INFIXES REALLY ARE (UNDERLYINGLY) PREFIXES/SUFFIXES: EVIDENCE FROM ALLOMORPHY ON THE FINE TIMING OF INFIXATION

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Infixation and allomorphy have long been investigated as independent phenomena—see, for example, Ultan 1975, Moravcsik 1977, and Yu 2007 on infixation, and Carstairs 1987, Paster 2006, Veselinova 2006, and Bobaljik 2012 on allomorphy. But relatively little is known about what happens when infixation and allomorphy coincide. This article presents the results of the first crosslinguistic study of allomorphy involving infixation, considering fifty-one case studies from forty-two languages (fifteen language families). Allomorphy and infixation interact systematically, with distinct sets of behaviors characterizing suppletive and non-suppletive allomorphy involving an infix. Perhaps most notably, suppletive allomorphy is conditioned only at/from the stem edge, while non-suppletive allomorphy is conditioned only in the surface (infixed) environment. The robustness of these and related findings supports a universal serial architecture of the morphosyntax-phonology interface where: (i) infixation is indirect, involving displacement from a stem-edge position to a stem-internal one, counter to several influential theories of infixation (see especially McCarthy & Prince 1993a and Yu 2007); (ii) suppletive exponent choice is prior to (i.e. not regulated by) the phonological grammar (in line with Paster 2006, Pak 2016, Kalin 2020, Rolle 2021, and Stanton 2023, inter alia); and (iii) realization—including exponent choice and infixation—proceeds from the bottom of the morphosyntactic structure upward (à la Bobaljik 2000, Embick 2010, Myler 2017).*

Keywords: morphology, infixation, allomorphy, suppletion, phonology, typology


Relatively little is known about what happens when infixation and allomorphy coincide: while there are discussions and analyses of allomorphy involving infixes in individual languages (e.g. Anderson 1972 and Cohn 1992 for Sundanese, Hardy & Montler 1991 for Alabama, Blevins 1999 for Leti, Yu 2017 for Tiene and Katu), no systematic crosslinguistic study of such patterns has ever been undertaken. In this article, I report

* This article has been a long time in the making and has benefited from numerous conversations and presentation venues. Thank you especially to Byron Ahn, Jonathan Bobaljik, Hossef Dole, David Embick, Noam Faust, Florian Lionnet, Jack Merrill, Irina Monich, Heather Newell, Nicholas Rolle, Craig Sailor, Hannah Sande, Andrea Sims, Philipp Weisser, and Sam Zukoff for insightful discussions of this project in varying stages of completion. Thank you to the Language editorial team, especially John Beavers and Christina Tortora, and to two very thoughtful and helpful anonymous referees. Thank you also to audiences at BCG 12, MIT, AMI 2019, McGill’s Parameters Workshop, Nanolab, NYU, UPenn, UConn, Bilbao, GLOW 44, and Leipzig for your probing questions and suggestions. Last but definitely not least, thank you to my incredible team of undergraduate research assistants at Princeton, Anna Macknick, Miriam Stern, Reis White, and Sebastian Williams, for helping compile case studies. This article was supported by the Princeton OA Fund.
on a study of fifty-one cases of allomorphy involving infixation, spanning forty-two languages (and fifteen language families), showing that the intersection of these two linguistic phenomena affords a uniquely informative window into the inner workings of the morphosyntax-phonology interface. In particular, the patterns found (and not found!) differentiate among theoretical approaches to morphology and phonology.

Following some preliminary considerations (§2), the bulk of this article presents the empirical findings of the study and their immediate theoretical implications, comprising four sections, each related to different empirical domains: §3 considers suppletive allomorphy involving an infix, §4 takes up nonsuppletive allomorphy involving an infix, §5 offers insights from this study into infixation more generally, and §6 briefly explores the (non)optimizing nature of suppletive allomorphy and infixation. The core findings, in very brief, are as follows. Suppletive and nonsuppletive allomorphy involving infixes have opposing profiles: suppletive allomorphy is conditioned only at/from the stem edge (specifically, the edge that the infix is oriented toward), while nonsuppletive allomorphy of an infix is conditioned only stem-internally, in the infix’s surface (infixed) position; suppletion is never conditioned by an infix’s surface (infixed) environment. Infixation, as a process, is exponent-specific and only looks inward, into phonological material and prosodic structure that are morphosyntactically more embedded than the morpheme that is exponed by the infix. And finally, both suppletive allomorphy and infixation are often nonoptimizing, occurring without phonological or prosodic motivation, and may even be surface-opaque.

The findings of §§3–6 are brought together in §7, where I argue that they show that (i) infixation is indirect, involving displacement from a stem-edge position to a stem-internal one—that is, infixes really are (underlyingly) prefixes/suffixes (§7.1); (ii) the choice among suppletive exponents for a morpheme properly precedes infixation of an infixed exponent and is not regulated by the phonological grammar (§7.2); and (iii) realization proceeds cyclically from the bottom of a morphosyntactic structure up, with basic linear order among morphemes determined first, then exponent choice, then exponent insertion (including infixation of an infixed exponent), and then (morpho)phonology (§7.3). These theoretical implications support a realizational, serial, piece-based model of the morphosyntax-phonology interface, for which DISTRIBUTED MORPHOLOGY and related approaches (e.g. Halle & Marantz 1993, 1994, Bobaljik 2000, 2012, Embick 2010, Bye & Svenonius 2012, Myler 2017) are a particularly natural fit given the set of findings. The theoretical implications are problematic, by contrast, for parallel models of morphology and phonology (like those of McCarthy & Prince 1993a,b, Prince & Smolensky 1993, Mascaró 2007, Wolf 2008, Bermúdez-Otero 2012) and for models that take infixation to be ‘direct’ (e.g. Inkelas 1990, Anderson 1992, McCarthy & Prince 1993a, Yu 2007, Wolf 2008, Samuels 2009).

2. Preliminaries: definitions and the sample. This section lays out a number of preliminaries of the study, including (i) definitions of suppletion (§2.1) and infixation (§2.2), (ii) a decision tree for identifying suppletive vs. nonsuppletive allomorphy (§2.3), and (iii) properties of the language sample (§2.4). Key terms are given in small caps in the places where they are first substantively mentioned/defined.

2.1. Definition of (types of) allomorphy. I use the term MORMHE to refer to an abstract morphological element corresponding to (i) a meaning or morphosyntactic function,1 and (ii) a set of phonological forms (EXONENTS); when (ii) is a nonsingleton set, the phonological forms are referred to as ALLOMORPHS of the morpheme. While I

1 In cases of allosemy, this may be more properly characterized as a SET of meanings or functions.
assume that both roots and affixes can have allomorphs, the present study focuses on
the latter, as the empirical domain is cases of allomorphy where at least one allomorph
is infixal.

As an example of allomorphy of an affix, consider the much-used case of the English
plural morpheme, as in 1.

(1) Some allomorphs of the English plural morpheme
   a. gorilla-[z]
   b. bat-[s]
   c. midge-[iz]
   d. child-[ɪən]
   e. moose-[∅]
   f. alumnn-[aj]

While I consider all of the distinct phonological forms of the plural suffix in 1a–f to be
allomorphs, they do not all have the same grammatical status. In particular, I make a bi-
nary distinction between suppletive and nonsuppletive allomorphs, which is elaborated
on below.

The main criterion I use in determining whether a given allomorph is
suppletive with
respect to another is what Veselinova (2006:15) refers to as ‘phonological distance’: how
much phonological material is shared between the allomorphs, and, relatively, can
both allomorphs reasonably be phonologically derived from one underlying form?2

The English allomorphs in 1 present a clear illustrative case: [z], [s], and [iz] are all very
closely phonologically related, and the alternation among them can be understood
through phonologically natural processes (voicing assimilation and vowel epenthesis),
conditioned by their particular environments; [z], [s], and [iz] are thus nonsuppletive
allomorphs derived from a single underlying form, /z/. By contrast, /z/ (underlying
[z]/[s]/[iz]), /ɪən/, /∅/, and /aj/ are all phonologically distant from one another—there
is no clear motivation for deriving one from any other nor for positing a shared underlying
form. Using the phonological distance criteria then, /z/, /ɪən/, /∅/, and /aj/ are all supple-
tive allomorphs (also known as ‘true’ allomorphs), each corresponding to a distinct
underlying form for the English plural morpheme. Phonological distance is, of course, a
continuum, which means that not all cases are as clear-cut as the English plural. I present
the decision tree that I use for determining whether a particular alternation is suppletive
or nonsuppletive for the current study in §2.3.

Exponent choice is the process of selecting a compatible underlying form from a
set of suppletive allomorphs in a particular environment; I equivalently refer to this as
suppletive allomorph choice. The following environmental factors robustly influ-
ence exponent choice (see e.g. Carstairs 1987, 1990, Bobaljik 2000, 2012, Paster 2005,

(2) Factors conditioning suppletive allomorphy (exponent choice)
   a. lexical: conditioned by a root or class of roots
   b. morphological: conditioned by morphosyntactic features
   c. phonological: conditioned by phonological features3
   d. prosodic: conditioned by prosodic size, weight, and/or shape

Each type of conditioning is exemplified with infix allomorphy data in §3.2.

2 For a more rigorous definition of suppletion, see Mel’čuk 1994.
3 Scheer (2016) has argued that the only ‘true’ phonologically conditioned suppletive allomorphy (PCSA)
is nonmelodic, in other words, is based on higher-level factors like syllable structure, stress, and sonority.
Several cases of infix allomorphy in the present sample pose a significant challenge to this view, as melody-
conditioned allomorphy is accompanied by positional changes for the exponents. See the case studies in the
appendix with the designation ‘phonological (melody)’.
There is a fair amount of controversy in the literature with respect to the line between suppletive and nonsuppletive allomorphy (see e.g. differing views in Embick & Halle 2005, Mascaro 2007, Merchant 2015, Scheer 2016, Sande et al. 2020). When a case of allomorphy is phonologically or prosodically conditioned and also derivable by a phonological process that is plausibly language-general (like with the English plural [z], [s], and [ɨz]), this is called surface allomorphy, and it is generally agreed by all that such alternations are nonsuppletive.

The more controversial cases are those where the phonological distance is small, but the alternation is morphologically or lexically restricted and/or morphologically or lexically conditioned. For example, consider the voicing of the final fricative in *leaf*/leaves and *house/hou[z]es*, which is both lexically restricted (to certain roots) and morphologically conditioned (it happens in plural forms). Such alternations, if treated as non-suppletive, are the purview of so-called ‘readjustment rules’ (Chomsky & Halle 1968, Halle & Marantz 1993, Embick & Halle 2005), which can be subdivided into three types (Embick & Shwayder 2018): phonologically conditioned alternations that only specific morphemes undergo, morphologically conditioned alternations that have a consistent/general phonological effect, and morphologically conditioned alternations that only specific morphemes undergo (like the English *leaf*/leaves example). It is only the first type of morphophonology that is robustly encountered in the present study—allomorphy where there is a phonologically conditioned alternation that is morphologically restricted (not language-general). I make the conservative choice to characterize such allomorphy as non-suppletive just in case it is phonologically optimizing/natural, and otherwise I treat such allomorphy as suppletive. (See §2.3 for more detail and discussion.) As we will see, this choice holds my generalizations to a high bar by characterizing more cases of allomorphy as suppletive. Importantly, if this high bar were lowered (with a more permissive definition of non-suppletive allomorphy), my core findings would remain intact.

2.2. Definition of infixation. I adapt Blevins’s (2014) definition of infixation, reproduced with one modification (in square brackets) in 3. (See Yu 2007:Ch. 2, ex. 2 for a comparable definition.)

(3) Infixation as affixation: a definition: Under infixation a bound [exponent] 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. (Blevins 2014, ex. 1)

I break down the definition in 3 using Blevins’s illustrative example of nominalization in Hoava (Austronesian, Solomon Islands) and, in doing so, introduce some additional terminology that I use throughout the article. (The infixal exponent is enclosed in angled brackets, as per the usual convention.)

(4) Infixation in Hoava: nominalizer *-in-* (data from Davis 2003)

a. to (alive) → t<in>o ‘life’
b. hiva (want) → h<in>iva ‘wishes’

The nominalizer in Hoava is a bound derivational morpheme, exponed by the segments $i$ and $n$. This exponent is infixed, per the definition in 3, because it can be preceded and followed by segments that together form a constituent to the exclusion of the infix, for example, $h$ and $iva$ in 4b. I refer to the constituent that the infix combines with as the stem of infixation (or sometimes just the stem); the stem of infixation may be monomorphemic, as in 4a–b, f–g, or multimorphemic, as in 4c–e.

Generally speaking, the placement of an infix can be described relative to a phonological or prosodic pivot. In the case of Hoava, the infix always appears before the first vowel of its stem. There is crosslinguistic evidence that consonants, vowels, syllables, and feet may all serve as pivots for infixation, with stress able to play a role as well (Ultan 1975, Moravcsik 1977, Yu 2007). Given the phonological/prosodic nature of infix placement, it should come as no surprise that an infix may appear inside a root (4a–b), inside an affix (4c–e), or even at the very edge of its stem (4f–g)—the infix is oblivious to these distinctions, as its surface position is determined solely by its pivot/placement. I thus consider -in- to be one and the same infixal exponent throughout 4a–g, in line with the definition in 3. Finally, I assume that what makes simple prefixes and suffixes different from infixes is that the former lack a pivot/placement. In other words, I use pivot/placement uniquely to describe infixes; I do not use pivot/placement to describe simple prefixation/suffixation. (This descriptive choice is guided by my findings in this study; see discussion in §7.1.)

The definition in 3 is less restrictive than some definitions of infixation (cf. Ultan 1975, Moravcsik 2000), in particular, in recognizing that the stem of infixation may consist of more than just a root. At the same time, the definition might be more restrictive than turns out to be empirically and theoretically justified, in the sense of artificially delineating what ‘counts’ as part of a unified phenomenon and what does not. Nevertheless, for practical data-gathering purposes, boundaries have to be drawn somewhere, and I leave it for future work to determine whether those drawn in 3 are the right ones. One could consider, for example, expanding the definition to include exponents consisting of subsegmental phonological features. Or the definition could be expanded in the opposite direction, to include free morphemes and complex words that appear inside of their stems (like English’s so-called expletive infixation) or even inside of phrasal constituents (like phonological second-position elements).

