A phonology–morphosyntax interface explanation of the “nasal infix” in (Proto-)Indo-European*

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1. Introduction

Among the numerous affixes reconstructed for Proto-Indo-European (PIE), there is only one which is an infix. This is the so-called “nasal infix” */né/, illustrated in (1), a verbal derivational morpheme with a variety of functions attested across the IE languages.[1]

(1) PIE *[ju⟨né⟩k-ti] ‘ yoke⟨NE⟩-3SG’ (> Sanskrit *yu⟨ná⟩k-ti*, Latin *iu⟨n⟩g-it*)

The nasal infix poses a puzzle with (at least) two distinct pieces. First, how do we explain the unique infixal nature of this morpheme within the language? And second, how do we explain the disparate attested functions of the nasal infix? We propose an analysis that provides an integrated solution to both questions. Using the MIRROR ALIGNMENT PRINCIPLE (MAP; Zukoff 2023), we derive its unique infixal positioning *from* its unique morphosyntactic properties.

In Section 2, we briefly summarize verbal stem formation in (P)IE, and show how the nasal infix stands out among the other stem-forming morphemes. In Section 3, we provide more details of the morphophonological and basic morphosyntactic behavior of the nasal infix. In Section 4, we introduce the MAP framework and summarize Zukoff’s (2023) analysis of infixation in Arabic that inspires our analysis of the PIE nasal infix, and then, in Section 5, we lay out our MAP analysis of infixation in PIE. This approach makes further predictions about the morphosyntactic status of the nasal infix, namely, that it is of a different category than other verbal derivational morphemes: *v* rather than Aspect. In Section 6, we provide philological evidence from the attested languages which confirms this predicted morphosyntactic distinction. Section 7 concludes.

*We would like to thank the audiences at NELS 55, WeCIEC 35, and AMP 2024, as well as the members of the UCLA Phonology Seminar. All mistakes are our own doing.

[1] List of language name abbreviations used: Hitt. = Hittite, Skt. = Sanskrit, Gk. = Ancient Greek, Lat. = Latin, Goth. = Gothic, Arm. = Classical Armenian, OIr. = Old Irish, MIr. = Middle Irish, Av. = Avestan.

2. Verb stem formation in Indo-European

Traditionally, the PIE verbal system is thought to be organized around a perfectivity contrast (see, e.g., Lundquist and Yates 2018:2157).[2] Each verbal root forms an underived simplex stem that is either imperfective (traditionally called the "Present" stem) or perfective (traditionally "Aorist"). Forms of the opposite aspectual category can be created through affixation. This contrast is shown for the two respective root types in (2) and (3):

(2) *$\sqrt{\text{g}^{\text{wɦ}}\text{en}}$ 'smash, kill'
⇒ */g$^{\text{wɦ}}$én-ti/ > Skt. *hán-ti* 'kill:PRS-3SG' (root present)
⇒ */**g$^{\text{wɦ}}$é**-g$^{\text{wɦ}}$n-e-t/ > Gk. *é-**pe**-phn-**e**-Ø* 'PTC-AOR-kill-TH-3SG' (derived aorist)

(3) *$\sqrt{\text{g}^{\text{w}}\text{em}}$ 'come'
⇒ */g$^{\text{w}}$m̥-**sk$^{\text{j}}$é**-ti/ > Skt *gá-**ccha**-ti* 'come-PRS-3SG' (derived present)
⇒ */g$^{\text{w}}$ém-t/ > Skt. *á-gan-Ø* 'PTC-come:AOR-3SG' (root aorist)

In (2), the PIE root *$\sqrt{\text{g}^{\text{wɦ}}\text{en}}$ forms a simplex imperfective stem */g$^{\text{wɦ}}$en-/, reflected in Sanskrit *hán-ti*. In contrast, the same root forms its perfective stem */g$^{\text{wɦ}}$é-g$^{\text{wɦ}}$n-e-/ by prefixal reduplication, reflected in Greek *é-**pe**-phn-e*. This system is flipped in (3), with the PIE root *$\sqrt{\text{g}^{\text{w}}\text{em}}$ forming a simplex *perfective* stem, reflected in Sanskrit *á-gan*, but an *imperfective* stem by suffixation, reflected in Sanskrit *gá-**ccha**-ti*. Based on comparative evidence, many other Present stem-building morphemes are reconstructible for PIE, some of which we show in (4):

