Infixes really are (underlyingly) prefixes/suffixes: Evidence from allomorphy on the fine timing of infixation*

Laura Kalin, Princeton University

GLOW 2021 – Breakout room handout

The plan for this breakout room session

- I have an 8ish minute mini talk that I'll repeat as relevant throughout the hour
- After the talk(s), I'll field questions—please indicate in the chat that you'd like to ask a question, or type your question in the chat and I'll read it aloud
- This handout is streamlined for the mini talk, but for easy reference during the question periods, there are a lot (a lot) of appendices
- Looking to read more? A paper draft is on Lingbuzz: https://ling.auf.net/lingbuzz/005581

1 Introduction

Both allomorphy and infixation introduce complexity into morphological systems:

- Allomorphy: Many-to-one correspondence between form and meaning/function

  (1) English PL: gorilla-[**z**], bat-[**s**], midge-[**ɨz**], child-[**rən**], moose-[**Ø**], alumn-[**aj**]

  – See, e.g., Carstairs 1987, 1990, Inkelas 1990, Mascaró 1996, 2007, Bobaljik 2000, 2012, Paster 2006, 2009, Veselinova 2006, Bonet et al. 2007, Bye 2008, Embick 2010, Bermudez-Otero 2012, Bye and Svenonius 2012, Pak 2016, Scheer 2016, Kalin 2020b (and many more)

- Infixation: One form interrupts the linear integrity of another form

  (2) Leti (Blevins 1999): **-ni-** (NOMZR) + **kakri** ('cry') = **k<ni>akri** ('act of crying')

  – See, e.g., Ultan 1975, Moravcsik 1977, McCarthy and Prince 1993a,b, Hyman and Inkelas 1997, Blevins 1999, Moravcsik 2000, Halle 2001, Horwood 2002, Yu 2007, Wolf 2008, Samuels 2009, Bye and Svenonius 2012, Blevins 2014, Harizanov 2017 (and many more)

⇒ **Interactions between allomorphy and infixation have never been systematically studied before**, a gap this work aims to fill.

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What I'll cover in this mini talk:

- §2: A brief overview of the empirical findings in the following domains:
  - §2.1: **On suppletive allomorphy involving an infix**
  - §2.2: **On non-suppletive allomorphy of an infix**
  - §2.3: **On the directionality of infixation**
- §3: Outline of a model of the morphosyntax-phonology interface
- For easy reference, here's a list of Appendices included in this handout:
  - Appendix A: Decision tree for diagnosing suppletive allomorphy
  - Appendix B: List of all case studies
  - Appendix C: On the precedence of exponent choice
  - Appendix D: A review of the infixation literature
  - Appendix E: Hunzib case study
  - Appendix F: A sample derivation in my proposed model
  - Appendix G: A reply to a purported counterexample
  - Appendix H: Assorted extra examples

2 Infixation and allomorphy crosslinguistically

The sample *(see Appendix B for a list of case studies)*

- **51 case studies from 42 languages** (15 language families), given in table below
  - 32 involve suppletive allomorphy (where at least one allomorph is infixal)
  - 34 involve non-suppletive allomorphy of an infix
  - *(See Appendix A for a decision tree)*

Family	**#**	**Languages and countries**
Afro-Asiatic	4	Bole, Mupun (Nigeria); Jebbāli (Oman); Turoyo (Turkey)
Algic	1	Yurok (United States)
Austro-Asiatic	5	Bahnar (Vietnam); Jahai (Malaysia); Katu (Lao PDR); Mlabri (Thailand); Nancowry (India)
Austronesian	14	Ambai, Ambel, Biak, Leti, Muna, Toratán, Sundanese, Wamesa, Wooi (Indonesia); Ida'an Begak (Malaysia); Nakanai (Papua New Guinea); Paiwan, Puyuma, Saisiyat (Taiwan)
Cochimí-Yuman	1	Yuma (United States)
Huavean	1	Huave (Mexico)
Kra-Dai	1	Thai (Thailand)
Mayan	1	Tzeltal (Mexico)
Movima (isolate)	1	Movima (Bolivia)
Muskogean	3	Alabama, Choctaw, Creek (United States)
Niger-Congo	3	Eton (Cameroon); Kichaga, Kimatuumbi (Tanzania)
Northeast Caucasian	3	Budukh (Azerbaijan); Hunzib, Lezgian (Russia)
Salish	2	Nxa'amxcin, Upriver Halkomelem (United States)
Torricelli	1	Yeri (Papua New Guinea)
Uralic	1	Estonian (Estonia)

2.1 On suppletive allomorphy involving an infix

Observation 1: **Suppletion involving an infix may be lexically, morphologically, phonologically, or prosodically conditioned**

- Lexical conditioning: *(**20** out of 32 suppletive case studies)*

(3) **Repetitive in Lezgian** (Northeast Caucasian; Dagestan; Haspelmath 1993:174-175)

a. **q^{h}i-** / {SAY, THROW, HIT, DO, GO, BE/BECOME}
   - e.g.: ***q^{h}i-****jağun* 'hit again' (root: *jağun*)

b. **xU-**[1]/ {GIVE, COME, BRING, EAT, CARRY}
   - e.g.: ***x-****gun*[2] 'give again' (root: *gun*)

c. **-x-** / {SEE, GET OFF, MIX, PUT/BUILD, SIT DOWN (and many more)}
   - **infix; pivot/placement:** after first vowel
   - e.g.: *ki*<***x***>*ligun* 'look again' (root: *kiligun*)

- Phonological conditioning: *(**12** out of 32 suppletive case studies)*

(4) **Agent voice past in Toratán** (Austronesian; Indonesia; Himmelmann and Wolff 1999:13)

a. **n-** / vowel-initial stem
   - e.g.: ***n-****empo* 'sat' (root: *empo*)

b. **-im-** / consonant-initial stem
   - **infix; pivot/placement:** after first consonant
   - e.g.: *t*<***im***>*umpa* 'jumped down' (root: *tumpa*)

- Prosodic conditioning: *(**9** out of 32 suppletive case studies)*

(5) **Nominalizer in Nakanai** (Austronesian; Papua New Guinea; Johnston 1980:176-179)

a. **-il-** / disyllabic stem
   - **infix; pivot/placement:** before stressed (penultimate) vowel
   - e.g.: *t*<***il***>*ága* 'fear' (root: *tága*)

b. **-la** / elsewhere
   - e.g.: *mutelé****-la*** 'generosity' (root: *mutéle*)

- Morphological conditioning: *(**2** out of 32 suppletive case studies)*

(6) **Nominalizer in Leti** (Austronesian; Indonesia; Blevins 1999:390)

a. **nia-** / Class I verbs
   - e.g.: ***nia-****keni* 'act of putting, placing' (root: *keni*–Class I)

b. **-ni-** / Class II verbs
   - **infix; pivot/placement:** before first vowel
   - e.g.: *k*<***ni***>*asi* 'act of digging' (root: *kasi*–Class II)

– Class membership is determined by: (i) phonological factors (CC-initial or not), (ii) **morphological factors** (denominalized V, causativized V, or neither), (iii) semantic factors (stative or non-stative V), (iv) lexical factors (idiosyncratically exceptions).