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5 It is a matter of some debate whether infixes (at least uniformly) have pivots, or whether infixes sometimes or always are simply placed into a phonologically optimizing position (see e.g. discussion in McCarthy & Prince 1993a, Horwood 2002, Yu 2007, Wolf 2008, Bye & Svenonius 2012). I continue to refer to pivots of infixes for descriptive convenience. In addition, the present study supports the theoretical need for pivots (§6.2), thereby supporting a subcategorization-based view of infixation (in line with Yu 2007).

6 I ultimately argue that ‘first’ as part of the pivot here is superfluous, being better represented as ‘closest’; this runs counter to direct infixation approaches like that in Yu 2007. See §7.1.

7 I diverge terminologically from Yu 2007 in that I do not refer to (e.g.) infixation before the first vowel as ‘prefixation’ to the first vowel. I use ‘prefixation’ and ‘suffixation’ exclusively to describe the position of an affix relative to its stem.
2.3. Decision tree: categorizing allomorphy as suppletive or nonsuppletive. Since the line between suppletive and nonsuppletive allomorphy is infamously murky and controversial, I have codified my categorization process as a decision tree (Figure 1). Understanding how I have made classificational decisions is crucial to the replicability of this (and any) typological study, as well as to interpreting the results.

A. Are there at least two phonological forms realizing the same morpheme?

- No
  - no allomorphy (not included in study)

- Yes
  - allomorphy

B. Considering one pair of allomorphs: Is there a small phonological distance between them?

- No
  - suppletive allomorphy (Alabama \( l'ka \))

- Yes
  - C. Is there a clearly motivated phonological process (or set of processes) that could explain the distribution and form of the two allomorphs, coming from one shared underlying form?

- No
  - suppletive allomorphy (Toratán \( n/i \m))

- Yes
  - nonsuppletive allomorphy

D. Is the process (or set of processes) active throughout the language?

- No
  - nonsuppletive allomorphy
    - RESTRICTED TYPE (Budukh \( mo/mo \))

- Yes
  - nonsuppletive allomorphy
    - SURFACE TYPE (Wamesa \( di/i \))

Figure 1. Decision tree for categorizing allomorphy as suppletive or nonsuppletive.

I exemplify and discuss each outcome in the decision tree, starting at the top. Consider again the Hoava words in 4, where the nominalizer always has the form \(-in-\). Such a case is classified as not involving allomorphy (‘no’ for question A), so I have not in-
cluded it in the present sample. The middle-voice morpheme in Alabama (Muskogean, US; Hardy & Montler 1991) gets us one step farther in the decision tree, having two allomorphs, -l- and -ka. These allomorphs are phonologically distant, so yield a ‘no’ to question B, thereby classifying them straightforwardly as suppletive allomorphs. (See §6.3 for more details on this case study.)

The remaining three exits in the decision tree require a bit more discussion. Question C asks, for a given pair where phonological distance is already determined to be small by question B: is there a process (or set of processes) that could relate both allomorphs to a single underlying form, where the phonological changes are clearly motivated in the environments in which the allomorphs find themselves? I use clearly motivated as shorthand for phonological processes that are: (i) optimizing (in the intuitive, pretheoretical sense), for example, hiatus repair; (ii) well attested crosslinguistically, for example, palatalization of a consonant before a high front vowel; or (iii) motivated within the language itself, as part of its general phonological system. If the answer to question C is ‘no’ (the alternation is not clearly motivated), I categorize the allomorphy as suppletive, and if the answer is ‘yes’, I categorize it as nonsuppletive (with one further distinction to be made below).

For a suppletive example via question C, consider the pair of allomorphs -im- and n- in Toratán, realizing past-tense agent voice (Austronesian, Indonesia; Himmelmann & Wolff 1999:13). For starters, -im- and n- have a small phonological distance, sharing a nasal feature and differing in the place of that nasal as well as the presence of an initial vowel. Could they perhaps be related to one underlying form via a change in place of articulation accompanied by vowel epenthesis or deletion? To answer this question, it is important to consider their distributions as allomorphs. The allomorph -im- is an infix, appearing after the first consonant of a consonant-initial stem, for example, t<im>umpa ‘jumped down’ (from root tumpa). The allomorph n- is a prefix, appearing before the first vowel of a vowel-initial stem, for example, n-empo ‘sat’ (root empo). While the presence/absence of the vowel in the affix could be taken to be regulated by optimization (cluster avoidance or onset preference), there is no clearly motivated phonological process that would account for the difference in the bilabial vs. alveolar place of the nasal across the allomorphs, either crosslinguistically or within the language (which does not, for example, have a restriction on word-initial m). I therefore characterize -im- and n- as a suppletive pair. As noted at the end of §2.1, this ends up putting my conclusions to a harder test, as compared to a more liberal use of (morpho)phonological processes.

The last distinction to make is in question D: given a pair of nonsuppletive allomorphs, is this allomorphy language-general (derivable by surface phonology)? In Wamesa (Austronesian, Indonesia; Gasser 2014:260–61), third singular subject marking has two realizations, di- and -i-: di- appears preceding vowel-initial stems (e.g. di-api, from the root api ‘eat’), and -i- appears as an infix, before the first vowel of consonant-initial stems (e.g. p<i>era, from the root pera ‘cut’). This pair of allomorphs makes it straightforwardly through question A (‘yes’) and question B (‘yes’). For question C, considering a hypothetical shared underlying form di, the answer is again ‘yes’—it is easy to understand why the d of di would be deleted when appearing before the first vowel of a consonant-initial stem, namely, to avoid a complex onset (cf. hypothetical *p<d>i>era). Complex onsets are in fact entirely disallowed in Wamesa (Gasser 2014:39), and repair through deletion of a nonroot consonant is the most common resolution strategy (Gasser 2014:45, 267). Thus, we have a ‘yes’ to question D—this is a case of surface allomorphy. Note, too, that di and i can actually also be given a consistent distribution, as an infix that wants to appear before the first vowel of its stem (like the Hoava case in §2.2).
Finally, consider Budukh (Northeast Caucasian, Azerbaijan; Alekseev 1994:279). The prohibitive morpheme has four allomorphs, -ma-, -me-, -mo-, -mə- (‘yes’ to question A). They are phonologically close (‘yes’ to question B), and all are infixal, appearing after the first syllable of their stem (e.g. yɨ<ma>x̂ər, from root yɨxə ‘be’). The quality of the vowel in the allomorphs is determined by the quality of the following vowel in the word, through regressive vowel harmony (‘yes’ to question C). But vowel harmony is not a general process of the language—it is found only with certain morphemes. In addition, different morphemes exhibit different vowel harmony patterns, with the other core harmony pattern in Budukh involving a distinct set of resultant vowels (i, ü, i, u) and progressive rather than regressive assimilation. I thus classify the variation in the prohibitive morpheme as nonsuppletive allomorphy that is restricted (‘no’ to question D).

In this decision tree, I have made two potentially controversial choices. The first, which I have mentioned at several points above, is found at question C (the ‘no’ branch): when a given alternation is describable through a phonological change, but this change is not clearly motivated (see above for what ‘clearly motivated’ means), should this alternation necessarily be considered suppletive? My answer, per the decision tree in 5, is yes, but proponents of more powerful readjustment rules might disagree, at least about some of the cases (see e.g. Embick 2013, Embick & Shwayder 2018). But cases moving from the suppletive to nonsuppletive category in question C would not be problematic for my major findings, so the stakes are low with respect to this decision; I leave open the possibility that question C ‘no’ cases are nonsuppletive. (See the discussion at the end of §3.1, which is essentially how these cases would be dealt with if I took them instead to be nonsuppletive.)

The second controversial choice, which would have a more profound effect on my findings, is at question D (the ‘no’ branch again): are domain-restricted or morphologically restricted phonological alternations encoded in the grammar as processes (nonsuppletively) or as lexically stored variants (suppletively)? Certainly, handling such alternations phonologically, as I have advocated for Budukh above, is more plausible than handling the question C ‘no’ cases phonologically. But still, some who would hold that the question C ‘no’ cases are suppletive (as I do) might want to extend this suppletive characterization to question D ‘no’ cases as well (see e.g. Mascaró 2007, Merchant 2015). Classifying such cases as suppletive (counter to the current decision tree) would significantly impact my major conclusions. However, I suggest that the nature of my findings actually furnishes an argument in favor of my characterization of these cases as nonsuppletive. I return to this in detail at the ends of §7.1 and §7.2.

2.4. The sample. This study considers fifty-one cases of allomorphy that involve infixation. These fifty-one cases come from forty-two different languages, belonging to fifteen different language families (including isolates), as summarized in Table 1.

Since infixation is rare to begin with, allomorphy involving infixation is (necessarily) even rarer. I utilized the following resources for identifying case studies: Ultan 1975, Paster 2006, Yu 2007, database searches for keywords (WorldCat, Google Scholar), and word of mouth (pointers from colleagues). The sample is clearly biased toward Austronesian languages, with Afro-Asiatic and Austro-Asiatic languages overrepresented as well. This bias reflects the abundance of infixes in languages of these families and (relatedly) overrepresentation in the sources utilized for finding case studies. The sample is also limited by practical considerations, namely, by what grammars/documentation were available to me online or through my university during the coronavirus pandemic. A complete
list of the morphemes that serve as the case studies, along with some other basic information about each case study, is given in the appendix.

To be included in this study, a given case needed to pass question A of the decision tree in Fig. 1, ‘Are there at least two phonological forms realizing the same morpheme?’. In addition, at least one of these phonological forms had to be infinal, in the sense defined in §2.2. For each case included in the study, I considered the morpheme/allomorphy carefully in the broader context of the language’s phonological and morphological system, and not just in isolation. Therefore another inclusion criterion for a case study was that the available data/description/documentation needed to be clear and thorough enough that I felt reasonably confident in drawing conclusions, especially in terms of what conditions the allomorphy, where the infix is phonologically/prosodically located, and whether a given instance of allomorphy is supplative. Zero allomorphs, reduplicants, and ablaut appear as exponents in a couple of the case studies, but never as the only source of allomorphy. Note that throughout, findings are based on my own analysis of the data, which does not always line up with analyses found in the sources themselves.

In including only cases that passed question A, this study excluded cases where one and the same phonological form appeared as infinal sometimes (having a phonological or prosodic placement) and noninfinal other times (as a simple prefix or suffix, lacking a phonological or prosodic placement). Examples of this are found, for example, with Ulwa construct state markers (Green 1999) and Lakhota subject markers (Albright 2002). Along similar lines, I further excluded cases (even if they technically passed question A) that looked like so-called ‘mobile affixes’, with one and the same underlying form (but potentially with nonsuppletive alternants) variably appearing as a prefix, an infix, and a suffix. This type of exponent mobility introduces what I take to be an orthogonal confound in making generalizations, in particular with respect to the same-edge observation; see further discussion in §3.4. I leave it as an open question whether one or both of these types of excluded cases might be fruitfully treated as involving homophonous suppletion (more than one suppletive exponent with the same underlying

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Table 1. Language sample (by family).

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<td>Ambai, Ambel, Biak, Leti, Muna, Toratan, Sundanese, Wamesa, Wooi (Indonesia); Ida’an Begak (Malaysia); Nakamai (Papua New Guinea); Patiwan, Puyuma, Saiyiyat (Taiwan)</td>
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<td>Uralic</td>
<td>1</td>
<td>Estonian (Estonia)</td>
</tr>
</tbody>
</table>

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8 Note that this does not mean I excluded cases where an infix sometimes satisfies its pivot/placement at the stem edge, like the Hoava nominalizer does, as seen in 4f–g above.
form), though I think that it is more likely that some other grammatical mechanisms are at play.

A final methodological note is in order. First, I assume that when a pattern is unattested in the sample, it is likely to be systematically absent from the world’s languages. Second, I assume, tentatively, that when a pattern is not attested in the world’s languages, it is not possible as a language structure. While both of these are controversial assumptions (and rightly so), they are necessary steps in formulating bold and meaningfully falsifiable hypotheses, and thus in testing and refining theories of natural language grammar. In addition, I think these assumptions are validated every time an apparent counterexample turns out, upon closer inspection, to not be a counterexample at all (as will be seen at various points throughout this article), and every time an in-depth analysis of a case study reveals the exact same intrinsically interwoven principles at play (see e.g. Kalin 2020, 2022b,c). For an opposing view, the reader is referred to Bickel 2015 for a recent discussion of the (dis)advantages of categorical/theoretical vs. statistical/cognitive/historical approaches to typology. I leave it to future work to explore the question of whether processing- and diachrony-based explanations can fruitfully explain some of my findings.

3. On suppletive allomorphy involving an infix: core findings and implications. Perhaps the most significant (and surprising) results of the study come from considering cases of suppletive allomorphy where at least one suppletive allomorph is an infix. Of the fifty-one cases of infix allomorphy in this study, thirty-two involve suppletion. The core findings are as follows and are elaborated in the indicated sections, with illustrative case studies.

- §3.1: Suppletive allomorphs may differ with respect to pivot/placement.
- §3.2: Suppletion involving an infix may be lexically, morphologically, phonologically, or prosodically conditioned.
- §3.3: Conditions on exponent choice are distinct from an exponent’s pivot/placement.
- §3.4: Suppletive allomorphs share an edge orientation.
- §3.5: Suppletion is conditioned based on the underlying form of the stem, at the stem edge identifiable via edge orientation.
- §3.6: The surface (infixed) environment of an infix cannot condition suppletion.

In §3.7, I briefly state what I take to be the core implications of these findings in aggregate.

3.1. Suppletive allomorphs may differ with respect to pivot/placement. Suppletive allomorphs of a morpheme may differ with respect to pivot/placement—none, some, or all suppletive allomorphs of a morpheme may be infixed. Most commonly, only one suppletive allomorph of a morpheme is infixed (true of twenty-five of the thirty-two suppletive case studies). When more than one suppletive allomorph is an infix (as found in seven case studies), pivot/placement can vary across these infixed allomorphs. Finally, there is no correlation between being infixed and being (or not being) the elsewhere allomorph of a morpheme.

