful input from editors and reviewers for this journal.

[1]The Leipzig glossing conventions are adopted, 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 within Hopi and within Zuni).

[2]Bliss (2005:11) briefly makes the same generalization for the languages discussed in Corbett 2000 (Hopi, Kawaiisu, Zuni; but her account itself is stipulative). More passing reference occurs in Harley & Ritter 2002:493 note 11, and Cowper 2005:443 note 3.

[3]Analysis is possible for Dene (in the Northwest Territories of Canada, and California, Oklahoma, and the US Southwest) and should soon be so for Yam, given ongoing work. For Uto-Aztecan, a starting point, beyond Hopi, is McLaughlin 2018 on Central Numic. Evidence elsewhere can be scant. For Southern Numic Frankenduals, only two Kawaiisu examples are available (Zigmond et al. 1990:67, 76), the same number (though minimal triples) as in Sapir’s discussion of number

in Southern Paiute (1930:160; glossed in McLaughlin 2018:363).

[4]Given the typology's size, I have folded most data exposition into the flow of the argument: Belfast English 21–23; Chamorro 9–20; Hiw 6–8, note 6; Hopi 1–3, 50–52, 67–79, 99–101, note 18; Koryak 95–97; Marori 86–94, note 15; Mi'gmaq 98, table 7; Ngkolmpu 80–85, note 11; Tlicho 59–64, 114–116, note 13; Tonkawa 102, table 8. For Koasati, Yuchi and Zuni, which present complications, see appendix A.

[5]My exposition of Chamorro follows Plank 1997, which relies on more than 20 studies. For clarity, I add 'Ø' to the gloss line in all languages where overt material contrasts with absence.

[6]For subjects, including subjects of intransitives, a specialised morpheme, *-r̄e*, is added to the nonsingular pronouns, *kimi* in 135–6, for a morphologically dedicated dual François (2009):

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

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

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

[7]More compositionally, features and values can be defined separately, with minus as negation and plus, vacuous:

(i) $[\![\text{atomic}]\!] = \lambda x \,.\, \text{atom}(x)$ $\qquad [\![+]\!] = \emptyset$ (i.e., vacuous)

$$[\![\text{minimal}]\!] = \lambda P \,.\, \lambda x \,.\, \frac{\neg\exists y\,(P(y) \wedge y \sqsubset x)}{P(x)} \qquad [\![-]\!] = \neg$$

[8]Thanks to Chris Kennedy for spotting and fixing this problem.

[9]The variable exponence of ±minimal is a matter of syntax as much as morphology. 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 two syntactic loci of −minimal: *ya* might be the real locus and might contextually condition root suppletion. However, the two are separate, tracking different arguments. As per table 4, if its subject is singular, 'kill' takes the form *niina* for a nonplural object and *qöya* for a plural one. Subject plurality is marked additionally, by suffixation for *niina-ya* kill.NPL_O-PL_S and by reduplication for *qö⟨q⟩ya* ⟨PL_S⟩kill.PL_O (Jeanne 1978:93–4).

[10]Sadler (2011) uses the same notation as Arka but posits +SG +PL for dual. Presumably her αSG is to be understood as Arka's $-\alpha$PL, and her αPL as his $-\alpha$SG.

[11]This is not to rule out zero morphemes, which are crucial for Ngkolmpu. There, first and second person, with a singular-nonsingular contrast, have transparent Frankenduals 80–82, but third person is *pi* for all numbers. Nonetheless, the verb will still distinguish plural (−minimal) from singular-dual (+minimal), even if exponence ignores the distinction between singular (+atomic) and dual-plural (−atomic). This captures the attenuated Frankendual in 134:

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

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

[12]Between them, Western Shoshoni (Crum & Dayley 1993), Koasati (Kimball 1991), and Kiowa

(Watkins 1984) show all four possible suppletive patterns. The multiple examples of three-way contrasts in Western Shoshoni 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.

[13]Tlicho verbs can show a three-way number contrast by other means too. On first person, see section 5.1 and 114–116. A different pattern arises with, for instance, ‘dance’ (Jaker et al. 2013:48). Although the root itself is equipped for a Frankendual (nonplural *tło*, plural *who*), preverbs distinguish dual from plural via reciprocal *łe-* and ‘areal’ *go-*. The latter is not plural proper, but connotes spatial distribution or abstractness (Nicholas Welch, p.c.):

(i) da- Ø- tło

PVB-3SG-dance.NPL
‘he/she dances’

(ii) da- **łe-** ge- tło

PVB-RECIP-3NSG-dance.NPL
‘they$_2$ dance’

(iii) da- **go-** ge- who

PVB-AREAL-3NSG-dance.PL
‘they$_{3+}$ dance’