⇒ **Implication:** Suppletive allomorphy involving an infix is just like all other suppletion.

[2]The high vowel in the prefix has undergone Pretonic High Vowel Syncope (Haspelmath 1993:36-38).

Observation 2: **Suppletive allomorphs may differ in their infixal properties**

- One may be a prefix/suffix and another an infix, as seen in all the examples above.
- More than one suppletive allomorph may be an infix, with distinct positioning, e.g.:

(7) **Instrumental nom. in Nancowry** (Austro-Asiatic, Nicobar Isl.; Radhakrishnan 1981:60-64)

a. **-an-** / monosyllabic stems
   - **infix; pivot/placement:** after first consonant
   - e.g., *k<**an**>ap* 'tooth' (root: *kap*)

b. **-in-** / disyllabic stems
   - **infix; pivot/placement:** after first vowel
   - e.g., *t<**in**>ko?*[3] 'to prod' (root: *tiko?*)

⇒ **Implication:** Infixation is an exponent-level property (not morpheme-level).

Observation 3: **Suppletive allomorphs share an edge orientation**

- Left-edge infixes co-vary with prefixes—*20 out of 32 suppletive cases*[4]
- Right-edge infixes co-vary with suffixes—*12 out of 32 suppletive cases*

⇒ **Implication:** Morphemes (prior to exponence) are associated with a particular edge.

Observation 4: **Suppletion is conditioned at the edge identifiable via edge-orientation**

(8) **Verbal plural in Hunzib** (Northeast Caucasian, Dagestan; van den Berg 1995:81-82)

a. **-baa** / Vː-final stems
   - e.g.: *ʔãqa**-baa*** 'be thirsty (pl)' (root: *ʔãqaa*)

b. **-ɑ́-** / elsewhere
   - **infix; pivot/placement:** before last consonant
   - e.g.: *e<**yɑ́**>k'e* 'burn (pl)' (root: *ek'e*)

⇒ **Implication:** A morpheme's underlying (edgemost) position constrains exponent choice.

Observation 5: **The surface environment of an infix cannot condition suppletion**

(9) **Inverse Hunzib** (invented, unattested type of example)

a. **-ɑ-** / following a long vowel in its infixed position
   - **infix; pivot/placement:** before last consonant
   - e.g., *bii<**yɑ**>t* (root: *biit*)

b. **-baa** / elsewhere
   - e.g.: *bit**-baa*** (root: *bit*)

⇒ **Implication:** Exponent choice is never made after or alongside infixation.

[3] The first vowel is lost due to illegal vowel hiatus created by infixation after the first vowel (Kalin 2021b).

[4] These numbers assume internal consistency when it's impossible to tell what edge an infix is oriented towards, e.g., because of short stems and/or prosodically-placed infixes.

2.2 On non-suppletive allomorphy of an infix

Observation 1: **Non-suppletive allomorphy is conditioned only in an infix's surface (infixed) position (the opposite of suppletive allomorphy)**

(8)′ **Verbal plural in Hunzib** (Northeast Caucasian, Dagestan; van den Berg 1995:81-82)

a. **-baa** / Vː-final stems
   - e.g.: *ʔãqa-**baa*** 'be thirsty (pl)' (root: *ʔãqaa*)

b. **-á-** / elsewhere
   - **infix; pivot/placement:** before last consonant
   - e.g.: *e<**yá**>k'e* 'burn (pl)' (root: *ek'e*)

(10) Some non-suppletive variants of infixal allomorph -***á***-

a. e<**yá**>k 'fall (pl)' ⋆ **insertion of *y* after front vowel** ⋆

b. šo<**wá**>še 'bandage (pl)' ⋆ **insertion of *w* after back vowel** ⋆

c. ča<**á**>x 'write (pl)' ⋆ **low vowel assimilation** ⋆

⇒ **Implication:** Phonology sees the infix in its surface/infixed (non-edge) position.

Observation 2: **No hypothetical position for an infix apart from its surface (infixed) position can induce non-suppletive allomorphy**

(8)′ **Verbal plural in Hunzib** (Northeast Caucasian, Dagestan; van den Berg 1995:81-82)

a. **-baa** / Vː-final stems
   - e.g.: *ʔãqa-**baa*** 'be thirsty (pl)' (root: *ʔãqaa*)

b. **-á-** / elsewhere
   - **infix; pivot/placement:** before last consonant
   - e.g.: *e<**yá**>k'e* 'burn (pl)' (root: *ek'e*)

(11) Root: *uĉ'e* 'cut' (Berg:82)

a. Attested verbal plural: *u<**wá**>ĉ'e* (= insertion of *w*)

b. Not attested: **u<**yá**>ĉ'e* (= insertion of *y* in **uĉ'e-á*, pre-infixation)

⇒ **Implication:** Phonology sees the infix *only* in its surface/infixed (non-edge) position.

Interim summary:

- **§2.1:** Suppletive allomorphy is *edge-based*—all suppletive allomorphs cluster at one edge of the stem, and it is only this edge that can factor into suppletive conditioning

  → **Implication:** Morphemes are linearly concatenated with respect to their stems prior to exponent choice; choice among exponents happens at the edge.

- **§2.2:** Non-suppletive allomorphy is *non-edge-based*—the edgemost environment is irrelevant for non-suppletive alternations of an infix, which are conditioned solely in its surface stem-internal (infixed) position

  → **Implication:** Infixation is immediate following exponent choice, preceding (or perhaps simultaneous with) the phonological computation.