For example, in Lezgian (Northeast Caucasian, Dagestan), the repetitive morpheme has three suppletive allomorphs, prefixes $q^{h}i$- and $xU$- and an infix $-x$-; the most widely distributed of these exponents is the infix (Haspelmath 1993:174–75). In Nakanai (Austronesian, Papua New Guinea), the nominalizer has two suppletive allomorphs, a suffix $-la$ and an infix $-il$-, with the suffix being the more widely distributed (Johnston 1980: 176–79). In Nancowry (Austro-Asiatic, Nicobarese Islands), the instrumental nominal-
izer has two main suppletive allomorphs that are both infixes, but with different pivots (or at least different positions with respect to the same pivot), -an- and -in- (Radhakrishnan 1981:60–64, Kalin 2022c).

The implication of these findings is that it is not morphemes that have a pivot/placement (i.e. that are infixes), but rather it is exponents of morphemes that have a pivot/placement. In other words, inflexion is exponent-specific.

Against this backdrop, it is important to mention a few case studies where it seems that (what could be posited to be) a single exponent may sometimes have a pivot/placement, and other times not. For example, in Biak (Austronesian, Indonesia), two of the allomorphs of third singular subject marking are phonologically close: i- appears prefixally on all CC-initial roots and some (lexically arbitrary) C-initial roots (shown in 5), and -j- appears infixally after the first consonant on all other C-initial roots (shown in 6) (van den Heuvel 2006:157–58). Note especially the homophonic roots in 5b and 6b.

(5) a. i-mar ‘3sg-die’ (root: mar ‘die’)  
b. i-so ‘3sg-follow’ (root: so ‘follow’)

(6) a. v<j>ov ‘<3sg>sell’ (root: vov ‘sell’)  
b. s<j>o ‘<3sg>throw’ (root: so ‘throw’)

It could be reasonable to posit a single underlying form for the two allomorphs, i, as this vowel would naturally become the glide j when preceding a vowel, like it does when it is infixed in 6. Biak third singular marking might then seem to furnish a counterexample to the statement that pivot/placement is an exponent-level property—here we have a single exponent that is sometimes infixed, as in 6, and sometimes not, as in 5. There are four case studies in my sample with this sort of profile, all from Austronesian languages.

There are a few ways to analyze cases like that found in Biak. One is to take the two allomorphs—in and j here—to be suppletively related, one exponent with a pivot/placement (-j-) and the other without (i-). Another would be to posit one underlying form and allow infixed placement of this exponent to be conditioned, with inflexion of the exponent found in some contexts, and simple prefixation/suffixation in other contexts. Yet another approach might posit a purely phonological rule of metathesis (à la Halle 2001), though note that in Biak, at least, this would have to be lexically conditioned rather than phonologically motivated. I opt for the first possibility, classifying these four cases in my sample as suppletive, which (as discussed in §2.3) puts my conclusions to a harder test. Nothing about my core findings would change if a different analysis of these cases were adopted. Going forward, I assume that (in the general case) inflexion is an exponent-level property.

3.2. Suppletion involving an infix may be lexically, morphologically, phonologically, or prosodically conditioned. The same triggers of suppletive allomorphy that are found in cases without any infixed exponents (see §2.1) are found in cases with infixed exponents: namely, triggers may be lexical (relevant for twenty-one of the thirty-two case studies involving suppletion), morphological (two of thirty-two), phonological (twelve of thirty-two), or prosodic (nine of thirty-two) in nature.9 All are exemplified below.

Returning to Lezgian, the exponents of the repetitive affix are lexically distributed.

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9 The cited numbers here do not add up to thirty-two because more than one conditioning factor may be involved in a single case study.

a. \( q\text{hi-} / \{\text{say, throw, hit, do, go, be/become}\) 
   - e.g. \( q\text{hi-}ja\text{gun} \) ‘hit again’ (root: \( ja\text{gun}\) )

b. \( xU- \) / \{\text{give, come, bring, eat, carry}\) 
   - e.g. \( x\text{gun} \) ‘give again’ (root: \( gun\) )

c. \( -x- \) / \{\text{see, get off, mix, put/build, sit down (and many more)}\) 
   - pivot/placement: follows first vowel
   - e.g. \( ki<x>\text{ligun} \) ‘look again’ (root: \( kiligun\) )

There is also a periphrastic repetitive strategy (Haspelmath 1993:175–76).

Turning to Nakanai, suppletive allomorphy of the nominalizer is prosodically conditioned, based on the syllable count of the stem.


a. \( -il- \) / bisyllabic stem
   - pivot/placement: precedes stressed (penultimate) vowel
   - e.g. \( t<i>la\text{ga} \) ‘fear’ (root: \( taga\) )

b. \( -la \) / elsewhere
   - e.g. \( mutele-la \) ‘generosity’ (root: \( mutele\) )

Lexical roots are minimally bisyllabic (Johnston 1980:259), so the elsewhere allomorph \( -la \) appears on roots/stems longer than two syllables.

In Toratán, the agent-voice past morpheme has two suppletive exponents, distributed based on whether the stem begins with a vowel or consonant.

(9) Agent past in Toratán (Austronesian, Indonesia; Himmelmann & Wolff 1999:13)

a. \( n- \) / vowel-initial stem
   - e.g. \( n\text{-empo} \) ‘sat’ (root: \( empo\) )

b. \( -im- \) / consonant-initial stem
   - pivot/placement: after first consonant
   - e.g. \( t<im>umpa \) ‘jumped down’ (root: \( tumpa\) )

These allomorphs are thus conditioned by the phonology of the stem.

Morphology is the least straightforward type of conditioning factor in the present sample, as it only ever appears in combination with other factors. Consider, for example, nominalization in Leti.

(10) Nominalizer in Leti (Austronesian, Indonesia; Blevins 1999:390)

a. \( nia- \) / class I verbs
   - e.g. \( nia\text{-}keni \) ‘act of putting, placing’ (root: \( keni\) )

b. \( -ni- \) / class II verbs
   - pivot/placement: before first vowel
   - e.g. \( k<ni>asi \) ‘act of digging’ (root: \( kasi\) )

The choice between the allomorphs is regulated by a verb’s ‘conjugation class’, diagnosable by the set of subject-marking prefixes (‘full’ for class I or ‘reduced’ for class II) with which a verb appears (Blevins 1999:387–88, van Engelenhoven 2004:134–38). Membership in class I or class II, in turn, is determined by phonological factors (whether the verb is CC-initial or not), morphological factors (whether the verb is de-nominalized, causativized, or neither), and lexical factors (whether the verb is stative or nonstative, and idiosyncratically exceptional verbs).

10 The ‘U’ in this exponent represents a high vowel that is subject to vowel harmony and may be realized as \( u, i, \) or \( y \) (Haspelmath 1993:56) or may undergo syncope; see also n. 11.

11 The high vowel in the prefix has undergone pretonic high vowel syncope (Haspelmath 1993:36–38).
Overall, suppletive allomorphy involving an infix is not fundamentally different from more typical suppletive allomorphy in terms of possible triggers, though it may be that the relative frequency of different triggers is skewed in cases where infixation is involved. While I am not aware of any attempt to quantify relative frequencies of different suppletion triggers crosslinguistically, my impression is that there is indeed a skew in my case studies: phonologically and prosodically conditioned suppletion is more common than I might otherwise expect (twenty-one total case studies of thirty-two), and morphologically conditioned suppletion is less common than I might otherwise expect (two of thirty-two case studies). Perhaps there are interesting clues here about the diachronic pathways to infixation, but I do not explore this further.

One further implication I take from these findings—related in particular to the robustness of prosodic conditioning—is that (re)prosodification happens at intermediate levels of morphological structure, a point I follow up on in §7.3.

3.3. Conditions on exponent choice are distinct from an exponent’s pivot/placement. The conditions on choosing an exponent are distinct from (i) whether an exponent has a pivot/placement (is an infix), and (ii) if the exponent is an infix, what its pivot and placement are. This is trivially true in cases where exponent choice is lexically or morphologically conditioned: in Lezgian, for example, lexical factors condition exponent choice, and phonological factors govern exponent placement, as in 7. But this is also true when both the condition on exponent choice and the pivot/placement are phonological or prosodic in nature. In Nakanai, as in 8, -il- is chosen as the nominalizer exponent when the stem is bisyllabic, and has as its pivot the stressed (penultimate) vowel. It is also possible (though less common) for the factor conditioning exponent choice to overlap with the pivot, as in Toratán in 9, where it is the first consonant that matters for both.

Kalin and Rolle (2022) argue that this independence of the condition on exponent choice from its pivot/placement shows that both cannot be subsumed under one and the same subcategorization mechanism—there must be (at least) two distinct types of subcategorization properties of an exponent, one constraining the choice/insertion of exponent, and the other determining its placement.

3.4. Suppletive allomorphs share an edge orientation. The previous sections established that suppletive allomorphs of a morpheme may differ in being infixal or not, and that even if multiple allomorphs are infixal, they may differ in their phonological pivot/placement. One thing, however, cannot vary, and that is the edge that the allomorphs are oriented toward—suppletive allomorphs share an EDGE ORIENTATION. This means that allomorphs of the same morpheme either are all left-edge infixes or prefixes (e.g. Lezgian, Toratán, and Leti above) or they are all right-edge infixes or suffixes (e.g. Hunzib and Alabama, below). Moravcsik (1977:124) observes the same from a much smaller sample: ‘if there is an adfix that is related to an infix … by identity of meaning, … the adfix will be prefixed if the position of the infix is counted from the beginning of the stem, and it will be suffixed if the position of the infix is counted from the end of the stem’. This is consistent throughout my sample, though an infix’s edge orientation is not directly observable for cases of a prominence-based pivot (e.g. Nakanai above, with the infix appearing before the stressed vowel), and there are ambiguous cases involving

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12 Moravcsik (2000:547) makes a related generalization: ‘If an infix has an alternative position outside the word, that external position is always at the edge of the word to which the infixed position is referenced’. However, this latter generalization is intended to be about cases where the same exponent sometimes appears as an infix, and sometimes as a prefix or suffix. A number of languages show that this version of the generalization is in fact not accurate, as discussed below in this section.
stems that are too small to be sure if an affix’s orientation is toward the left or right edge.\textsuperscript{13} Assuming internal consistency in ambiguous cases, of the thirty-two cases involving suppletive allomorphy in my sample, twenty are analyzable as left-edge-oriented, and twelve as right-edge-oriented.\textsuperscript{14}

It is important to note here that the present sample systemically excludes (as discussed in §2.4) a series of cases that seem to counterexemplify this claim. Consider, for example, class-number markers in Archi (Northeast Caucasian, Dagestan; Kibrik 1989: 307–8), which are sometimes prefixes, sometimes infixes, and sometimes suffixes. Crucially, however, there is no suppletion involved in such cases, as it is arguably the same underlying exponent (e.g. \textit{w}, the class I/V singular marker in Archi) appearing in all of these positions. This situation (variant position without variant form) may be related to so-called ‘mobile affixation’, where one and the same exponent can appear as a prefix or suffix, as is notoriously found (for example) for a number of affixes in Huave (Huavean, Mexico; Stairs & Hollenbach 1969, Noyer 1993, Kim 2010). Indeed, a quick glance through a number of documented cases of mobile affixation suggests that this is a systematic feature of the phenomenon—the prefix vs. suffix position of an affix does not co-vary with an affix’s (suppletive) form.\textsuperscript{15} I therefore put aside this pattern as separate from the one at hand and leave it as a topic for future research.

Since the circulation of the first draft of this manuscript, one potential counterexample has surfaced. Papillon (2021) discusses subject agreement in Sáliba (Sálivan, Colombia; Morse & Frank 1997) and argues that this agreement involves suppletive allomorphs with opposite-edge orientations. However, once mobile affixation is factored out, Sáliba turns out to not be a counterexample after all. In very brief, animate subject agreement affixes in Sáliba are placed variably with respect to their stems, as determined by the phonological shape of the stem: (i) vowel-initial stems take agreement as a prefix, (ii) CVV-initial stems take agreement as a left-edge infix, and (iii) trisyllabic (or larger) stems that end in VV take agreement as a right-edge infix. For most of the agreement affixes, the form of the affix is the same across its three distinct positions, making it a classic example of mobile affixation. For two of the affixes, though, there are suppletive allomorphs of the agreement marker: for first singular, \textit{tʃ} is found in positions (i) and (iii), and \textit{d} in position (ii); and for second singular, \textit{kw} is found in positions (i) and (ii), and \textit{g} in position (iii). Since a mobile affixation operation of some kind is needed to describe the basic agreement data anyway (scoping over all of the agreement markers), it would be highly redundant to encode affix position alongside the individual suppletive exponents of first singular and second singular. Even in Sáliba, then, edge orientation is not a property of individual exponents.

The core finding here remains intact: suppletive allomorphs of a morpheme share an edge orientation. This suggests that morphemes have a linear position with respect to

\textsuperscript{13} In some cases, such as Alabama (see 14 and §6.3), a right-edge infix might appear all the way at the left edge of the stem, when the stem is small enough (or vice versa for a left-edge infix). Such cases are not counterexamples to the claim being made here, because the infix can still be stated with reference to a consistent pivot/placement, calculated with respect to a consistent edge. A similar edge ambiguity arises in a case I have included in my study from Nxa’amxcin (Salish, United States), where an exponent that typically looks like a suffix is arguably better (re)analyzed as a left-edge infix that appears after the first syllable (see e.g. data in Willett 2003:49).

\textsuperscript{14} This left vs. right asymmetry is almost certainly due to the overrepresentation of Austronesian languages in the sample.

\textsuperscript{15} Paster (2006:66, 253–54) notes one case that may be an exception to the generalization that a morpheme cannot have different suppletive exponents based on when it appears as a prefix vs. when it appears as a suffix: Chimariko pronominal markers (isolate, California; Conathan 2002). But the mobile allomorphs involved in Chimariko are similar enough in phonological form that this may be a case of non-suppletive allomorphy, and thus is not (necessarily) a counterexample.
the stem, and that the position of a morpheme constrains the position of its exponents (putting aside mobile affixation, as discussed above). Put another way, morphemes are linearized as preceding or following their stem, prior to being exoned, and exponents are then tied in some way to the morpheme’s prefixal or suffixal position. The following subsections strengthen this conclusion.