[14]To count events, ±atomic and ±minimal require retyping (cf, 27, 44). Making the event argument of verbs (ignored above) explicit, we can write:

(i) a. $[\![\text{V}]\!] = \lambda x \,.\, \lambda s \,.\, V(s)(x)$

b. $[\![\pm\text{atomic}]\!] = \lambda s \,.\, (\neg)\text{atom}(s)$

c. $[\![\pm\text{minimal}]\!] = \lambda P_{\langle st \rangle} \,.\, \lambda s \,.\, \dfrac{(\neg)\neg\exists y(P(y) \wedge y \sqsubset s)}{P(s)}$

Pending further investigation, I propose, to avoid positing an extra compositional rule, that 133b–c compose with each other and that their output composes with 133a (via event modification; Kratzer 1996:122).

[15]First person verb-internal Frankenduals are structurally interesting, but possibly theoretically irrelevant. More complex than second person, first decomposes, in i–iii, into two sets of exponents: singular-nonsingular *u–en–en* (like the pronouns, *na–nie–nie*) and nonplural-plural *d–d–m* (like number marking on *to* 'be', *mbo–mbo–re*) (Arka & Dalrymple 2016:97; Arka, p.c.):

(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.'

Legalistically, ii falsifies 5, as *d–d–m* is no more peripheral to first person than *u–en–en* is: both are fused with it. Equally legalistically, rephrasing 5 so that (non)singularity is no more peripheral than (non)plurality fixes this. More sensibly though, one can take the true locus of person to be external to the verb. Consistent with this, first person Frankenduals are straightforward once agreement is absent (Arka & Dalrymple 2016:97):

(iv) Na John-i kamaen pnde- ∅- ben

1SG John-U hate 3SG.M.AUX-NPL-1REC
'I hated John'

(v) Nie yanadu John-i kamaen pnde- Ø- 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'

[16]Third person and nonsingular number do not fuse, but create a string where number flanks person, *ulti-j-ig* PL-3-NSG ($t \mapsto j$; Little 2018:245). This is neutral with regard to the Frankendual generalization, pending evidence on the proximity of person to either number morpheme.

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

[18]In fact, a single number head might explain apparent counterexamples, though I have yet to find robust ones. Consider nouns like Hopi 'deer' (Jeanne 1978:83), for which the plurality-sensitive suffix *w–w–Ø* intervenes between the root and (non)singular *Ø–t–t* of 99–101:

(i) Ø- cöövi-w- Ø

NPL-deer- AUG.NPL-SG

'deer$_1$'

(ii) Ø- cöövi-w- t

NPL-deer- AUG.NPL-NSG

'deer$_2$'

(iii) cöö-cöp- Ø- t

PL- deer-AUG.PL-NSG

'deer$_{3+}$'

Jeanne (*ibid.*:64) labels *w* an 'augmentative', regarding it as historic. If merely a nominal formative sensitive to number, *w* is not where ±minimal is interpreted, but simply shows (potentially long-distance) allomorphy for that feature. So, it is a dubious counterexample. But, if *w–w–Ø* were actual number, one could neutralize the counterexample by collocating ±atomic and ±minimal under Num_N, making them equidistant from the noun and irrelevant to 5.

[19]The measure is crude because a typologically balanced sample of singular-dual-plural systems is not the same as the singular-dual-plural subset of a typologically balanced sample. The former might contain 620 languages, the latter 62, but both might include the same 19 Austronesian ones.

[20]If the number features reside in a single head, then nothing rules out allomorphic sensitivity of person to ±minimal but not ±atomic (cf, note 18). If, however, the pronominal bases are not allomorphs but are fused exponents of person and a number feature, then, arguably, that feature can only be ±atomic. This gives the template in the main text more ways of arising than its reverse and, so, it is expected to be a dominant tendency, though not a surface universal.

[21]Koasati presents all possible patterns of suppletion (table 6). Suppletive triples are to be treated as per 65, and singular-plural pairs, as per the first exponent of 65 with ±minimal excised.

[22]My starred example is based on Linn's description and Wagner's (1933–1938:353) statement that forming 'an exclusive dual by prefixation of *nɔ-* to the singular stem is apparently not possible.'

[23]For any person, duals may be optionally marked by *ˀa·či* (Nichols 2008:117 note 5). Common nouns may also take *ˀa·či*. Compare examples below (Corbett, *op. cit.*) with 119:

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

ˀA·či is distinct from 'two' (*kwili*(·), Bunzel 1933–1938:411, 503) and can occur more than once per argument (Newman 1965:48). I take it as a nominal modifier, not intrinsic to nominal number.