2.3 On the directionality of infixation

Observation 1: An infix can satisfy its pivot/placement looking inwardly at the stem edge (without displacing), never looking outwardly

- It is well-known that when an infix can satisfy its pivot/placement by looking inwardly at the stem edge, it can stay at the stem edge, e.g.:

(6)′ **Nominalizer in Leti** (Austronesian; Indonesia; Blevins 1999:390)

a. **nia-** / Class I verbs
   - e.g.: ***nia-****keni* 'act of putting, placing' (root: *keni*–Class I)

b. **-ni-** / Class II verbs
   - **infix; pivot/placement:** before first vowel
   - e.g.: *k*<***ni***>*asi* 'act of digging' (root: *kasi*–Class II)

(12) The infix ***-ni-*** with vowel-initial stems (Blevins:401)

a. <***ni***>*atu* 'knowledge' (root: *atu*)
b. <***ni***>*odi* 'act of carrying, load' (root: *odi*)

- Compare a pivot/placement that could hypothetically be found outwardly:

(8)′ **Verbal plural in Hunzib** (Northeast Caucasian, Dagestan; van den Berg 1995:81-82)

a. **-baa** / Vː-final stems
   - e.g.: *ʔãqa****-baa*** 'be thirsty (pl)' (root: *ʔãqaa*)

b. **-ǵ-** / elsewhere
   - **infix; pivot/placement:** before last consonant
   - e.g.: *e*<***yǵ***>*kʼe* 'burn (pl)' (root: *ekʼe*)

(13) The verbal plural with outer tense marking (van den Berg 1995:82)

a. r-i<**yǵ**>ƛe-n (cf. *r-iƛe<**yǵ**>-n/*r-iƛ<**ǵ**>-n))
   PL.CLASS-kill<V.PL>-PRET.GER
   'killed (iterative, plural object)' (Berg:82)

b. [AGR [[[kill] VPL] PRET.GER]]

- Even when an infix could hypothetically satisfy its pivot/placement outwardly from the stem edge, it cannot stay at the stem edge; it must displace inwardly.

Observation 2: Infixes displace to their surface position inwardly, never outwardly

(6)′ **Nominalizer in Leti** (Austronesian; Indonesia; Blevins 1999:390)

a. **nia-** / Class I verbs
   - e.g.: ***nia-****keni* 'act of putting, placing' (root: *keni*–Class I)

b. **-ni-** / Class II verbs
   - **infix; pivot/placement:** before first vowel
   - e.g.: *k*<***ni***>*asi* 'act of digging' (root: *kasi*–Class II)

(14) A re-verbalized nominalized verb in Leti (Blevins 1999:389-390)

a. ta-s<**ni**>òi (cf. *t<**ni**>a-sòi)
1PL.INCL.I-<NOM>shift
'we (incl.) inherit'

b. [AGR [VBLZ [NOM [shift]]]]

c. sòi ('shift') → s<**ni**>òi ('inheritance') → ta-s<**ni**>òi 'we (incl.) inherit'

⇒ **Implication:** At the point of infixation, there's no phonologically-contentful outer material.

Interim summary:

- **§2.3:** An infix does not have the option of displacing or looking away from its stem.

  → **Implication:** An infix must satisfy its positional requirements as soon as possible, and exponent choice and infixation proceed from the **bottom-up**.

3 A model of the morphosyntax-phonology interface

The following **binary ordering statements** are supported by the present findings (§2), where $<$ indicates a derivational precedence relation ($\alpha < \beta = \alpha$ derivationally precedes β).

(15) a. EXPONENT CHOICE < INFIXATION
(i) Infixation is a property of individual exponents.
(ii) Suppletive allomorphy is conditioned at the stem edge.
(iii) An infix's surface environment cannot condition suppletive exponent choice.

b. LINEAR CONCATENATION < EXPONENT CHOICE
(i) Suppletive allomorphs share an edge orientation.
(ii) Suppletive allomorphy is conditioned at this shared edge.

c. INFIXATION < PHONOLOGY
(i) Non-suppletive allomorphy of an infix is conditioned in its infixed position.
(ii) Non-suppletive allomorphy shows no trace of a non-infixed position.
(iii) Infixation is often non- or anti-optimizing. (See Kalin 2020a:§6.2.)
(iv) Infixal positioning can be opaque. (See Kalin 2020a:§5.3.)

d. EXPONENT CHOICE < PHONOLOGY
(i) An infix's surface environment cannot condition suppletive exponent choice. (See also Appendix C.)
(ii) Suppletive allomorphy is often non- or anti-optimizing. (See Kalin 2020a:§6.1.)

Cumulatively across (15), the **internally-consistent ordering** arrived at is shown in (16).

(16) LINEAR CONCATENATION < EXPONENT CHOICE < INFIXATION < PHONOLOGY

Taking some liberty with filling in underdetermined aspects of the ordering (exactly when linearization happens, whether infixation can happen both before and simultaneous with cyclic phonology), and incorporating these into a bottom-up model...

(17) ***The fine timing of the morphosyntax-phonology interface***

a. Build the abstract morphosyntactic structure and linearly concatenate it

b. Bottom-up realization: Go to the most embedded unexponed morpheme, and apply a cycle of the following operations, in this order:

(i) Exponent choice (**suppletive allomorphy**)

(ii) Linear displacement (**i.e., infixation, for infixal exponents**)

(iii) Restricted/cyclic phonology (**non-suppletive "restricted" allomorphy**)[5]

(Repeat (i)-(iii) until there are no more unexponed morphemes in domain)

c. Apply surface/post-cyclic phonology (**non-suppletive "surface" allomorphy**)

(Repeat (a)-(c) for every spell-out domain)

See Appendix F for a sample derivation.

4 Summing up and looking ahead

Core findings:

- **Infixation is...**
  - a property of exponents, not morphemes
  - inward
- Allomorphy and infixation interact crosslinguistically in a consistent set of ways:
  - **Suppletive allomorphy is...**
    - ◇ edge-constrained, in terms of both conditioning and relative exponent positioning
    - ◇ not synchronically driven by optimization (see Kalin 2020a)
  - **Non-suppletive allomorphy of an infix is...**
    - ◇ edge-free, with no trace of an edgemost position—variation is determined by the surface environment only
    - ◇ optimizing (see Kalin 2020a)

Core implications:

- The morphosyntax is converted into a phonological form from the bottom up.
  - Exponence, infixation, and phonology are cyclic, applying in that order.
  - Suppletive allomorph choice (exponence) uniformly precedes phonology.
- Infixes are prefixes/suffixes (linearized first as preceding/following their stem) that later go astray (become infixal).

[5] See, e.g., Kiparsky 1982, 2000, Myler 2017, Kalin 2021a (and many others) for discussions of the need to have at least some phonology apply early, here interspersed with exponent choice. See also Kalin 2020a for a discussion of the distinction made here between "restricted" and "surface" non-suppletive allomorphy.