3.5. **Suppletion is conditioned based on the underlying form of the stem, at/from the stem edge identifiable via edge orientation.** The edge orientation of allomorphs plays a crucial role—it is at/from the relevant edge, and only at/from this edge, that suppletion is conditioned. Suppletive allomorphs find their conditioning environment inwardly, from the perspective of the edge of the stem that is identifiable from its edge orientation, even for infixes. This is most visible whenever phonology or prosody is involved in conditioning the allomorphy.

Consider the suppletive allomorphs involved in nominalization in Bahnar, given in 11. (The lexically conditioned exponent in 11a is included for completeness.)

(11) Nominalizer in Bahnar (Austro-Asiatic, South Vietnam; Banker et al. 1979:100–105)
   a. `a-`/{tie.up} • e.g. `a-chô` ‘a bundle’ (root: `chô`)
   b. `bo`-/m-initial stems • e.g. `bo-muih` ‘a field in the woods’ (root: `muih`)
   c. `-om`-/elsewhere • pivot/placement: after first consonant • e.g. `t<om>är` ‘woven bamboo’ (root: `tär`)

In Bahnar, as in Toratán (9), it is clearly an edgemost segment that is involved in suppletive conditioning, and crucially, the conditioning edge is the edge that the allomorphs cluster close to.

More notably, there are cases where the infixal allomorph does not stay immediately local to the conditioning environment at the edge, and/or where affixation destroys the conditioning environment, rendering the allomorphy opaque. Consider Hunzib in 12.

(12) Verbal plural in Hunzib (Northeast Caucasian, Dagestan; van den Berg 1995:81–82)
   a. `-b`aa/aa-final stems • e.g. `åqa-b`aa` ‘be thirsty (pl.)’ (root: `åqa`)
   b. `-å`/elsewhere • pivot/placement: before last consonant • e.g. `e<yå>k` `e`19 ‘burn (pl.)’ (root: `ek`e)`

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16 I have not found any examples of outward conditioning of suppletive allomorphy involving an infix. While this result is expected for lexical, phonological, and prosodic conditioning (which are generally only inward looking), it is not expected with respect to morphological conditioning (see e.g. discussions in Bobaljik 2000, Adger et al. 2003). However, recall from §3.2 that only two of my case studies involve morphological conditioning at all. The sparsity of morphological conditioning may thus be responsible for this apparent gap, or perhaps there is a true generalization to be made. Either way, the core implications of my study would remain intact, so I leave this as an open question.

17 There are also a few verbs of varying phonological forms that, idiosyncratically, take `baa` as an infix (van den Berg 1995:82).

18 The vowel [ä] is described by the grammar as ‘lower and more retracted than IPA [ɑ]’ (van den Berg 1995:21). Note also that the infix is underlyingly stressed, even if not in the canonical position for receiving stress (van den Berg 1995:81, n. 92). Consider, for example, `e<yå>k` ‘fall (pl.)’ (van den Berg 1995:81). Unlike `-ät`, `-b`aa is not underlyingly stressed—if further suffixation adds more than one additional mora to the word, stress shifts away from `-b`aa and it shortens to `-ba`.

19 The glide `y` is inserted before the infix to break up the illicit vowel cluster; the quality of the glide, as `y`, is conditioned by the fact that the first vowel in hiatus is a front vowel. I have included the glide in the angled
The phonological nature of this allomorph conditioning can be confirmed with a pair like that in 13, based on the same root.

(13) a. ũcu ‘hide’ → ũ<\-\w>cṵ ‘hide (PL)’
   b. ũcu-laə ‘hide (antipassive)’ → ũcu-la-baa ‘hide (antipassive, PL)’

When the verbal plural combines with a simple root, it is the right edge of the root that conditions the allomorphy (13a), and when it combines with a complex stem, it is the right edge of this complex stem that conditions allomorphy (13b).

There are two important features of the Hunzib example for our present purposes. First is that the choice of suppletive exponent is in fact always surface-opaque, since long vowels are shortened when they do not receive stress, which typically falls on the penultimate mora (van den Berg 1995:22). This can be seen in the example provided for 12a: the long vowel at the end of the stem ḥa1a conditions the choice of -baa, and after -baa is suffixed, that stem-final long vowel shortens, as stress has moved to -baa. Second, the choice between the suppletive exponents in 12a and 12b is crucially made with respect to the final segment of the stem (is it a long qa, or not?), and yet one of the allomorphs, the infix, can actually surface in a position that is nonlocal to the final segment. For example, in 13a, the infix surfaces before the final CV of the verb stem, even though it is just the final V that is relevant for choosing between -baa and -gpu. (For much more detail on this case study, see Kalin 2022b.)

Another revealing example is found with the middle-voice morpheme in Alabama, whose allomorphs are shown in 14.

(14) Middle voice in Alabama (Muskogean, United States; Hardy & Montler 1991:2–3)
   a. -ka / two-mora final foot (= final heavy syllable, or light-light sequence)
      • e.g. albitii-ka ‘be covered, covering’ (root: albitii)
   b. -l- / elsewhere
      • pivot/placement: before final consonant (cluster)
      • e.g. i<l>pa21 ‘be eaten, food’ (root: pa)

Allomorph choice is prosodically conditioned in Alabama, based on the edgemost foot at the (right) end of the stem. Further, it is again the UNDERLYING form of the stem prior to affixation that must be visible for exponent choice. After infixation and phonotactic repairs, the underlying prosodic structure of the stem may be obscured. This is the case in the example in 14b, where the apparent stem (minus the infix), ipa, would constitute a two-mora final foot and condition the wrong (unattested) exponent, -ka. For more detail on this case study, see §6.3.

Suppletive allomorph choice is conditioned based on the underlying form of the stem, from the perspective of ‘looking in’ from the edge identifiable from an affix’s edge orientation. I have found no cases of suppletive allomorph choice being made on the basis of the opposite stem edge, or based on the surface form of a stem, or (as is highlighted in the following subsection) in an unambiguously stem-internal position.

The implication of this finding is a major one with respect to differentiating theories of infixation: at the point of exponent choice, morphemes must have already been LINEARIZED with respect to their stem. Importantly, this appears to be true even for mor-

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20 As noted in n. 19, when infixation of -ά- concatenates nonidentical vowels, a glide is inserted to repair this illicit configuration. Here, the glide is w because the first vowel in hiatus is a back vowel.

21 The i preceding the infix is due to a language-general phonological process of epenthesis (Hardy & Montler 1991:6).
phemes with infixal exponents—infixal exponents correspond to an earlier prefixal or suffixal position with respect to the stem, prior to becoming infixed.

3.6. THE SURFACE (INFIXED) ENVIRONMENT OF AN INFIX CANNOT CONDITION SUPPLETION. The most remarkable and perhaps the most counterintuitive finding of this study is that, of the twenty-one total case studies involving prosodically and/or phonologically conditioned suppletive allomorphy, suppletion is never unambiguously conditioned in the surface (infixed) environment of the infix. Of course, since infixes typically stay very close to the stem edge, in some cases the conditioning environment is local to the infix both in the infix’s hypothesized edgemost position (see previous sections) and in its surface (infixed) position. For example, in Bahnar (11), the first consonant is the conditioning environment for suppletion, and this consonant is immediately local to the infix in its surface position as well as in its hypothesized left-edge (prefixal) position. But even in these ambiguous cases, it is notable that only material that is at the edge (and none in the surface/derived environment only) can influence allomorph choice. And in unambiguous cases like Hunzib (12), we see that it really is the edge—and only the edge—that matters, even when infixation moves the infix apart from the conditioning edge.

What would it look like for suppletion to be conditioned stem-internally? Imagine the following invented allomorph distributions.

(15) Invented example 1 (unattested)
   a. -n- / before a nasal in its infixed position
      • pivot/placement: before final syllable
      • e.g. ba<n>mat
   b. -ka / elsewhere
      • e.g. basat-ka

(16) Invented example 2 (unattested)
   c. -n- / before a nasal in its infixed position
      • pivot/placement: before final syllable
      • e.g. ba<n>mat
   d. -ka- / elsewhere
      • pivot/placement: before final syllable
      • e.g. ba<ka>sat

In 15, a right-edge infix -n- alternates with a suffix -ka, based on whether the infix would find itself next to a nasal in its pre-final-syllable position. The invented case in 16 is similar, but with both exponents being infixes with the same placement. Neither type of imagined stem-internal suppletion occurs in my sample.

This finding again strengthens the implications of the previous subsections: exponent choice is made at/from a stem-edge position, prior to infixation of an infixal exponent; exponent choice is not made in an infix’s surface position. (Note, though, that there are several cases of infix allomorphy that have been argued to implicate global optimization. I postpone discussing these cases until §6.3, where I argue that they neither necessitate a global treatment nor falsify the present generalization.)

3.7. IMPLICATIONS (CUMULATIVELY). The picture of infixation and suppletive allomorphy that we are led to through the findings presented in this section is one where operations are strictly ordered.

(17) linear concatenation < exponent choice < infixation

Affixal morphemes are linearized as preceding or following the stem they combine with, prior to exponent choice. The choice among exponents is made at this stem edge,
prior to the infixation (inward placement) of infixal exponents. At some stage, then, even exponents that end up inside their stem (as infixes) start their morphological ‘life’ preceding their stem (as a prefix) or following it (as a suffix).

Throughout the following sections—and coming together in §7.3—the ordering in 17 is enriched with the place of phonology (after infixation) and couched within a cyclic, bottom-up framework, where the series of operations in 17 repeats with every exponed morpheme.

4. **On nonsuppletive infix allomorphy: core findings and implications.** The picture is quite different when considering nonsuppletive allomorphy. Recall from §2.3 that what I consider to be nonsuppletive allomorphy are alternations that must be both phonologically derived and phonologically or prosodically motivated. The phonological processes involved may be language-general (in which case it is surface nonsuppletive allomorphy) or restricted to certain morphemes or morphological environments (restricted nonsuppletive allomorphy).

We will see in this section, based on the thirty-seven case studies with nonsuppletive infix allomorphy in the sample, that both surface and restricted nonsuppletive allomorphy behave alike, in that both are sensitive only to the surface/infixed environment of the infix (§4.1–4.2), in stark contrast to suppletive allomorphy. The same observation extends to phonological alternations around the infix: the stem may undergo phonological processes in reaction to the infix, but only in its surface/infixed position (§4.3). The implications of these findings are brought together in §4.4.

4.1. **Nonsuppletive infix allomorphy is conditioned in an infix’s surface (infixed) position.** Nonsuppletive alternations of infixes are conditioned only in an infix’s surface position. Consider again Leti: Blevins (1999) argues extensively for treating the many variants of the nominalizer morpheme as linked to just two suppletive underlying forms, as shown in 18, expanded from 10 above—see in particular the many nonsuppletive variants of the allomorph -ni- in 18b. (The discussion here is not exhaustive.)

(18) Nominalizer in Leti (Austronesian, Indonesia; Blevins 1999:390)

a. nia- / class I verbs
   - e.g. nia-keni ‘act of putting, placing’ (root: keni)

b. -ni- / class II verbs
   - pivot/placement: before first vowel
   - e.g. k<ni>asi ‘act of digging’ (root: kası)
   - Nonsuppletive alternants (Blevins 1999:391–92):
     - s<n>uri ‘pour, pouring’ (root: suri)
     - d<i>avra ‘act of cutting, cut’ (root: davra)
     - r<i>esi ‘victory’ (root: resi)
     - r<∅>uru ‘trembling’ (root: ruru)

The infixal exponent -ni- may be affected by two language-general phonological processes: deletion of i before a high vowel (as in s<n>uri), and deletion of n after d or l (as in d<i>avra). There is also a restricted process (not language-general) whereby n is deleted after a nonsyllabic sonorant (as in r<i>esi), which may compound with deletion of i to produce a zero alternant (as in r<∅>uru).

Additional examples abound. I mention here some that relate to case studies already discussed above. Nonsuppletive allomorphy due to language-general phonological processes is found in Wamesa (as discussed in §2.3), with deletion of the initial consonant of the exponent -di- (3sg) when it is in an illicit cluster. Nonsuppletive allomorphy
due to restricted phonological processes is found for Budukh's prohibitive morpheme (see again §2.3), where the phonological process the exponent undergoes is a crosslinguistically natural one (regressive vowel harmony), but one not evidenced throughout the language. Finally, there are a number of cases in the sample where a process is inde-
terminately but plausibly language-general, like in Bahnar (11), which has very limited morphology in general—the suppletive allomorph -om- has several nonsuppletive alter-
nants, including -əd- (e.g. k<əd>rōu ‘fish poison’) and -əŋ- (k<əŋ>lat ‘a slice’); these repairs happen when infixation creates an illicit consonant cluster (here, *nr and *nl) (Banker et al. 1979:103–4).

It is relevant to note here the uniform behavior of general and restricted phonological processes that result in nonsuppletive allomorphy—both apply to an infix only in its surface position. The main implication, building on the findings of §3, is that displacement of an exponent into an infixal position from the edge is immediate after suppletive exponent choice, such that all (morpho)phonological processes see the infix in its surface position.

4.2. No hypothetical position for an infix apart from its surface (infixed) position can induce nonsuppletive allomorphy. As an equal-but-opposite general-
alization to that about suppletive allomorphy in §3.6, nonsuppletive allomorphy is never sensitive to the morpheme’s hypothesized edgemost underlying position (as a prefix or suffix), unless of course that environment is still immediately local to the infix in its infixed position.

What would this even look like, if it were possible? Consider Hunzib from 12: when the infixed exponent -ā- ends up in hiatus with another vowel in its infixed position, a glide is inserted, with the glide’s quality determined by the frontness of the preceding vowel (see n. 19 and n. 20, and Kalin 2022b). If the phonology could ‘see’ the infix -ā- in the morpheme’s underlying (stem-final) position, we might expect the final segment of the stem to impact glide insertion/quality. Consider the root in 19: if the phonology could see the infix in its hypothesized stem-final position prior to infixation, *ahu<α>, we would potentially expect the glide w to be inserted to break up the u<α> sequence, deriving the unattested form in 19b after infixation.