[24]It is unclear whether sentences like 128 have an approximative interpretation like paucals or are strictly dual. If the latter, then the cut induced by ±additive must be restricted by convention to

dyads in this morphosyntactic context. Restrictions on paucals are well known in counting(-like) contexts (e.g., Ainu, section 3.3; Byak, Russian, Harbour 2014:222 note 36) and 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.

<table>
<tr><th></th><th>Pronoun</th><th>Verb</th><th colspan="2">Features</th></tr>
<tr><td>Singular</td><td>pam</td><td rowspan="2">wari</td><td>+atomic</td><td rowspan="2">+minimal</td></tr>
<tr><td>Dual</td><td rowspan="2">puma</td><td rowspan="2">−atomic</td></tr>
<tr><td>Plural</td><td>yùutu</td><td>−minimal</td></tr>
</table>

TABLE 1: Hopi: shared morphemes, shared features.

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

TABLE 2: Frankenduals crosslinguistically.

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

TABLE 3: Features of singular, dual, plural.

S	O		
	SG	DL	PL
SG	nɨˀ mi- t niina 1SG 3SG-OBL.NPL kill.NPL$_O$ 'I killed that'	nɨˀ mimɨ-t niina 1SG 3NSG-OBL.NPL kill.NPL$_O$ 'I killed them$_2$'	nɨˀ mimɨ-y qöya 1SG 3NPL-OBL.PL kill.PL$_O$ 'I killed them$_{3+}$'
DL	ˀitam mi- t niina 1NSG 3SG-OBL.NPL kill.NPL$_O$ 'We$_2$ killed that'	ˀitam mimɨ-t niina 1NSG 3NSG-OBL.NPL kill.NPL$_O$ 'We$_2$ killed them$_2$'	ˀitam mimɨ-y qöya 1NSG 3NPL-OBL.PL kill.PL$_O$ 'We$_2$ killed them$_{3+}$'
PL	ˀitam mi- t niina- ya 1NSG 3SG-OBL.NPL kill.NPL$_O$-PL$_S$ 'We$_{3+}$ killed that'	ˀitam mimɨ-t niina- ya 1NSG 3NSG-OBL.NPL kill.NPL$_O$-PL$_S$ 'We$_{3+}$ killed them$_2$'	ˀitam mimɨ-y qö⟨q⟩ya 1NSG 3NPL-OBL.PL ⟨PL$_S$⟩kill.PL$_O$ 'We$_{3+}$ killed them$_{3+}$'

TABLE 4: Simultaneous Hopi Frankenduals (Jeanne 1978, K. Hill, p.c.).

	Harbour 2014 *et seq.*	Arka 2011 *et seq.*
Singular	+atomic +minimal	+SG −PL
Dual	−atomic +minimal	−SG −PL
Plural	−atomic −minimal	−SG +PL

TABLE 5: Isomorphic systems of nonequivalent features.

	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 6: Suppletive variation in three North American languages.

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

TABLE 7: Mi’gmaq animate intransitive Frankendual.

	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 8: Tonkawa pronouns.

	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 9: Mokilese emphatic pronouns.

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 10: Theoretical requisites for explaining Frankenduals.

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 11: Yuchi pronouns (left) and a nonsuppletive verb ('laugh.PRES').

<table>
<tr><th></th><th>Noun</th><th>Verb</th><th colspan="2">Features</th></tr>
<tr><td>Singular</td><td rowspan="2">'acce</td><td>šemaka</td><td rowspan="2">−additive</td><td>+minimal</td></tr>
<tr><td>Paucal</td><td rowspan="2">šemapka</td><td rowspan="2">−minimal</td></tr>
<tr><td>Plural</td><td>'aawacce</td><td>+additive</td></tr>
</table>

TABLE 12: Zuni reverse paucal ‘Frankenduals’.

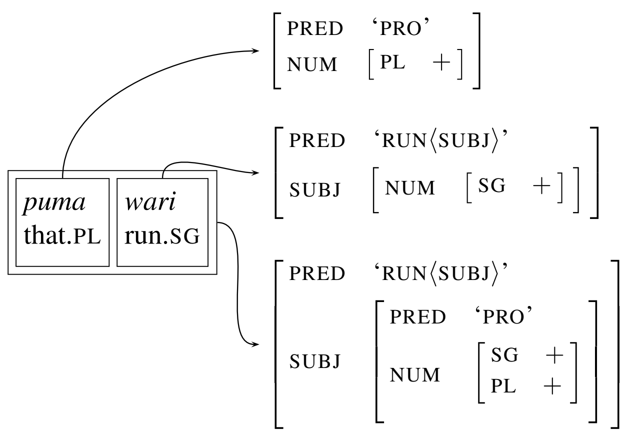


FIGURE 1: A Frankendual in LFG.