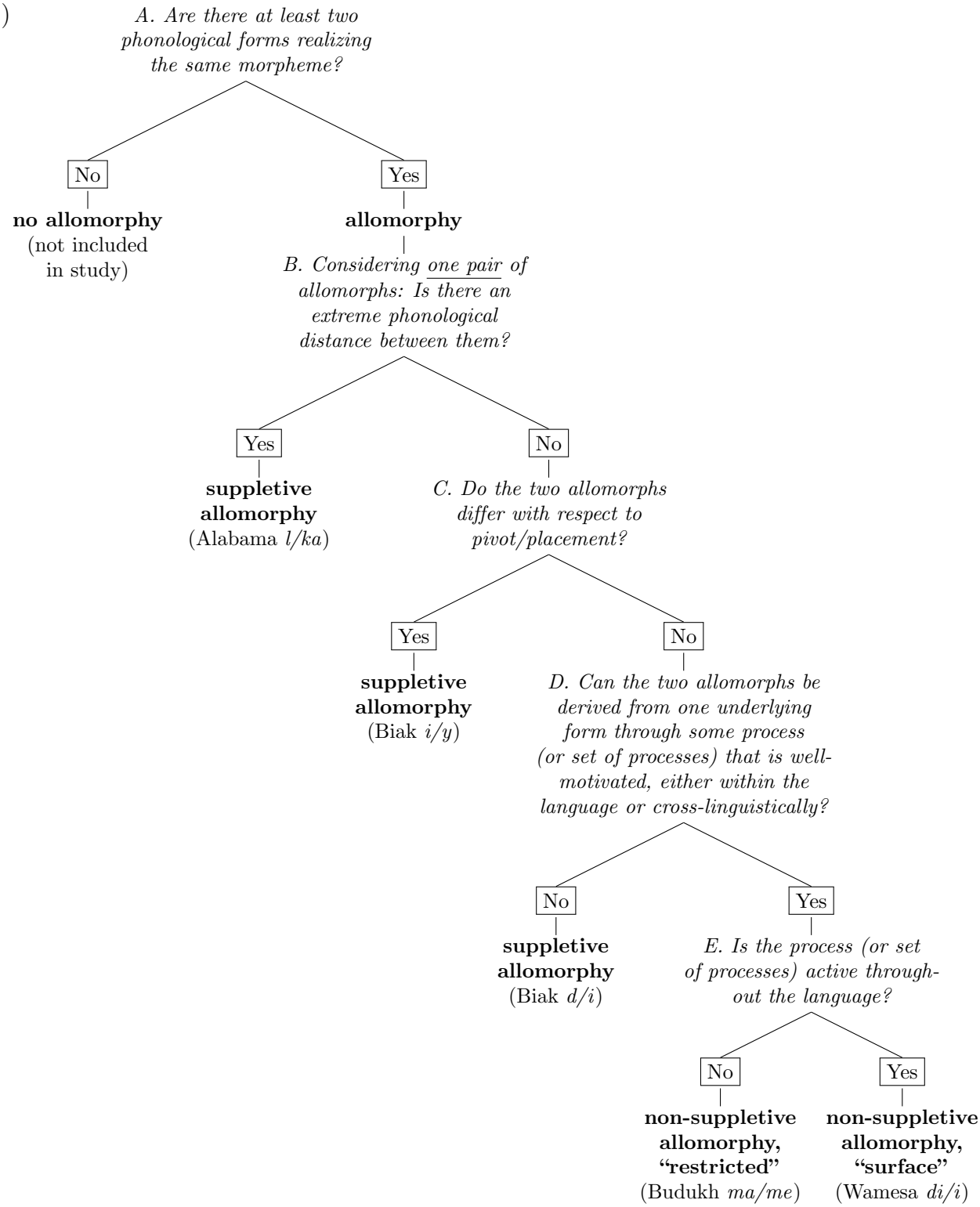
⇒ These conclusions are very naturally accommodated within a general architecture like that assumed by **Distributed Morphology** (Halle and Marantz 1993, 1994), providing strong novel support for this type of theory of morphology.

Extensions of the study

- Collecting more case studies, especially from a wider variety of language families
- Understanding the relationship between infixation and other displacement phenomena, e.g.
  - Second position elements
  - Endoclitics
  - Mobile affixes
  - Root and template morphology
- Allomorphy *around* the site of infixation (see Kalin 2021a, manuscript in prep)

Appendix A: Decision tree for diagnosing suppletive vs. non-suppletive allomorphy (Kalin 2020a)

(18)



Appendix B: List of case studies

- Identifying case studies: Ultan 1975, Paster 2006, Yu 2007, database searches for keywords (WorldCat, Google Scholar), and word of mouth
- Inclusion criteria: **(i)** at least two phonological forms realize the same morpheme; **(ii)** at least one of these is an infix; **(iii)** available/accessible documentation is sufficient for at least a relatively complete and clear picture of each case study

Table 1: Case studies (by family and language)

Language (country)	**Morpheme**	**Edge**	**Suppl. condition**	**Main source(s)**
Afro-Asiatic				
Bole (Nigeria)	distributive	left	lexical	Gimba 2000, Zoch 2017
Jebbāli (Oman)	plural	right	prosodic, lexical	Al Aghbari 2012
Mupun (Nigeria)	pluractional	right	lexical	Frajzyngier 1993
Turoyo (Turkey)	past	left	(none)	Jastrow 1993, Kalin 2020b
Algic				
Yurok (United States)	intensive	left	(none)	Garrett 2001
Austro-Asiatic				
Bahnar (Vietnam)	nominalizer	left	phonological (mel.), lexical	Banker 1964
Jahai (Malaysia)	causative	left	prosodic, lexical	Burenhult 2002
Katu (Lao PDR)	nominalizer	left	lexical	Costello 1998
Mlabri (Thailand)	nominalizer	left	(none)	Rischel 1995
Nancowry (India)	causative	left	prosodic	Radhakrishnan 1981
	instrumental	left	prosodic	Radhakrishnan 1981
Austronesian				
Ambai (Indonesia)	2sg subject	left	(none)	Silzer 1983
	3sg subject	left	(none)	Silzer 1983
Ambel (Indonesia)	sg partic. sbj	left	lexical	Arnold 2018
Biak (Indonesia)	2sg subject	left	lexical	van den Heuvel 2006
	3sg subject	left	phonological	van den Heuvel 2006
Ida'an Begak (Malaysia)	reciprocal	left	phonological (mel.), lexical	Goudswaard 2005
Leti (Indonesia)	nominalizer	left	phonological, lexical, morphological	Blevins 1999, van Engelenhoven 2004
Muna (Indonesia)	irrealis	left	(none)	van den Berg 1989
Nakanai (PNG)	nominalizer	right	prosodic, lexical	Johnston 1980
Paiwan (Taiwan)	agent focus	left	(none)	Ferrell 1982
Puyuma (Taiwan)	AV/intransitive	left	phonological (mel.)	Teng 2008
	perfective	left	phonological (melody)	Teng 2008
Saisiyat (Taiwan)	agent voice	left	(none)	Zeitoun et al. 2015
Sundanese (Indonesia)	plural	left	(none)	Cohn 1992
Toratán (Indonesia)	AV past	left	phonology	Himmelmann and Wolff 1999
	UV past	left	phonological (melody), lexical	Himmelmann and Wolff 1999
Wamesa (Indonesia)	2sg subject	left	(none)	Gasser 2014
	3sg subject	left	(none)	Gasser 2014
Wooi (Indonesia)	2sg subject	left	(none)	Sawaki 2016
	3sg subject	left	(none)	Sawaki 2016
Cochimí-Yuman				
Yuma (United States)	verbal pl (PL3)	left	(none)	Halpern 1947, Gillon and Mailhammer 2015