(19) Root: ahu ‘take’
   a. Attested verbal plural: α<ā>hu
   b. Not attested: *α<wā>hu

Or we might expect the underlying stem-final vowel to affect which glide is inserted, as it would with the root in 20. Generally speaking, the sequence e<α> is broken up by the glide y, while the sequence u<α> is broken up by the glide w. It is clearly only the latter environment, in the infix’s surface position, that impacts glide choice, as in 20a, and not that of the underlying environment, which would produce 20b after infixation.

(20) Root: uc‘e ‘cut’
   a. Attested verbal plural: u<wā>‘e
   b. Not attested: *u<yā>‘e

In no case does the infix undergo a phonological process (restricted or surface) in its hypothesized pre-infixation position.

The environment where an affix ‘started’ (as a prefix or suffix) determines suppletive exponent choice (§3.5), but this environment CANNOT influence nonsuppletive allomorphy—all phonological processes treat the infix in its surface position. The implication, as noted in the previous section, is that infixation is immediate—when exponent choice
converges on an infixal exponent, that exponent takes its infixed position as soon as it is inserted; an infix does not ever phonologically occupy a stem-edge position, but rather must find its pivot/placement immediately.

4.3. An infix may condition phonological stem changes only from its surface (infixed) position. An infix, in its surface position, may also condition changes in the stem, both changes that reflect surface phonology and changes that fall into the more restricted (nongeneral) category. We have already seen some examples of the surface kind: for example, in Alabama (14), when infixation creates an illicit consonant cluster, a general process of vowel epenthesis is triggered (see n. 21 and §6.3). An example of a restricted phonological process affecting the stem is found in Lezgian (7). Recall that the infix -x- is a lexically conditioned suppletive allomorph of the repetitive. When infixation of -x- creates a cluster with a voiced velar obstruent, there is sometimes devoicing of the (stem) obstruent: for example, egeč’un ‘enter’ becomes e<x>keč’un ‘enter again’ (Haspelmath 1993:175). This is not a general process of the language, but can be seen as a natural one, involving voicing assimilation.

I have found no cases in my sample where a change in a stem segment seems to be conditioned by an infixal exponent in an underlying (noninfixal) edgemost position. Returning to the Hunzib examples in 19–20, we might, for example, expect hiatus between the infix (in its underlying position) and the final vowel of the stem to condition deletion of that stem-final vowel—indeed, deletion of an unstressed vowel is the usual repair for hiatus in the language (see Kalin 2022b). However, as is obvious from all of the Hunzib examples, the final vowel of the stem does not delete in these cases.

Again, the implication here is that after exponent choice, the exponent does not linger in its underlying edgemost (morphemic) position. Phonological processes affecting both the stem and the infix ‘see’ the infix only in its surface environment.

4.4. Implications (cumulatively). Nonsuppletive alternations of both the surface and restricted kinds pattern together—phonological processes impact an infix, and its stem environs, only with respect to the infix in its stem-internal (infixed) position. Thus, while the evidence from suppletion (given in §3) points to the need for a stem-edge underlying position for all morphemes (from which position suppletive exponent choice is made), when an exponent is chosen that is infixal, infixation of this exponent is immediate.

5. On infixation: core findings and implications. While the present study includes only a narrow slice of infixes, it nevertheless reveals a few patterns that are likely generalizable to infixation beyond just cases of infix allomorphy, namely: infixation is uniformly inward (§5.1–5.2), and infixal positioning may be opaque (§5.3).

I do not think this study, given its narrowness, is a particularly useful window into the nature of infixal pivots more generally, but I offer a few observations. By far the most common infixal pivots/placements in this sample are before or after the first or last consonant or vowel. Prominence-based pivots are rare in my sample (two of fifty-one cases: Jahai and Nakanai), in line with their general rarity (Yu 2007). There is also some evidence for noncanonical pivots, including after the penultimate vowel (Choctaw) and before the final consonant cluster (Alabama). (See Samuels 2009:150 for pivots found across different studies of infixation.)

5.1. Infixes displace inwardly, never outwardly. Infixes only ever move inwardly, into more embedded phonological material. This may seem like a trivial observation, and indeed, I am not aware that anyone has stated this explicitly before (perhaps
because it was taken to be self-evident). However, while this may be trivial when the infix is the outermost affix in a word, it is not trivial when the infix is not the outermost affix. In such cases, an infix’s pivot could hypothetically be found by moving outward into less embedded phonological material, but, notably, this never seems to happen.

Recall from Leti (10) that the nominalizing morpheme has an infixal allomorph -ni-, which wants to be before a vowel, for example, k<ni>asi ‘act of digging’ (from root kasi). Nominalized verbs can be reverbalized, appearing as ‘zero-derived verb stems for resultative constructions’, in which case they take class I inflectional prefixes marking person/number (Blevins 1999:388). Consider the complex word in 21.

(21) Leti (Blevins 1999:389–90)
\[
\begin{align*}
&\text{ta-s} < \text{ni} > \dot{o}i \\
&\text{1PL.INCL.I-<NMZN>shift}
\end{align*}
\]
‘we (incl.) inherit’

Assuming that -ni- is an infix that starts at the left edge of the root sòi, there is no a priori reason why -ni- should not have the option of moving to precede the vowel to its left in 21 (hypothesized underlying order *ta-<ni>sòi → unattested *t<ni>a-sòi), rather than moving to precede the vowel to its right (hypothesized *ta-<ni>sòi → attested ta-s<ni>òi). Both the attested rightward displacement in 21 and the hypothetical leftward displacement move the infix exactly one segment away from the leftmost edge of the root, both create consonant clusters, both result in vowel hiatus, and both are well-formed in the language (despite their markedness). Of course, modeling 21 as resulting from stepwise exponence offers an explanation, as laid out in 22.

(22) sòi ‘shift’ → s<ni>òi ‘inheritance’ → ta-s<ni>òi ‘we (incl.) inherit’

If the (outer) prefix has not yet been exponed at the point of infixation of -ni-, then it is natural that -ni- cannot satisfy its pivot/placement by moving into the prefix. For a complete stepwise derivation of this type of example, see §7.3.

The point here is that even in complex words where an infix’s pivot/placement could be found by displacing locally in either direction, the infix does not actually have the option of displacing away from its stem. This finding is consistent throughout my sample, and it falls out naturally if, as modeled in 22, there is no phonologically contentful ‘outer’ material at the point when an infix displaces into its stem. If there were phonologically contentful ‘outer’ material, some additional stipulation would need to be made, to constrain the direction of infixation.

5.2. AN INFIX CAN SATISFY ITS PIVOT/PLACEMENT INWARDLY AT THE STEM EDGE, BUT NEVER OUTWARDLY. Related to the finding above, an infix can surface at the stem edge when its pivot/placement can be satisfied inwardly (with respect to more embedded material) in that location. For example, returning again to Leti, the infix wants to be before a vowel and can satisfy that requirement at the left edge when the stem is vowel-initial (Blevins 1999), as in <ni>atu ‘knowledge’ (from root atu). However, the opposite is not true—an infix cannot surface at the stem edge when its pivot/placement could hypothetically be satisfied outwardly, that is, with respect to less embedded material.

Consider, for example, the right-edge infix in Hunzib, -á- in 12 above, which has as its placement that it wants to be before a consonant. We might thus expect that if a con-

Note that the problem cannot be the creation of a tn onset, as this is permitted: for example, t<ni>eti, ‘chopping’ (Blevins 1999:390). Note also that the infix can surface inside an affix in Leti, so long as that affix is inward relative to the nominalizer: for example, -ni- + va-kini (RECIP-kiss) → v<ni>a-kini ‘reciprocal kissing’ (Blevins 1999:400).
sonant-initial suffix is added to the right edge of the word, outside of the verbal plural, that -á- could stay at the right edge of the root. This is not borne out—even when there is such a suffix attaching to the stem after the infix does, the infix must find its pivot/placement inwardly, that is, in its stem (23).

(23) Hunzib (van den Berg 1995:82)
\[ r-\text{i<y}a>\lambda e-n \]
\text{PL\_CLASS\_kill<\text{VPL}>\_PRET\_GER}
\text{‘killed (iterative, plural object)’}

More concretely, we do not find the hypothetical forms *r-\text{i<y}a>-n (with glide insertion) or *r-\text{i<y}>\lambda -n (with deletion of the unstressed root-final vowel), where -á- satisfies its pivot/placement at the right edge of its stem, with respect to the outer suffix, -n.

Strengthening the conclusion from the previous subsection, the finding here is most naturally understandable if an infix must find its pivot/placement right away, and that when it does so, the only visible phonological material is that in its stem (i.e. of more embedded material).

5.3. Infixal positioning may be opaque. While all of the infixes in my sample can be described as aligning themselves with respect to a consistent phonological pivot, their pivot/placement is not always transparently satisfied on the surface, due to phonological changes to the stem induced by infixation.

In Alabama (14 and §6.3), for example, the middle-voice infix -l- always precedes the final consonant (cluster), but when this positioning leads to a phonotactically illicit consonant sequence, i is epenthesized to break it up. Thus, in a form like ho<\text{l}> isso ‘be written, book’ (from stem hosso ‘write’) (Hardy & Montler 1991:2), the infix has satisfied its pivot if the underlying, pre-repaired form is considered (*ho<\text{l}>sso), but not on the surface post-epenthesis, where it precedes a vowel.

Deletion can also create opacity. In Nancowry, the causative has two suppletive allomorphs, ha- and -um-.

(24) Causative in Nancowry (Austro-Asiatic, Nicobar Islands; Radhakrishnan 1981:54–56)

a. ha- / monosyllabic stems
   • e.g. ha-pin ‘to thicken something’ (root: pin)
b. -um- / disyllabic stems
   • pivot/placement: follows first vowel
   • e.g. p<um>loʔ ‘to loosen something’ (root: palo?)

As analyzed in Kalin 2022b, the causative infix has as its pivot/placement that it follows the first vowel. In this position, it always creates hiatus, which is prohibited in unstressed syllables. Hiatus is resolved by deletion of the first vowel—in other words, the infix’s pivot is deleted. In forms like p<um>loʔ, then, the infix has not (obviously) satisfied its pivot/placement on the surface, as the infix looks like it is post-consonantal; only the pre-repair form shows the infix’s pivot/placement being satisfied: *pa<um>loʔ.

The implication of opacity of infix placement is that satisfaction of an infix’s pivot/placement can properly precede phonological processes that apply to the derived form. It is an open question whether an infix’s pivot/placement is always satisfied prior to phonological processes, or whether satisfaction alongside phonological processes is also possible in some cases.

5.4. Implications (cumulatively). Putting together all of these observations about infixation, it is easy to see that they go hand in hand with the findings of §3 and §4. An
infixal exponent takes its surface (infixed) position immediately after the exponent has been chosen, and before any other affixes are added (or at least exponed), and before (or perhaps sometimes simultaneous with) phonology. In other words, word formation, including exponent choice and infixation, is cyclic and applies from the bottom up.

6. On optimization: core findings and implications. Finally, in this section I briefly consider the empirical landscape of this study in terms of phonological optimization. By optimization, I am referring to whether a particular operation has an effect that is phonologically improving (optimizing), phonologically neutral (nonoptimizing), or phonologically worsening (anti-optimizing), given a rather general set of phonological/phonotactic preferences that are known to be active across languages, like a preference for onsets, a dispreference for codas, avoidance of hiatus, and so forth. (Note that I do not mean ‘optimizing’ in the strict optimality theory sense, where exactly what is optimizing depends on one’s theory of possible constraints and a particular ranking of those constraints.)

I turn first to suppletive allomorphy (§6.1), then infixation (§6.2), and finally to putatively globally optimizing cases of infix allomorphy (§6.3).

6.1. Suppletive allomorphy involving an infix may be optimizing, but often is not. To consider whether suppletive allomorphy is optimizing in this sample, I consider exponents as whole packages—their suppletive conditioning (i.e. the environments they appear in) plus their pivot/placement if they have one (i.e. for an infixal exponent, its surface position). Note that lexically and morphologically conditioned suppletion is generally not optimizing, because the criteria for exponent choice are not phonological in nature. See, for example, Leti in 10 and Lezgian in 7 above. (I am not claiming here that infixation itself cannot still be optimizing in such cases, just that the choice between exponents is not optimization-driven; see §6.2.)

Of the cases already considered in this article that involve phonological or prosodic conditioning, which are better candidates for being optimizing, the findings are a real mix. An obviously optimizing case is found in Toratán in 9, where the agent-voice past morpheme is a prefix n- with vowel-initial stems and an infix -im- with consonant-initial stems. Suppletive choice in this case aligns with avoiding an onsetless syllable/word (favoring n- over -im- with vowel-initial words) and avoiding complex onset clusters (favoring -im- over n- with consonant-initial words). The avoided configurations are crosslinguistically marked, though not illicit in Toratán more generally.

In Nakanai (8), the choice between nominalizer -il- and -la is conditioned by stem size, -il- appearing before the penultimate vowel of bisyllabic stems. An important consideration here is that stress is on the penult, so the infix appears in a position where stress placement (on the stem) is preserved. The suffix, by contrast, results in a shift in stress, as it adds a syllable to the end of the stem. If there is more pressure to preserve stress in bisyllabic stems than in larger ones (Donca Steriade, p.c.), then this suppletive allomorphy in Nakanai can be seen as optimizing as well. Similar to the situation in Toratán, though, preserving the stress of bisyllabic stems is not a hard constraint in Nakanai, as there are a number of suffixes that induce stress shift on bisyllabic stems. Both cases can thus be seen as displaying the emergence of the unmarked (TETU) effects.

Most of the rest of the cases in the sample are nonoptimizing. For example, in Bahnar (11), where bo- is chosen for m-initial stems and -om- appears elsewhere (with pivot/placement being after the initial consonant), there is no phonological/phonotactic motivation for this split—bo- would be a fine prefix for all stems, and -om- would be a fine
infix for all stems. This can be confirmed with a dictionary of Bahnar (Banker et al. 1979), which shows robustly that the sequences that are avoided through this suppletive allomorphy are permissible.

Two anti-optimizing cases come from Nancowry, discussed in detail in Kalin 2022c. Here I comment just on the causative morpheme, from 24. Recall that the exponent ha- is chosen for monosyllabic stems, and -um- for disyllabic stems; the latter is an infix, which Kalin 2022c argues is best understood with the infinal pivot/placement being after the first vowel. The crucial observation here is that ha- would make a perfectly fine prefix for all stems, not just monosyllabic ones; and conversely, the choice of -um- over ha- leads to a phonotactic problem (vowel hiatus) where there otherwise would not have been one, with no clear payoff.

With respect to exponent choice, then, while there certainly are a few clearly optimizing cases in the sample, most are nonoptimizing, and there also seem to be some anti-optimizing cases. This aligns with general findings for prosodically and phonologically conditioned suppletive allomorphy—see especially Paster 2005, 2006. Taking these results at face value, it may seem that they implicate the need for exponent choice to be regulated by the phonology in some cases and by the morphology in other cases. However, in §7.2 I argue that the cumulative findings of the study argue that the latter—exponent choice prior to phonology—is the only option.

6.2. Infixation may be optimizing, but often is not. Putting aside suppletion and considering just infixation, we see a similar sort of picture—sometimes the fact that an exponent is an infix, together with its pivot/placement, is optimizing; sometimes it is nonoptimizing, and sometimes it is anti-optimizing.

A number of examples of infixal exponents discussed so far are either optimizing language-internally or understandable as TETU effects. For example, in Bahnar (11), there is not an optimizing motivation for choosing between the two suppletive allomorphs bơ- and -ơn-, as discussed above. But once one exponent is selected over the other, it is indeed optimizing that the prefixal one is prefixal, and the infinal one infinal—all syllables must have an onset in Bahnar (Banker et al. 1979).

Nonoptimizing infixation is also found in many languages of the sample. Consider Hunzib’s infixation of -ā- in 12. The exponent -ā- would be perfectly fine as a suffix; it would sometimes create vowel hiatus as a suffix, but it does so in infinal position sometimes too. Recall also that this exponent is not in general constrained to appearing in the naturally stressed (penultimate) position (see n. 18). Lezgian, too, furnishes a case of nonoptimizing infixation: the exponent -x- as in 7, by appearing after the first vowel, always introduces a coda; sometimes this serves to avoid a complex onset (e.g. ki<x>ligun ‘look again’, from root kiligun), but sometimes it is totally gratuitous, leaving a word without an onset altogether (e.g. a<x>watun ‘fall off again’, from root awatun).

Finally, let us consider some anti-optimizing cases. Leti, as seen in 18, is a particularly clear example of anti-optimizing infixation, as discussed by Blevins (1999:§5):

In terms of prosody and phonotactics, /ni-/ is a perfectly well-formed syllable, and particularly well-positioned before the initial C of a class II verb. On the other hand, the output of infixation creates syllable-initial CC clusters and VV sequences, both of which are marked cross-linguistically and within Leti. Similarly, in Wamesa, infixation of -di- before the first vowel, described in §2.3, is anti-optimizing (Gasser 2014:261), creating illicit vowel and consonant clusters that would be absent without infixation, and not serving to avoid marked syllable structures.

These findings, along with the abundance of nonsuppletive allomorphy in the stem and/or affix in the presence of infixation (§4), show that creating some kind of illicit phonotactic configuration is not a synchronic deterrent of infixation. The findings thus
support a model of infixation for which at least some infixes have their surface location regulated via a condition on their placement, that is, through the explicit use of pivots (in line with Yu 2007). I leave it as an open question whether all infixes have pivots, or whether some are regulated simply by the phonology. (See also the discussion in §5.3.)

6.3. Putatively globally optimizing cases can be analyzed locally and sometimes are not actually optimizing. A few case studies of infix allomorphy have been singled out as necessitating global optimization considerations. In this section we look closely at one such case study, from Alabama (Hardy & Montler 1991), and I mention a few others as well. I argue that global optimization is not necessary in any of the cases.

In Alabama, syllables maximally have two onset consonants and one coda consonant (Rand 1968:98). Syllables can be light (no coda, no long vowel), heavy (coda consonant or long vowel), or extra heavy (coda consonant and long vowel). Hardy and Montler (1991; also Montler & Hardy 1991) argue for a phonotactic constraint on derived verbs that they call the ALABAMA VERB FRAME (AVF), which requires all derived verbs to end in a three-mora heavy-light foot (Hardy & Montler 1991:5), that is, one of the following two configurations.

(25) ALABAMA VERB FRAME
   a. …VC.CV
   b. …VV.CV

The AVF seems to play a role in constraining exponent choice and exponent placement for a number of morphemes—most importantly here, the middle-voice morpheme, whose exponents and their distribution are described in 26 (repeated in a simplified form from 14).

(26) Middle voice in Alabama (Hardy & Montler 1991:2–3)
   a. -ka / two-mora final foot (= final heavy syllable, or light-light sequence)
   b. -l- / elsewhere (pivot/placement: before final consonant (cluster))

Hardy and Montler (1991) argue that the location of the middle-voice exponent (as an infix sometimes and a suffix other times) is driven by the AVF (25), in combination with a stipulated requirement that affixation of l must add a mora to the stem (though not necessarily through l itself being moraic). Further, for historical reasons, they say that just in case the middle-voice exponent would end up as a suffix, -ka appears instead of -l-.

Let us consider whether the AVF and mora-adding condition make the right predictions. The idea, as laid out by Hardy and Montler (1991, ex. 12) is as follows: (i) if a stem already conforms to the AVF, as in 27b–c, then it will take an infix so as to ‘preserve the configuration’; and (ii) if a stem does not conform to the AVF, as in 27a and 28a–c, then the stem will take a prefix (which I analyze as still being an infix) or suffix to ‘complete the configuration’.

(27) 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>ilwa23  ‘be sung, song’

23 While this particular example is not a good one because of the l in the stem, it is 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, for example, second person -c- in ta<c>ilwa ‘you sing’ (Hardy & Montler 1991:9).
(28) Alabama middle voice: -ka allomorph (sometimes with vowel deletion)
   a. tala → tal-ka\(^{24}\) ‘be woven, weaving’
   b. bat → bat-ka ‘get whipped, paddle’
   c. albitti → albitti-ka ‘be covered, covering’

In the end, the output of this affixation is always a final heavy-light foot, in conformity with the AVF. But note that this conformity with the AVF is often not due to the affixation itself, but rather comes about through phonological stem changes around the affix, in particular, vowel epenthesis in 27a,c and vowel deletion in 28a.

The AVF and mora-adding condition are not sufficient to predict the distribution of the middle-voice exponents on their own. For example, the account as offered in Hardy & Montler 1991 cannot explain why CV stems like \(pa\) are made to conform to the AVF via ‘prefixation’ of \(l\) and vowel epenthesis (attested \(i<l>pa\)) rather than suffixation of -ka, accompanied by vowel deletion and vowel epenthesis (unattested *ip-ka). Nor can it explain why a CVCV form like \(ta\) cannot be made to conform to the AVF via infixation (unattested *ta<l>la) instead of suffixation and vowel deletion (attested \(ta\)-ka).

A careful consideration of the full set of constraints needed to predict the distribution of the middle-voice exponents shows that the pattern in 27–28 still cannot straightforwardly be accounted for as optimizing. In particular, there are a number of confounds in ranking constraints, including: (i) -l- is placed ‘gratuitously’ far inside the stem—it could be closer to the edge and still result in an additional mora and conform to the AVF, for example, *coop<l>a, *ip<l>a, and *tali<l>wa/*taliw<l>a; and (ii) if suffixation and vowel deletion are preferred over infixation, as they must be for \(ta\)-ka to be preferred over *ta<l>la/*tal<l>a, then the attested output \(coo<l>pa\) over unattested *coop-ka is unexplained.

I therefore conclude that the Alabama middle-voice exponents are best understood as distributed and placed based on arbitrary (nonoptimizing) conditions, along the lines of their description in 26. Once exponent choice and pivot/placement are determined, conformation to the AVF and to the mora-adding condition is regulated by vowel epenthesis and vowel deletion, that is, by phonological processes, not morphological ones. Alabama middle voice is thus included in my typological database as involving right-edge-based prosodically conditioned suppletive allomorphy.

Yu (2017) puts forward two other cases of infix allomorphy that, he argues, require global optimization. One case comes from Katu-L (Austro-Asiatic; dialect of Katu spoken in the Lao PDR). As described by Costello (1998), nominalization in Katu-L takes a number of different forms, some prefixal and some infixal, distributed lexically. Yu (2017), with a closer eye on the phonological forms of the examples, argues that while most of these nominalizing exponents are distributed arbitrarily, a small subset—those taking the infixes -an- or -r-—are differentiated from each other on the basis of optimization: -an- combines with monosyllabic stems in the lexical set, while -r- combines with disyllabic stems in the lexical set. For the verb katas ‘to name’, for example, the nominalized form is ka<r>tas, and for cai ‘to judge’, the nominalized form is c<an>ai. Words in Katu-L are maximally bisyllabic (Costello & Sulavan 1996), so assuming that Katu-L prefers bisyllabic words, the choice of -an- vs. -r- and their respective infixal placements can be predicted based on optimization (with other aspects of Katu-L phonotactics taken into account as well).

There are a few reasons to doubt the need for global optimization for the Katu-L nominalizers. Stem size can condition even non/anti-optimizing suppletive allomorph

\(^{24}\) Note the loss of the stem-final vowel for …CV.CV roots.
choice, as discussed in §6.1. And given the overwhelming role of lexical arbitrariness in the Katu nominalizer system, it is not clear what motivation there is for positing that one small corner of this system is determined via optimization rather than just lexical conditioning. Finally, it has recently been argued by Rolle (2021) that the alternation between the two infixes at hand, -an- and -r-, is actually nonsuppletive allomorphy (both come from underlying -rn-). The Katu nominalizer is included in my typological database as involving lexically conditioned suppletive allomorphy, but counting it instead as nonsuppletive (à la Rolle) would not impact my results.

The second relevant case from Yu (2017) is that of the Tiene stative/reversive (Niger-Congo, DRC), drawing on data and discussion in Hyman & Inkelas 1997. However, Rolle (2021) shows that forms bearing the stative or reversive are extremely rare, as noted in the primary documentation of the language itself. Across all available documentation, Rolle found just ten stative examples and six reversive examples. Given this rarity, Rolle argues that there is no synchronically separable affixation involved in the reversive or stative at all. I therefore have not included Tiene in my sample.

The final language I will mention is Ida’an Begak (Austronesian, Malaysia; Goudswaard 2004, 2005), where both the past-tense morpheme (realized as ni-, -i-, or -ən) and the dependent morpheme (m-, -u-, or -əm) seem to involve globally determined suppletive allomorphy, with the first vowel in the stem crucially involved in regulating the choice between the two infixal exponents of each morpheme (Goudswaard 2004). However, as noted by Goudswaard herself (2004:§4), it is straightforward to derive the infixal variants from one underlying form, based on vowel reduction in an antepenultimate syllable and nasal deletion to maintain bisyllabicity. Under this analysis, -i- and -ən both come from the underlying form -in-, and -u- and -əm both come from underly- ing -um-. Goudswaard emphasizes that what is not derivable in the phonology is the prefixal variant. I therefore suggest a reanalysis along exactly these lines, where the past-tense morpheme and the dependent morpheme each have two suppletive forms (ni- and -in- for the past tense; m- and -um- for the dependent), and the infixal exponents each have two nonsuppletive variants. Under this alternative analysis, vowel-initial stems take the prefixal suppletive allomorph, while consonant-initial stems take the infixal one; no global suppletive choice is involved at all. Because of the tentativeness of this alternative analysis, I have not included the dependent or past morphemes in Ida’an Begak in my typological database for this article.

The takeaway of this section is that putative cases where suppletive allomorph choice must be made by the phonology are either unsustainable or amenable to reanalysis.

6.4. Implications (cumulatively). The findings in this section suggest that neither infixation nor prosodically/phonologically conditioned suppletion can be uniformly modeled as optimizing, that is, as regulated by the phonological component. The implications of these findings are discussed in much more detail throughout the following section.

7. Discussion and big-picture implications. This section is organized around the major implications of the findings in this study, offering answers to some long-debated questions in the field. Are infixes, at some derivational point or level of representation, actually prefixes/suffixes? The findings here offer a clear ‘yes’ (§7.1). Can suppletive exponent choice be made alongside/by the phonological component? The findings say

25 Other factors influencing nonsuppletive variation of/around the infix include metathesis and vowel coalescence, as discussed in Goudswaard 2004.
'no', it cannot (§7.2). Section 7.3 brings these implications together with the rest of the findings to propose a model of the fine timing of the morphosyntax-phonology interface.

7.1. Infixes really are (underlyingly) prefixes/suffixes. Does a morpheme exponed by an infix linearly concatenate with the stem it combines with (i.e. as following or preceding the stem) before the infinal exponent takes its surface (infixed) position inside the stem? Or is infixation direct, without a preliminary step of linear concatenation?

The findings of this study offer a clear answer: morphemes are linearly ordered with respect to their stems (as prefixes or suffixes), prior to infixation. The findings do not, however, tell us what the nature of this linearization is—for example, the ordering could be a byproduct of the syntactic structure (à la Kayne 1994, Bye & Svenonius 2012, inter alia), or the ordering could come from idiosyncratic properties of each phrase, head, or morpheme involved (e.g. Harley 2011); the ordering could formally be a part of syntax, or a part of morphology. But crucially, however linear order is determined, this linearization must be established prior to both exponent choice and infixation.26 And further, this basic prefixal/suffixal underlying order must not be encoded by individual exponents (contra Inkut 1990, Yu 2007, Idsardi & Raimy 2013, Sande et al. 2020, inter alia); only deviant reordering (i.e. infixation) is encoded at the level of the exponent.

The first relevant finding that bears on this question, discussed in §3.4, is that suppletive allomorphs of a morpheme all cluster at one edge of a stem; thus, allomorphy may involve a left-edge infix and a prefix, as in Bahnar (11), or a right-edge infix and a suffix, as in Hunzib (12), but never a mismatch. This is already suggestive of an affixal morpheme having a single underlying position, as preceding or following the stem, from which position individual allomorphs may stray (to a limited degree) if they are infixes.