Table 2: Case studies (by family and language) continued

Language (country)	Morpheme	Edge	Suppl. condition	Main source(s)
Huavean				
Huave (Mexico)	passive	right	lexical	Kim 2008
Kra-Dai				
Thai (Thailand)	specialization	left	(none)	Huffman 1986, Blevins 2014
Mayan				
Tzeltal (Mexico)	intransitivizer	right	lexical	Slocum 1948
Movima (isolate)				
Movima (Bolivia)	irrealis	left	(none)	Haude 2006
Muskogean				
Alabama (United States)	middle voice	right	prosodic	Hardy and Montler 1991
Choctaw (United States)	iterative	right	(none)	Ulrich 1986, Broadwell 2006, Lombardi and McCarthy 1991
Creek (United States)	dual/plural	right	phonological (melody)	Martin 2011
	perfective	right	phonological	Martin 2011
Niger-Congo				
Eton (Cameroon)	G-form	right	prosodic	Van de Velde 2008
Kichaga (Tanzania)	intensive	right	(none)	Yu 2007, Inkelas p.c.
Kimatuumbi (Tanzania)	perfective	right	pros., phono. (mel.), morph.	Odden 1996
Northeast Caucasian				
Budukh (Azerbaijan)	prohibitive	left	(none)	Alekseev 1994
Hunzib (Russia)	verbal plural	right	phonological	van den Berg 1995
Lezgian (Russia)	repetitive	left	lexical	Haspelmath 1993
Salish				
Nxa'amxcin (United States)	inchoative	left	lexical	Willett 2003
Upriver Halkomelem (U.S.)	verbal plural	left	lexical	Galloway 1993, Thompson 2009
Torricelli				
Yeri (Papua New Guinea)	additive	left	lexical	Wilson 2014
	imperfective	left	lexical	Wilson 2014
Uralic				
Estonian (Estonia)	illative	right	lexical, prosodic	Hirvonen 2020

Appendix C: Are morphology and phonology separate, or simultaneous?

Can suppletive allomorph choice be regulated by considerations of phonological optimization? Or is suppletive allomorph choice prior to and independent of such considerations?

Three answers to this question in the literature:

A. Phonologically- and prosodically-conditioned allomorphy is always regulated by the phonological component of the grammar.

- See, e.g., McCarthy and Prince 1993a,b, Mester 1994, Kager 1996, Hyman and Inkelas 1997, Horwood 2002, Wolf 2008.

B. Suppletive allomorph choice is always prior to and independent from the phonological component.

- See, e.g., Halle and Marantz 1993, Trommer 2001, Paster 2006, Bye 2008, Embick 2010, Bye and Svenonius 2012, Pak 2016, Dawson 2017, Rolle 2020, Stanton 2020

C. Phonologically- and prosodically-conditioned suppletive allomorphy are split into two types: non-/anti-optimizing allomorphy, which is determined prior to phonology, and optimizing allomorphy, which is regulated by the phonology.

- See, e.g., Booij 1998, Mascaró 2007, Bonet et al. 2007, Nevins 2011, Bermudez-Otero 2012, Yu 2017, de Belder 2020

The findings in this paper add a new typological argument in support of the non-hybrid, morphology-before-phonology approach.

- If suppletive allomorph choice could be made in the phonological component/alongside the phonological computation, then...
  - (i) the surface (infixed) environment of an infix should be able to influence suppletive allomorph choice, and
  - (ii) there should be cases of suppletive allomorphy that are not analyzable via edge-based subcategorization, i.e., that necessitate global optimization
- But, such cases are absent from my findings.
  - In Kalin (2020a:§6.3), I argue that apparent counterexamples (e.g., those in Yu 2017), do not hold up to scrutiny.

Appendix D: How and when do affixes get to be infixes?

The literature has offered a plethora of accounts of infixal positioning, which can be grouped into two broad types:[6]

- **Indirect infixation accounts:** Infixation after prefixation/suffixation (w.r.t. the stem)
  (see, e.g., Anderson 1972, Moravcsik 1977, Halle 2001, Horwood 2002, Plank 2007, Embick 2010, Bye and Svenonius 2012, Bacovcin and Freeman 2016)
- **Direct infixation accounts:** No intermediate step of linear concatenation; two types:
  - A. Infixes have a prefixal/suffixal nature (w.r.t. the stem)
    (see, e.g., Cohn 1992, Prince and Smolensky 1993, McCarthy and Prince 1993a, Zoll 1996, Buckley 1997, Hyman and Inkelas 1997, Kaufman 2003, Klein 2005, Wolf 2008)
  - B. Infixes are infixes through and through (no prefixal/suffixal nature w.r.t. the stem)
    (see, e.g., Anderson 1992, Inkelas 1990, Yu 2007, Samuels 2009)

[6]These three types map loosely, but not perfectly, onto Yu's (2007) groupings of accounts into (i) derivational versions of the Phonological Readjustment theory of infixation; (ii) constraint-based versions of the Phonological Readjustment theory of infixation; and (iii) versions of the Phonological Subcategorization theory of infixation.

Direct infixation accounts

⇒ Infixes take their infixed position *directly*, without stopping off first as a prefix/suffix.

A. Infixes are still prefixes/suffixes (w.r.t. the stem) in some abstract way; what this underlying nature of an affix does is compel stem edge proximity.

- E.g., McCarthy and Prince 1993a:

(19) **Tagalog actor focus** (McCarthy and Prince 1993a:21, citing French 1988)

	root	root+AF
'teach'	aral	<**um**>aral
'write'	sulat	s<**um**>ulat
'graduate'	gradwet	gr<**um**>adwet

(20) Relevant constraints for Tagalog (McCarthy and Prince 1993a:22-24):

a. NO-CODA: Syllables are open
b. ALIGN-*um*: Align($[\text{um}]_{\text{Af}}$, L, Stem, L) (= *um* is a prefix)

(21) Input (unlinearized): {gradwet, um}

Candidates	NO-CODA	ALIGN-*um*
a. [–um.grad.wet.	*** !	
b. [g–um.rad.wet.	*** !	g
c. ☞ [gr–u.mad.wet.	**	gr
d. [grad.w–u.met.	**	gradw !

B. There is no designation of infixes as prefixes or suffixes (w.r.t. the stem).

– E.g., Yu (2007:48), "infixes are formally no different from prefixes and suffixes, except for the fact that, while prefixes and suffixes target morphological constituents, infixes target phonological ones".