The strongest evidence for a preliminary step of prefixation/suffixation comes from the observations laid out in §3.5 and §3.6, that not only do suppletive allomorphs of a morpheme share an edge orientation, but also it is the edge (around which suppletive allomorphs cluster) and only this edge that is relevant for phonologically and prosodically conditioned suppletive allomorphy. Again, this has a natural explanation if, at the point of suppletive allomorph choice (which itself necessarily precedes infixation, as is discussed in §7.3), a morpheme already has a linear position with respect to the stem—suppletive exponent choice is made at/from one edge of the stem, and if an exponent is chosen that is an infix (has a pivot/placement), the exponent will subsequently displace to a stem-internal position. A further implication is that infixes are constrained to finding the closest (or perhaps second closest) instance of their pivot; an exponent cannot be given the instruction to find the ‘last X’ or ‘first X’ (counter to the descriptive way I encoded pivots/placements in all examples above, and counter to some theories of infixation discussed below). Rather, simple subcategorization frames, like __ V (‘be before a vowel’), suffice, given prior linearization of the morpheme being exponed.

If there were no linearization of an affixal morpheme with respect to its stem prior to infixation, then we would not expect to find one stem edge privileged over the other, either with respect to infinal location (relative to the position of other suppletive allomorphs) or with respect to suppletive conditioning environment. In particular, we might expect to find the following sorts of cases: (i) one suppletive allomorph of a morpheme is a prefix and the other is a right-edge infix (or vice versa, with a suffix and left-edge

26 Note that mere ‘immobilization’, which establishes adjacency among syntactic nodes but not precedence, is not enough prior to exponence, contra Idsardi & Raimy 2013.
infix); (ii) one suppletive allomorph of a morpheme is a left-edge infix and the other is a right-edge infix; (iii) a left-edge infix has as its conditioning environment (for suppletive allomorph choice) a phonological or prosodic trigger at the right edge of the stem (or vice versa); or (iv) an infix has as its conditioning environment (for suppletive allomorph choice) a phonological or prosodic trigger in the infix’s surface/infixed position. I have found no such cases.

The literature has offered a plethora of accounts of infixal positioning, which can be grouped into what I call indirect and direct accounts: indirect accounts of infixation are those where an infix has a preliminary prefixal/suffixal location with respect to its stem, while direct accounts deny any noninfixal linearized position of the infix. Indirect infixation characterizes an otherwise very diverse set of proposals—see, for example, Anderson 1972, Moravcsik 1977, Halle 2001, Horwood 2002, Plank 2007, Embick 2010, Bye & Svenonius 2012, Bacocein & Freeman 2016. It is indirect infixation that is supported by the present study, though only a proper subset of indirect proposals receive support once other findings are also considered (see §§7.2–7.3).

Direct infixation accounts come in two subtypes: (i) those that take affixes to still have an abstract prefixal/suffixal nature with respect to the stem, and (ii) those that take infixes to be infixes through and through. In proposals of the first type, while there is no literal step of prefixal/suffixal concatenation prior to infixation, infixes are still prefixes/suffixes in some abstract way (see e.g. Cohn 1992, McCarthy & Prince 1993a, Prince & Smolensky 1993, Zoll 1996, Buckley 1997, Hyman & Inkelas 1997, Kaufman 2003, Klein 2005, Wolf 2008). In such proposals, the underlying designation of an affix as a prefix or suffix serves to constrain what stem edge the infix appears near (left or right), as well as how far away it may be from that edge. In this camp are the classic optimization-based accounts of infixation, where an affix might want to (e.g.) be a prefix, but it will be realized stem-internally as an infix in order to (e.g.) avoid creating an on-setless syllable at the beginning of the word.

The second type of direct infixation account denies that there is any designation of infixes as prefixes or suffixes, however abstract (see e.g. Inkelas 1990, Anderson 1992, Yu 2007, Samuels 2009). For example, for 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’.27 There is no step of prefixal/suffixal linearization in these accounts, nor any ‘pull’ to the edge coming from an affix’s supposed underlying nature. Infixes are infixes through and through—pivots/placements must specify ‘first X’ and ‘last X’, and this proximity to a particular edge has a purely diachronic source, not tied to any synchronic explanation. The findings of the present study argue against direct infixation approaches of both types.

It is worth pausing for a moment to consider whether the conclusion argued for in this section would be impacted if the division between suppletive and nonsuppletive

27 Yu’s (2007) core arguments against other types of approaches are as follows. With respect to optimization-based accounts of infixation, Yu notes that ‘infixation can occur for no obvious prosodic or phonotactic gains’ (p. 30) and that, if optimization-based accounts were on the right track, ‘hyperinfixation should be the norm rather than the exception’ (p. 38). With respect to indirect/derivational accounts of infixation, where the infix starts as a prefix/suffix, Yu’s arguments are centered on readjustment-type accounts (e.g. Halle 2001), where infixation is derived by moving phonological constituents around: for example, by swapping the first two onsets of a word, or by preposing the stem’s onset. Such accounts can model only a (very) proper subset of cases of infixation (see Yu 2007:32–33). To my understanding, none of Yu’s criticisms apply to the account argued for in this article, which combines a derivational step of prefixation/suffixation with a pivot-based approach to infixation; see §7.3.
allomorphy were drawn in a different place; see example 5 and the discussion at the end of §2.3. In particular, what would happen if all alternations apart from those that can be reduced to language-general surface phonology were treated as involving suppletion (i.e. taking a ‘no’ response to question D in the decision tree in Fig. 1 to diagnose suppletive allomorphy)? This would mean, for example, reclassifying some of the infixed alternants in Leti and Budukh (see §4.1) as being suppletively related, thereby implicating the infixed environment in suppletive allomorph choice. Importantly, this would not impact the specific claim of this subsection—that infixation is fed by prefixation/suffixation—because there are still clear cases of exponent choice needing to be made at the stem edge prior to infixation (§3.5). This thought experiment is continued at the end of the following section.

7.2. Suppletive allomorph choice precedes phonology. Can suppletive allomorph choice be regulated by considerations of phonological optimization, or by the phonological grammar more generally? Or is suppletive allomorph choice prior to and independent of such considerations?

The literature is divided on this question. Some accounts hold that phonologically and prosodically conditioned suppletive allomorphy is always regulated by the phonological component of the grammar (see e.g. McCarthy & Prince 1993a,b, Mester 1994, Kager 1996, Hyman & Inkelas 1997, Horwood 2002, Wolf 2008), capturing the fact that such allomorphy is often optimizing. Other accounts hold the opposite view, that suppletive allomorph choice is always prior to and independent from the phonological component (see e.g. Halle & Marantz 1993, Trommer 2001, Paster 2006, Bye 2008, Embick 2010, Bye & Svenonius 2012, Pak 2016, Dawson 2017, Kalin 2020, Rolle 2020, Stanton 2023), capturing the fact that such allomorphy, even when phonologically or prosodically conditioned, may be nonoptimizing and even anti-optimizing. Finally, there are accounts that split phonologically and prosodically conditioned suppletive allomorphy into two types—non/anti-optimizing allomorphy, which is determined prior to phonology, and optimizing allomorphy, regulated by the phonology (see e.g. Booij 1998, Bonet et al. 2007, Mascarak 2007, Nevins 2011, Bermudez-Otero 2012, Yu 2017, De Belder 2020). When looking only at one case or one language, it is hard to argue for one of the absolute approaches as compared to the hybrid dual-route approach. Considering the languages here, one might take Toratán’s optimizing suppletive allomorphy, as in 9, to fit better with the morphology-with-phonology approach, but Bahnar’s nonoptimizing suppletive allomorphy, as in 11, to fit better with the morphology-before-phonology model, thereby supporting a hybrid approach that allows both orderings.

However, it is possible to make an argument for the nonhybrid, morphology-before-phonology approach on typological grounds. Paster (2006:§6.4) notes that, if optimizing and nonoptimizing suppletive allomorphy were distinct in their timing (the former in the phonology, the latter before the phonology), then we would expect to find two different empirical profiles for them. In particular, optimizing suppletive allomorphy would be sensitive only to surface phonology and could be conditioned nonlocally (and potentially outwardly); nonoptimizing suppletive allomorphy would be sensitive only to underlying phonological forms and conditioned locally (and inwardly). As Paster (2006) shows, however, this division is not borne out; rather, all suppletive allomorphy has the characteristics expected if suppletive allomorph choice is always made prior to the phonology.

The findings in this article add a new typological argument that provides support for the nonhybrid, morphology-before-phonology approach. If suppletive allomorph
choice could be made in the phonological component/alongside the phonological com-
putation, then (i) the surface (infixed) environment should be able to influence supple-
tive allomorph choice, and (ii) there should be true cases of suppletive allomorphy that
are not analyzable locally, but only globally. Of the twenty-one cases of phonologically
or prosodically conditioned suppletive allomorphy, none have characteristic (i) or (ii)—
see §3.6 and §6.3, respectively. It is notable, in this context, that there is such a sharp di-
vide between suppletive and nonsuppletive allomorphy on this front. As seen in §3.5
and §3.6, suppletive allomorph choice is regulated only from the underlying edgemost
(prefixal/suffixal) position of a morpheme (see §7.1), while nonsuppletive allomorphy
is regulated only in the surface/infixed position of an exponent (§4.1–§4.2).

Again, it is worth pausing to consider the consequences of the assumptions made in
§2.3—if a more conservative view of nonsuppletive allomorphy were adopted, where
only strictly surface allomorphy is treated via phonological processes, would these con-
clusions hold up? In fact, this hypothetical change in classification would be very pro-
blematic for the argument that suppletive allomorph choice always precedes phonol-
gogy, as there would be a number of cases (see §4.1) of suppletive exponent choice in
stem-internal/infixed positions. In turn, the subsequent finding would be that suppletive
exponent choice could be made from the edgemost position or in the infixed position,
thereby necessitating a hybrid dual-route approach to suppletive allomorphy.

Importantly, though, the findings of the present study actually provide evidence
against classifying what I label restricted alternations (phonologically conditioned,
phonologically natural, but not language-general) as suppletive. For the thirty-seven in-
fixes that undergo alternations in their surface/infixed positions (at least eighteen of
which are of the restricted type), these alternations all involve a small phonological
distance. Put another way, there are no cases of alternations conditioned in a
surface/infixed position that involve a large phonological distance. For compari-
son, considering the twenty-one cases I classify as phonologically or prosodically con-
ditioned suppletion (all of which take place at/from the edge of the stem), a third of
them (seven of twenty-one) involve a large phonological distance. (Ten involve a small
phonological distance, and four are somewhere in between.) All else being equal, if
suppletion could be conditioned in a stem-internal/infixed position, we would expect at
least some of the internally conditioned alternations to have a large phonological dis-
tance. But, none do. I therefore conclude that the inclusion of restricted phonological al-
ternations in the nonsuppletive category is justified, and so the conclusion in this
section holds as well: suppletive allomorph choice precedes phonology.

7.3. Putting it all together: cyclicity and derivational ordering. In this
section I synthesize the implications of §3–§6 with those discussed in §7.1 and §7.2 in
order to lay out the fine timing of the morphosyntax-phonology interface.

The following binary ordering statements are supported by the present findings,
where ‘<’ indicates a derivational precedence relation (‘α < β’ = ‘α derivationally pre-
cedes β’).

(29) a. exponent choice < infixation  (§3.1, §3.5, §3.6, §6.1)
b. linear concatenation < exponent choice & infixation  (§3.4, §3.5, §3.6, §7.1)
c. infixation < (morpho)phonology
   (§4.1, §4.2, §4.3, §5.3, §6.2)
d. exponent choice < (morpho)phonology
   (§6.1, §6.3, §7.2)
Cumulatively across 29, the internally consistent ordering arrived at is shown in 30.

28 These findings do not, however, rule out infix placement sometimes being handled by the phonology.
There is a derivationally early step of linear concatenation of morphemes, establishing affixal morphemes as preceding or following their stems. (See the discussion at the beginning of §7.1 about how this ordering may fall out from syntactic structure, or be established early in the morphology.) It is in this linearized position that exponent choice happens, that is, where the choice among suppletive allomorphs is made. Some exponents are infixal (have a phonological pivot/placement), and when inserted, they displace (if needed) to the closest stem-internal position where they can satisfy their pivot/placement. Finally, phonological processes apply, potentially deriving nonsuppletive alternations of and around infixal exponents.

Further, the findings of this study support cyclicity of exponent choice, infixation, and (morpho)phonology (in particular, (re)prosodification). Cyclicity is used here to mean that a set of operations repeats with every morpheme, starting from the most embedded morpheme in the structure and working upward; every morpheme thus defines a cycle. The evidence for cyclicity of exponent choice comes from the observation that suppletion based on phonological and prosodic factors is uniformly inward-looking; see §3.5 and Paster 2006. The evidence for cyclicity of infixation comes from the observation that infixes only ever displace inwardly (§5.1) and can only satisfy their pivot/placement inwardly (§5.2); this goes hand in hand with cyclic exponent choice. Crucially, if realization were simultaneous across a domain (e.g. Prince & Smolensky 1993, Mascaro 1996, Svenonius 2012, Rolle 2018) or could go from the outside in (Deal & Wolf 2017), the following sorts of patterns are predicted to exist: outward-moving infixes, infixes that can satisfy their pivot/placement at the stem edge looking outward, and outwardly sensitive phonologically/prosodically conditioned suppletive allomorphy. None of these patterns are found in my sample.

Finally, the evidence for cyclicity of (morpho)phonology comes from (i) the fact that prosody is a robust conditioning factor in suppletive allomorphy involving infixes (§3.2), as well as (ii) the fact that infixes may have prosodic pivots (Yu 2007). For prosodic factors to matter for suppletion and infixation, which are themselves cyclic, there must also be (re)prosodification throughout the cyclic derivation, starting with prosodification of the most embedded morphological piece, the root. (See Kalin 2022c for a detailed case study of Nancowry that makes this argument on expanded grounds.)

Putting together cyclicity and the overall ordering in 30, I propose the following derivational timing of the morphosyntax-phonology interface.

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30 See also Kiparsky (2021), who argues that the Nez Perce data that are analyzed by Deal and Wolf (2017) do not necessitate outwardly sensitive phonologically conditioned suppletive allomorphy.

31 Evidence for the cyclicity of other morphophonological processes comes from cases where an infix appears between two morphemes that have some sort of allomorphic relationship, for example, one conditioning a nonsuppletive alternation of the other. See Kalin 2022a,b.
(31) Derivational timing
   a. Build the abstract morphosyntactic structure
   b. Realization—Go to the most embedded unexponed morpheme; apply the following operations, in order:
      (i) Concatenation (i.e. establish linear precedence)
      (ii) Exponent choice
      (iii) Exponent insertion (including infixation of infixal exponents)
      (iv) Morphophonology and cyclic phonology
      (Repeat cycle in (i)–(iv) until no more unexponed morphemes in domain)
   c. Apply surface/post-cyclic phonology
      (Repeat (a)–(c) for every phase/spell-out domain)

A few commitments made in 31 are underdetermined by the present findings. First, I have couched 30 within a post-syntactic model of morphology. Next, I have posited linearization as the first step in cyclic realization, whereas the present findings themselves tell us only that linearization must happen prior to exponent choice and infixation: for example, linearization could hypothetically apply to the whole structure prior to realization. 32 Last, I have located infixation as part of exponent insertion, which is after exponent choice has taken place, and before morphophonology/cyclic phonology. This sequentiality is supported by my findings—infixal exponents have no phonological life at the edge of the stem, and there are a number of cases of nonoptimizing and/or opaque infixation. But, it is also possible that in some cases infixation is later, part of cyclic (morpho)phonology. (This would essentially be a hybrid/dual-route approach to infixation.)

Let us run through a derivation to see exactly how 31 works in practice, using the following example from Leti (Blevins 1999:389); recall 18 and the discussion in §5.1.

(32) na-l<i>òkra
    3sg.I-<NMZN>_swear
    ‘he has sworn’

The first step is building the morphosyntactic structure, given in 33. I assume, building on the discussion in Blevins 1999:388, that a null v resultative head (not shown above in 32) mediates between the inflectional agreement prefix and the nominalized verb, and is responsible for the classification of the derived form as class I.

```
(33)

Agr

3sg

v

RESULT_I

n

NMZN
ty \sqrt{SWEAR}_{II} 

V
```

Starting from the most deeply embedded morpheme, the root, 34 through 37 go through (cyclic) concatenation, exponent choice, exponent insertion/infixation, and (morpho)phonology (prosodification not shown for this case, as it is not relevant), culminating in surface phonology (38). (Recall that I assume that a simple exponent-specific subcategorization frame suffices for infixal placement, as seen in 35c, and that simple prefixes/suffixes lack such a positional subcategorization frame; see Kalin & Rolle 2022.

32 Considerations of modularity point away from an early step of linearization over the whole structure, because this would require linearizing while also maintaining the underlying hierarchical structure (for the purposes of finding the bottom for bottom-up exponence). Thank you to Gillian Ramchand, Craig Sailor, and Neil Banerjee for helpful discussion of this point at GLOW 44.
for more detail. In addition, I assume that class membership—indicated with subscripts on the relevant morphemes and exponents—and morphological boundaries survive until surface phonology.)

(34) **Cycle 1**

a. Linear concatenation: (vacuous) \( \sqrt{\text{SWEAR}}_{II} \)

b. Exponent choice: \( \sqrt{\text{SWEAR}}_{II} \rightarrow \text{lòkra}_{II} \)

c. Exponent insertion: \( \text{lòkra}_{II} \)

d. Restricted/cyclic phonology: (none relevant) \( \text{lòkra}_{II} \)

(35) **Cycle 2**

a. Linear concatenation: \( \text{NMZN-} \text{lòkra}_{II} \)

b. Exponent choice: \( \text{NMZN} \rightarrow \text{-ni-} / \text{class II verbs} \)

c. Exponent insertion: \( \text{-ni-}'s \text{ piv/place = } \text{V} \)

d. Restricted/cyclic phonology: \( n \rightarrow \emptyset / [\text{syll, +son}] \ldots \text{NOM} \)

(36) **Cycle 3**

a. Linear concatenation: \( \text{RESULT-} \emptyset \)

b. Exponent choice: \( \text{RESULT} \rightarrow \emptyset \)

c. Exponent insertion: (no piv/place) \( \emptyset \rightarrow \text{l<i-} \text{òkra}_{II} \)

d. Restricted/cyclic phonology: (none relevant) \( \emptyset \rightarrow \text{l<i-} \text{òkra}_{II} \)

(37) **Cycle 4**

a. Linear concatenation: \( 3\text{sg-} \emptyset \rightarrow \emptyset \)

b. Exponent choice: \( 3\text{sg} \rightarrow \text{na-} / \text{class I verbs} \)

c. Exponent insertion: (no piv/place) \( \text{na-} \rightarrow \emptyset \rightarrow \text{l<i-} \text{òkra}_{II} \)

d. Restricted/cyclic phonology: (none relevant) \( \text{na-} \rightarrow \emptyset \rightarrow \text{l<i-} \text{òkra}_{II} \)

(38) **Surface/post-cyclic phonology:** \( naliòkra \)

The crucial cycle is cycle 2, in 35, where both infixation and morphophonology take place. (Recall from the beginning of §4.1 that this instance of \( n \) deletion is not language-general.) The derivation successfully captures the fact that the nominalizing morpheme is at the left edge of its stem, that the infix displaces inwardly, not outwardly (see §5.1), and that the infix undergoes phonological alternations only in its surface position.

A bottom-up, cyclic, serial derivation like that shown above can successfully account for all infixation and allomorphy patterns found in the present study.

8. CONCLUSIONS. This article presented the findings of a large-scale study of allomorphy involving infixation. The overall picture that has emerged is that allomorphy and infixation interact in consistent, systematic ways, suggestive of a universal architecture of the morphosyntax-phonology interface. I hope this study provides a useful backdrop for investigating individual case studies of allomorphy and infixation, and for informing models of morphology and phonology.

The major theoretical implications of this study are that (i) infixes really are (underlyingly) prefixes/suffixes, (ii) suppletive allomorph choice precedes phonology, and (iii) exponent choice, infixation, and (morpho)phonology/prosodification are cyclic. Conclusions similar to these have been reached by recent investigations of root-and-template morphology; see especially Kastner 2019. These implications provide strong novel support for a derivational, realizational, piece-based approach to morphology. One such model that is particularly well-suited to accommodate these findings is distributed morphology (Halle & Marantz 1993, 1994, Embick 2010). Notably, the findings are not compatible with theories that take infixation to be direct (e.g. Yu 2007), that make some/all suppletive choices in the phonology (e.g. Mascaró 2007, Wolf 2008, Bermudez-Otero 2012), or that lack a serial architecture altogether (e.g. McCarthy &
Prince 1993a,b). The findings are also challenging to explain in word-and-paradigm theories (e.g. Stump 2001, 2016), related to the representational (rather than derivational) and process-based nature of many such models.

A natural next step in this research is to look at other nonconcatenative/displaced elements—like ablaut, mora affixation, tmesis, mobile affixes, endoclitics, and second-position clitics—and compare their behavior to the present results. Doing so can help to diagnose how many distinct phenomena we are really dealing with: if the behavior of any of these displacing elements is just like that of canonical infixes with respect to allomorphy, then we might conclude that these phenomena are fundamentally the same as infixation, but if not, then this suggests other mechanisms are at play. If we shift the focus away from the behavior of the displacing elements themselves, another relevant question in supporting the model proposed here is about what sorts of stem-internal processes survive the intrusion of an infix, and which do not. I am pursuing this question in ongoing work.

### Appendix: List of Case Studies

<table>
<thead>
<tr>
<th>LANGUAGE (COUNTRY)</th>
<th>MORPHEME</th>
<th>EDGE</th>
<th>SUPPLETIVE CONDITION</th>
<th>MAIN SOURCE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Afro-Asiatic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bole (Nigeria)</td>
<td>distributive</td>
<td>left</td>
<td>lexical</td>
<td>Gimba 2000, Zoch 2017</td>
</tr>
<tr>
<td>Jebbāli (Oman)</td>
<td>plural</td>
<td>right</td>
<td>prosodic, lexical</td>
<td>Al Aghbari 2012</td>
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<tr>
<td>Mupun (Nigeria)</td>
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<td>right</td>
<td>lexical</td>
<td>Frajzyngier 1993</td>
</tr>
<tr>
<td>Turoyo (Turkey)</td>
<td>past</td>
<td>left</td>
<td>(none)</td>
<td>Jastrow 1993, Kalin 2020</td>
</tr>
<tr>
<td><strong>Algeic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yuruk (US)</td>
<td>intensive</td>
<td>left</td>
<td>(none)</td>
<td>Garrett 2001</td>
</tr>
<tr>
<td><strong>Austro-Asiatic</strong></td>
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<td></td>
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</tr>
<tr>
<td>Bahnar (Vietnam)</td>
<td>nominalizer</td>
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<td>phonological (melody, lexical</td>
<td>Banker 1964</td>
</tr>
<tr>
<td>Jahai (Malaysia)</td>
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<td>left</td>
<td>prosodic, lexical</td>
<td>Burenhult 2002</td>
</tr>
<tr>
<td>Katu (Lao PDR)</td>
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<td>left</td>
<td>lexical</td>
<td>Costello 1998</td>
</tr>
<tr>
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<td>left</td>
<td>(none)</td>
<td>Rischel 1995</td>
</tr>
<tr>
<td>Nancowry (India)</td>
<td>causative</td>
<td>left</td>
<td>prosodic</td>
<td>Radhakrishnan 1981</td>
</tr>
<tr>
<td><strong>Austronesian</strong></td>
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</tr>
<tr>
<td>Ambai (Indonesia)</td>
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<td>(none)</td>
<td>Silzer 1983</td>
</tr>
<tr>
<td>Ambel (Indonesia)</td>
<td>3sg subject</td>
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<td>(none)</td>
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</tr>
<tr>
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<td>lexical</td>
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<tr>
<td>Ida’an Begak (Malaysia)</td>
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<td>phonological (melody), lexical</td>
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<tr>
<td>Leti (Indonesia)</td>
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<td>left</td>
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<td>Blevins 1999, van Engelenhoven 2004</td>
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<tr>
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<td>Nakanai (PNG)</td>
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<td>prosodic, lexical</td>
<td>Johnston 1980</td>
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<tr>
<td>Paiwan (Taiwan)</td>
<td>agent focus</td>
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<tr>
<td>Puyuma (Taiwan)</td>
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<td>phonological (melody)</td>
<td>Teng 2008</td>
</tr>
<tr>
<td>Saisiyat (Taiwan)</td>
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<td>(none)</td>
<td>Zeitoun et al. 2015</td>
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<tr>
<td>Sundanese (Indonesia)</td>
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<td>Cohn 1992</td>
</tr>
<tr>
<td>Toratán (Indonesia)</td>
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<td>phonological</td>
<td>Himmelmann &amp; Wolff 1999</td>
</tr>
<tr>
<td>Wamesa (Indonesia)</td>
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<td>(none)</td>
<td>Gasser 2014</td>
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<tr>
<td></td>
<td>3sg subject</td>
<td>left</td>
<td>(none)</td>
<td>Gasser 2014</td>
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(Table A1. Continues)
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<tr>
<th>Language (country)</th>
<th>Morpheme</th>
<th>Edge</th>
<th>Suppletive Condition</th>
<th>Main Source(s)</th>
</tr>
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<td>Wooi (Indonesia)</td>
<td>2sg subject</td>
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<td>Sawaki 2016</td>
</tr>
<tr>
<td>Cochimi-Yuman Yuma (US)</td>
<td>verbal pl. (PL3)</td>
<td>left</td>
<td>(none)</td>
<td>Halpern 1947, Gillon &amp; Mailhammer 2015</td>
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<td>Huavean</td>
<td>3sg subject</td>
<td>left</td>
<td>(none)</td>
<td>Sawaki 2016</td>
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<tr>
<td>Krat-Dai Thai (Thailand)</td>
<td>specialization</td>
<td>left</td>
<td>(none)</td>
<td>Huffman 1986, Blevins 2014</td>
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<tr>
<td>Mayan Tzeltal (Mexico)</td>
<td>intransitivizer</td>
<td>right</td>
<td>lexical</td>
<td>Slocum 1948</td>
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<tr>
<td>Movima (isolate) Movima (Bolivia)</td>
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<td>left</td>
<td>(none)</td>
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<td>Muskogean Alabama (US)</td>
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<td>right</td>
<td>lexical</td>
<td>Hardy &amp; Montler 1991</td>
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<td>phonological (melody)</td>
<td>Martin 2011</td>
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<tr>
<td>Niger-Congo Eton (Cameroon)</td>
<td>G-form</td>
<td>right</td>
<td>phonological</td>
<td>Van de Velde 2008</td>
</tr>
<tr>
<td>Kichaga (Tanzania)</td>
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<td>right</td>
<td>prosodic</td>
<td>Yu 2007, Inkelas p.c.</td>
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<tr>
<td>Kimatuumbi (Tanzania)</td>
<td>perfective</td>
<td>right</td>
<td>prosodic, phonological (melody), morphological</td>
<td>Odden 1996</td>
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<tr>
<td>Northeast Caucasian Budukh (Azerbaijan)</td>
<td>prohibitive</td>
<td>left</td>
<td>(none)</td>
<td>Alekseev 1994</td>
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<tr>
<td>Hunzib (Russia)</td>
<td>verbal plural</td>
<td>right</td>
<td>phonological</td>
<td>van den Berg 1995, Kalin 2022b</td>
</tr>
<tr>
<td>Lezgian (Russia)</td>
<td>repetitive</td>
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<td>lexical</td>
<td>Haspelmath 1993</td>
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<tr>
<td>Salish Nxa’amxcin (US)</td>
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<td>left</td>
<td>lexical</td>
<td>Willett 2003</td>
</tr>
<tr>
<td>Upriver Halkomelem (US)</td>
<td>verbal plural</td>
<td>left</td>
<td>lexical</td>
<td>Galloway 1993, Thompson 2009</td>
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<tr>
<td>Torricelli Yeri (PNG)</td>
<td>additive</td>
<td>left</td>
<td>lexical</td>
<td>Wilson 2014</td>
</tr>
<tr>
<td>Uralic Estonian (Estonia)</td>
<td>illative</td>
<td>right</td>
<td>prosodic, lexical</td>
<td>Hirvonen 2020</td>
</tr>
</tbody>
</table>

Table A1. Case studies (by family and language).

REFERENCES


Infinitives really are (underlyingly) prefixes/suffixes