(22) **Mlabri nominalization** (Yu 2007:76-79, citing Rischel 1995:85)

	root	root+NOM
'be ablaze'	gɯh	g<**rn**>ɯh
'sing'	kap	k<**rn**>ap
'sweep the ground'	peelh	p<**rn**>eelh

(23) ALIGN-*rn*: Align(*rn*, L, C_1-Stem, R) (= *rn* follows the first C)

(24) Input (unlinearized): {kap, rn}

	ALIGN(*rn*, L, C_1-STEM, R)
a. k**rn**ap	✓
b. **rn**kap	✗
c. ka**rn**p	✗

Indirect infixation accounts

⇒ Infixes concatenate first as prefixes or suffixes (w.r.t. the stem), and then undergo phonological displacement to become infixes.

- Supported by the present findings:
  - **Suppletive allomorphy across the sample is edge-constrained**:
    - ◇ All suppletive allomorphs are oriented w.r.t. ***the same edge***.
    - ◇ It is this edge—and ***only this edge***—that is relevant for suppletive allomorphy.
    - ⇒ **Implication:** At the point of exponent choice, ***morphemes have already been concatenated with and linearized with respect to their stem***.
    - → Exponent choice is made at this stem edge, prior to infixation.
  - Note that direct infixation accounts cannot capture these facts in any straightforward way, related to the lack of a pre-infixation step of linearization (and exponent choice).
- The findings do *not*, however, tell us what the *nature* of this preliminary step of concatenation and linearization is (or exactly when it takes place).
  - Morpheme ordering could be a byproduct of the morphosyntactic structure (à la Kayne 1994, Bye and Svenonius 2012, *i.a.*)
  - Morpheme ordering could come from idiosyncratic properties of each phrase, head, or morpheme involved (e.g., Harley 2011).

Appendix E: Hunzib case study

Hunzib is a Northeast Caucasian language spoken in southern Dagestan.

- *Data below all come from van den Berg 1995, but much of the basic analysis, and all of the conclusions and implications, are my own.*

Basic phonology and morphology (van den Berg 1995):[7]

- CV(ː)(C) syllables; native roots are maximally disyllabic (Berg:27)
- Rich verbal morphology (incl. class prefixes, derivational and inflectional suffixes) (Berg:74)
- Stress is generally on the penultimate vocalic mora of the word (Berg:28-31)

(25) a. ʔíyu ‘mother’
b. k’išáa ‘play’
c. ʔɨs-ná-la-s ‘siblings (genitive)’
d. qoqó-o ‘house (dative)’

[7]I diverge from the grammar’s orthographic conventions in the following ways: (i) I indicate word-initial glottals; (ii) I use IPA [ɑ] for the low back vowel (notated as α in the grammar); (iii) I don’t indicate bound roots.

- Constraints on vowels and vowel sequences: (Berg:22)
  - Vowel length is contrastive for all vowel qualities, but /aa/ is by far the most common
  - Long vowels may occur underlyingly or via morphological concatenation
  - But, **long vowels can only surface in stressed syllables**; in an unstressed syllable, long vowels are shortened
  - **Sequences of non-identical vowels are not tolerated**; general repairs: (Berg:33)

(26) a. $V_1\ V_2 \rightarrow V_2$ (general case: first vowel deletes)
b. aa V → aa (if first vowel is *aa*: second vowel deletes)

The verbal plural morpheme (van den Berg 1995:81-83):

- Marks iterativity or plurality of internal argument; compatible with ∼40% of verbs
- Two suppletive allomorphs (phonologically conditioned), (27):

(27) Suppletive allomorphs of the verbal plural marker
a. **-baa** / V꞉__ (suffixal on long-V-final stems[8])
b. **-á-** / elsewhere (infixal, before final C)

(28) Suffixal allomorph ***-baa*** (n.b. opacity: stem vowel shortens)
a. ʔãqáa (be.thirsty) → ʔãqa**-báa** 'be thirsty (pl)' (Berg:283)
b. ũcu-láa (hide-AP) → ucu-la**-báa** 'hide (pl, intrans)' (Berg:338)
c. miyaw-dáa (mew-IDEO) → miyaw-da**-báa** 'mew (pl)' (Berg:320)

(29) Infixal allomorph ***-á-*** and its non-suppletive variants
a. áhu (take) → ɑ<**á**>hu 'take (pl)' (Berg:284)
⋆ creates a long vowel; **no phonological changes** to/around infix
b. ék (fall) → e<**yá**>k 'fall (pl)' (Berg:295)
⋆ hiatus resolution via ***y*-insertion** after V[+front] (stem V protected by prior stress)
c. šóše (bandage) → šo<**wá**>še 'bandage (pl)' (Berg:334)
⋆ hiatus resolution via ***w*-insertion** after V[–front] (stem V protected by prior stress)
d. čáx (write) → ča<**á**>x 'write (pl)' (Berg:292)
⋆ hiatus resolution via **assimilation** (infix vowel may be underspecified?)
e. íx-lə (warm-VBLZ) → ɨx<**á**>-le[9] 'warm (pl)' (Berg:308)
⋆ interconsonantal vowel **centralization** (infix vowel may be underspecified?)
f. réλe-k' (straight-CAUS) → reλ<**á**>-k' ''straighten (pl)' (Berg:330)
⋆ hiatus resolution via **deletion** ((26a): $V_1\ V_2 \rightarrow V_2$); followed by **centralization**

[8]There is also a handful of verbs that, idiosyncratically, take *baa* as an infix.

(30) Allomorphs of the verbal plural marker (summary)

a. **-baa** / V**ː**__ (suffixal on long-V-final stems)

b. **-á-** / elsewhere (**infix; pivot/placement:** before C)

(i) -yá- / V[+front,–low] __ *(= glide insertion)*

(ii) -wá- / V[–front,–low] __ *(= glide insertion)*

(iii) -á- / a__ *(= assimilation)*

(iv) -á- / C__C *(= centralization)*

- A plural verb can have many (further) suffixes; but, the plural infix can never satisfy its pivot/placement (≈ "be before a consonant") by looking outward; it must look inward:

(31) r-i<**yá**>ƛe-n (cf. *r-iƛe<**yá**>-n/*r-iƛ<**á**>-n)
PL.CLASS-kill<V.PL>-PRET.GER
'killed (iterative, plural object)' (Berg:82)

Observations about this data in Hunzib:

- **On suppletive allomorphy:**
  - The right edge of the stem plays **a central role**:
    - ◇ Both suppletive allomorphs are **oriented w.r.t. this edge** (suffix, R-edge infix).
    - ◇ Suppletion is **conditioned by this edge**.
      - · Relevant factor: *Is the final segment a long vowel or not?*
    - ◇ Suppletive allomorphy is based on the **underlying form** of this edge; opacity!
      - · After choice of *-baa*, stem-final V shortens; e.g., (28a): ʔãqáa → ʔãqa**-báa**
      - · After infixation of *-á-*, any stem-final vowel would necessarily be short too
  - There is apparent non-locality: The infix can end up in a surface position that is **not immediately local** to the conditioning (right) edge, e.g., (29a): áhu → a<**á**>hu
  - Suppletive allomorph choice is not optimizing: *-baa* would be a perfectly fine suffix on all stems; and *-á-* would be no worse in long-V-final stems than any other.
- **On non-suppletive allomorphy of the infix:**
  - The right edge of the stem plays **no role**.
    - ◇ Non-suppletive alternations are determined stem-internally, **purely locally**, by the infix's immediate environment in its surface (infixed) position.
  - Non-suppletive allomorphy is optimizing, mainly centered on **hiatus avoidance**.
- **On infixation:**
  - Infixation of *á* is not optimizing; *á* would fare similarly well/poorly as a suffix, e.g.:

(32) a. áhu → hypothetical (*á* suffix): ah-**á** *vs.* attested (*á* infix): a<**á**>hu

b. ék → hypothetical (*á* suffix): ek-**á** *vs.* attested (*á* infix): e<**yá**>k

◇ n.b.: There are underlyingly stressed suffixes consisting of a single V. (Berg:29)

  - Infixation is necessarily *inward*, with displacement into the stem of infixation.

⇒ Summary of findings for Hunzib, and implications for timing:

1. **Suppletive allomorph choice** is sensitive only to the rightmost edge of the stem, is opaque, and is not optimizing.

   → EXPONENT CHOICE (AT RIGHT EDGE) < PHONOLOGY

2. **The infixal allomorph** can surface in a position non-local to this conditioning edge.

   → EXPONENT CHOICE (AT RIGHT EDGE) < INFIXATION

3. **Non-suppletive allomorphy** of the infix is sensitive only to the surface position of the infix, and is optimizing. But **infixation** itself is not optimizing.

   → INFIXATION < PHONOLOGY

4. **Infixation** is only inward-looking for pivot/placement satisfaction.

   → EXPONENCE AND INFIXATION PROCEED CYCLICALLY, BOTTOM UP

Appendix F: A sample derivation

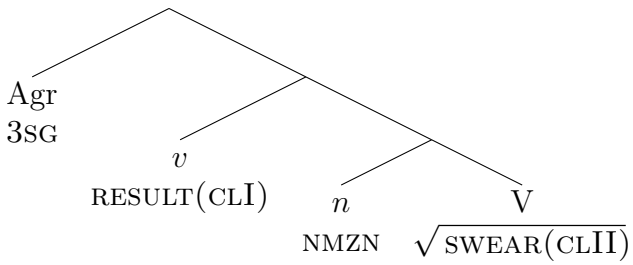
(33) A re-verbalized nominalized verb in Leti (Blevins 1999:389)

na-l<**i**>òkra (**n*<*i*>*a-lókra*)
3SG.I-<NMZN>swear
'he has sworn'

I assume, building on the discussion in Blevins (1999:388), that a null v resultative head (not shown above in (33)) mediates between the inflectional prefix and the nominalized verb and is responsible for the classification of the derived form as Class I.

Step 1: Building

(34)



Step 2: Linearizing

(35) [3SG- [RESULT(CLI)- [NMZN- [√SWEAR(CLII)]]]]

Step 3: Cyclic operations

(36) **Cycle 1**

a.	Exponent choice: √SWEAR(CLII) → *lòkra*$_{II}$	*lòkra*$_{II}$
b.	Linear displacement: n/a	- - -

c. Restricted phonology: n/a - - -
→ Output: $l$òkra$_{II}$

(37) **Cycle 2**

a. Exponent choice: NMZN → *-ni-* / Class II verbs <*ni*>$l$òkra$_{II}$
b. Linear displacement: *-ni-* → __V l<*ni*>òkra$_{II}$
c. Restricted phonology: $n \rightarrow \emptyset$ / [[-syll,+son]__ ...]$_{NOM}$ l<*i*>òkra$_{II}$
→ Output: l<*i*>òkra$_{II}$

(38) **Cycle 3**

a. Exponent choice: RESULT(CLI) → $\emptyset_I$ $\emptyset_I$-l<*i*>òkra$_{II}$
b. Linear displacement: n/a - - -
c. Restricted phonology: n/a - - -
→ Output: $\emptyset_I$-l<*i*>òkra$_{II}$

(39) **Cycle 4**

a. Exponent choice: 3SG → *na-* / Class I verbs *na*-$\emptyset_I$-l<*i*>òkra$_{II}$
b. Linear displacement: n/a - - -
c. Restricted phonology: n/a - - -
→ Output: *na*-$\emptyset_I$-l<*i*>òkra$_{II}$

Step 4: Surface phonology

(40) *naliòkra*

Appendix G: A response to Papillon (2021)

Papillon (2021) aims to provide a counterexample to two of my findings.

- The two findings of mine that are relevant: Suppletive allomorphs share an edge orientation; and suppletion is conditioned at the stem edge identifiable via edge orientation
  - What I take to be the implications of these particular findings:
    - ◇ Morphemes are linearized with respect to their stems prior to exponent choice
    - ◇ Prefixation/suffixation are not exponent-specific properties
- The purported counterexample: Suppletive allomorphs that have opposite-edge orientations; also apparent opposite-edge suppletive conditioning
  - Papillon's conclusion: There is no step of morpheme linearization prior to infixation.
    - ◇ Prefixation, suffixation, and infixation are all encoded alongside exponent choice conditions, in an enriched subcategorization frame; these subcategorization frames are totally unrestricted (as is morphology more generally).
    - ◇ (nb. see Kalin and Rolle 2021, in prep, for a number of arguments against an enriched subcategorization model)
    - ◇ The observed typological patterns are due entirely to diachronic factors.

Overview of my response: The data put forward are not a true counterexample, but rather involve an orthogonal morphological process—mobile affixation—which is quite crucially not exponent-specific, and therefore does not impact my findings/conclusions.

The language: Sáliba (Colombia; Morse and Frank 1997)

→ *Note that the discussion below follows the data as described by Papillon 2021.*

- Animate subject agreement affixes in Sáliba are placed variably with respect to their stems, as determined by the phonological shape of the stem.
  - Class I: V-initial stems — take agreement as a prefix
  - Class II: CVV-initial stems — take agreement as a left-edge infix (after the first vowel)
  - Class III: Trisyllabic (or larger) stems that end in VV — take agreement as a right-edge infix, appearing between the last two Vs
- For most of the agreement affixes, it's one and the same affixal form in all these places (i.e., the exponent does NOT differ across positions), e.g., 3PL *h*:

(41) ***h***-*íxa?da?ma-?g-á́* 3PL-arrive-FUT-IND (p.42)
*bé-**h**-e?e-te?-o* guard-3PL-guard-CLASSIFIER-PURPOSE (p.47)
*kelé-**h**-a-?g-á?a* make-3PL-make-REFL-NOMIN (p.88)

- Two instances of suppletion among the agreement affixes:
  - 1SG: *d* in Class II; *tʃ* elsewhere

(42) a. ***tʃ***-*itʃ-á́-xa* 1SG-deliver-IND-3F.COMP (51)
b. *ɸe-**d**-ada-?g-á́* sweep-1SG-sweep-FUT-IND (83)
c. *maɲu-**tʃ**-á́* work-1SG-IND (98) (< /maɲua/ 'work')

  - 2SG: *g* in Class III; k^w elsewhere

(43) a. ***k**^{w}*-*itʃ-á-?ri* 2SG-deliver-INTERR-3SG.COMP (87)
b. *gu-**k**^{w}*-*á?-a* walk-2SG-walk-INTERR (97)
c. *koko-**g**-á-di-g-ã́* load-2SG-load-NEG-FUT-IND (12)

⇒ These two cases of suppletion seem to show suppletive exponents varying positionally, with (in the case of 2SG) a left-edge environment conditioning suppletion of a right-edge affix.

I contend that this data is not a counterexample at all, but just shows that mobile affixation (see the list of "extensions" in §4 above) complexifies the empirical landscape in interesting but ultimately orthogonal ways (as discussed in §3.4 of Kalin 2020a).

- First, it is quite clear that the variable affix positioning is *not* exponent-specific in Sáliba, as it holds uniformly across the whole agreement paradigm.
  - Papillon treats this variable affix positioning as due to enriched subcategorization frames of individual exponents, which has two undesirable consequences:
    - ◇ For the 3PL, (41) (and other non-varying agreement forms), Papillon needs to posit 3 homophonous exponents that differ only in their position.

◇ Papillon is unable to generalize across verb classes with respect to exponent positioning—it must be (for him) an accident that agreement always precedes Class I verbs, agreement is always a left-edge infix for Class II verbs, and agreement is always a right-edge infix for Class III verbs.

⇒ A more parsimonious account, which does away with this redundancy and accidental homophony is to *factor out* the mobile affixation from exponence entirely.

◇ If mobile affixation is phonological, then (under my proposed model) it's natural that it should not impact nor co-vary with exponent choice.

- Second, the case of suppletion occurring only with Class III verbs, for 2SG, (43), is not opposite-edge conditioned; it's whole-stem conditioned (as argued for explicitly by Papillon in his §3.1, who shows that both edges matter).

- My proposal (in broad strokes) for this Sáliba data:
  - These agreement morphemes are left-edge morphemes (i.e., underlying prefixes).
  - Suppletive exponent choice is conditioned at/from the left edge (considering either the leftmost edge or the whole stem).
  - After exponent choice, later mobile affixation operations (co-varying with Class, i.e., verb shape) may displace these exponents to their surface positions.

Appendix H: Assorted extra examples

(44) **Definition of Infixation** (Blevins 2014; formatting/emphasis added)

Under infixation a *bound morpheme*
whose phonological form **consists minimally of a single segment**,
is **preceded and followed** *in at least some word-types* by **non-null segmental strings**
which together **constitute a relevant form-meaning correspondence of their own**,
despite their non-sequential phonological realization.

(45) **Nominalizer in Bahnar** (Austro-Asiatic, S. Vietnam; Banker et al. 1979:100-105)

a. **a-** / {TIE.UP}
   - e.g.: ***a-****chô* 'a bundle' (root: *chô*)

b. **bơ-** / *m*-initial stems
   - e.g.: ***bơ-****muih* 'a field in the woods' (root: *muih*)

c. **-ơn-** / elsewhere
   - **infix; pivot/placement:** after first consonant
   - e.g.: *t*<***ơn***>*ăr* 'woven bamboo' (root: *tăr*)

(6)′ **Nominalizer in Leti** (Austronesian; Indonesia; Blevins 1999:390)

a. **nia-** / Class I verbs
   - e.g.: ***nia-****keni* 'act of putting, placing' (root: *keni*–Class I)

b. **-ni-** / Class II verbs
   - **infix; pivot/placement:** before first vowel
   - e.g.: *k*<***ni***>*asi* 'act of digging' (root: *kasi*–Class II)

(46) Non-suppletive variants of infixal allomorph -***ni***-

a. s<**n**>uri ‘pour, pouring’ ⋆ ***i* deletion before high vowel** ⋆

b. r<**i**>esi ‘victory’ ⋆ ***n* deletion after sonorant cons.** ⋆

c. r<**∅**>uru ‘trembling’ ⋆ ***n* and *i* deletion** ⋆

(47) **Middle voice in Alabama** (Muskogean, USA; Hardy and Montler 1991:2-3)

a. **-ka** / two-mora final foot (= final heavy syllable, or light-light syllable sequence)
   - e.g.: *albitii-**ka*** ‘be covered, covering’ (root: *albitii*)

b. **-l-** / elsewhere
   - **infix; pivot/placement:** before final consonant(s)
   - e.g., *i<**l**>pa*[10] ‘be eaten, food’ (root: *pa*)

(48) Alabama middle voice: *-l-* allomorph (sometimes with vowel epenthesis)

a. pa → i<l>pa ‘be eaten, food’

b. coopa → coo<l>pa ‘be bought, sale’

c. talwa → ta<l>ilwa[11] ‘be sung, song’

(49) Alabama middle voice: *-ka* allomorph (sometimes with vowel deletion)

a. taɬa →taɬ-ka[12] ‘be woven, weaving’

b. bat → bat-ka ‘get whipped, paddle’

c. albitii → albitii-ka ‘be covered, covering’

(50) Alabama middle voice is not optimizing

a. *-l-* is placed “gratuitously” far inside the stem—it could be closer to the edge, e.g., **coop<l>a*, **ip<l>a*, and **tali<l>wa*/**taliw<l>a*

b. if suffixation and vowel deletion are preferred over infixation, as they must be for *taɬ-ka* to be preferred over **ta<l>ɬa*/**taɬ<l>a*, then the attested output *coo<l>pa* over unattested **coop-ka* is unexplained

[10]The *i* preceding the infix is due to a general phonological process of epenthesis (Hardy and Montler 1991:6).

[11]While this particular example is not a good one because of the *l* in the stem, it’s the only example of this stem-type offered by Hardy and Montler (1991). I assume that the infixal location is accurately indicated here, as *preceding* the cluster, based on the distribution of other exponents that also have this same position, e.g., second person *-c-* in *ta<c>ilwa* ‘you sing’ (Hardy and Montler 1991:9).

[12]Note the loss of the stem-final vowel for ...V.CV roots.

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