(4) PIE present stems derived from aorist roots

	Affix	Aorist root			Present stem		Reflexes
a.	*/-sk$^{\text{j}}$é/	*$\sqrt{\text{prek}^{\text{j}}}$	'ask'	⇒	*/pr̥k$^{\text{j}}$-sk$^{\text{j}}$é-/	>	Lat. ***po-sci**-t*, Skt. ***pr̥-cchá**-ti*
b.	*/´-e/	*$\sqrt{\text{dejk}^{\text{j}}}$	'show'	⇒	*/déjk$^{\text{j}}$-e-/	>	Lat. ***dīc-i**-t*, Goth. *ga-**teih-i**-þ*
c.	*/-jé/	*$\sqrt{\text{mer}}$	'die'	⇒	*/mr̥-jé-/	>	Lat. ***mor-i**-tur*, Skt. ***mri-yá**-te*
d.	*/RED-/	*$\sqrt{\text{deh}_3}$	'give'	⇒	*/di-deh$_3$-/	>	Gk. ***dí-dō**-si*, Skt. ***dá-dā**-ti*
e.	*/⟨né⟩/	*$\sqrt{\text{jewg}}$	'yoke'	⇒	*/ju⟨né⟩g-/	>	Lat. ***ju⟨n⟩g**-it*, Skt. ***yu⟨ná⟩k**-ti*

In contrast to the abundance of reconstructible suffixes ((4a–c) is not an exhaustive list), the only reconstructible Present stem-building prefix and infix are the ones in (4d,e). Prefixal reduplication is not particularly unusual, as it is independently reconstructible for various other verbal inflections (Steriade 1988, Keydana 2006, Zukoff 2017), most prominently the "Perfect" stem. However, (4e) is the only reconstructible infix in the entirety of PIE.

[2] We will describe this aspectual contrast in terms of [±perfective], though Hollenbaugh (2018) has raised serious doubts about whether this is the correct analysis. What is relevant for our claims is only that this contrast existed in Proto-Nuclear-Indo-European (see Section 6 below), not what its exact nature was.

3. Infixation in Indo-European

Based on comparative evidence, much is reconstructible about the behavior of the nasal infix in PIE. Morphophonologically, the nasal infix is constrained in both the shape of the roots with which it combines, and the root-internal position in which it surfaces, as illustrated in (5). The maximal typical PIE root is of the shape *$\sqrt{\text{CReRC}}$ (see, e.g., Fortson 2010); in other words, one to two consonants, followed by the inherent vowel */e/, followed by one to two consonants, where internal members of clusters are sonorant consonants (**m, *n, *l, *r, *j, *w*). The nasal infix is primarily attested with roots that contain a sonorant consonant adjacent to the inherent vowel.

(5) PIE roots with nasal infix forms

a. *$\sqrt{\text{jewg}}$ ‘yoke’ ⇒ */ju⟨né⟩g-/ (> Lat. *iu⟨n⟩g-it*, Skt. *yu⟨ná⟩k-ti*)
b. *$\sqrt{\text{lejk}^{\text{w}}}$ ‘leave’ ⇒ */li⟨né⟩k^{w}-/ (> Gk. *lí⟨m⟩panei*, Lat. *li⟨n⟩qu-it*)
c. *$\sqrt{\text{k}^{\text{j}}\text{lew}}$ ‘hear’ ⇒ */k^{j}l̩⟨né⟩w-/ (> Skt. *śr̥⟨ṇó⟩-ti*)
d. *$\sqrt{\text{pleh}_1}$ ‘fill’ ⇒ */pl̩⟨né⟩h_1-/ (> Skt. *pr̥⟨ṇā́⟩-ti*, Arm. *l⟨n⟩ow-ē*)
e. *$\sqrt{\text{demh}_2}$ ‘tame’ ⇒ */dm̩⟨né⟩h_2-/ (> Gk. *dám⟨nē⟩-si*, OIr. *-dam⟨na⟩i-d*)

The forms in (5) also show how the nasal infix interacts with the root: the inherent vowel */e/ deletes, and the adjacent sonorant consonant, whether to the left or the right, becomes syllabic. The nasal infix then surfaces between the syllabic consonant and the root-final consonant. For example, (5a) shows that the root *$\sqrt{\text{jewg}}$ ‘yoke’ loses its inherent vowel */e/, syllabifies the adjacent */w/ into *[u], and slots */⟨né⟩/ between the *[u] and the root-final consonant */g/. This right-oriented root-internal position will be important for the analysis presented below.

The core morphosyntactic function of the nasal infix can also be reconstructed. In languages that preserve the perfectivity contrast central to the IE verbal system, reflexes of the nasal infix consistently form the Present stem, and never the Aorist stem. In Vedic Sanskrit, for example, the nasal infix is continued in three morphemes: the infix ⟨*ná*⟩ in (6a), the suffix *-nó* in (6b), and the suffix *-nā́* in (6c). The latter two of these result from reanalysis of the nasal infix before a root-final consonant: verbs like (5c) with root-final */w/, yielding *-nó* (< */⟨né⟩w/) by regular sound change; and verbs like (5d) with a root-final laryngeal, yielding *-nā́* (< */⟨né⟩h_x/) also by regular sound change. Synchronically, all three morphemes function as Present stem-building affixes.

(6) Nasal-infix and reanalyzed nasal-suffix forms in Vedic Sanskrit

a. $\sqrt{\textit{bhid}}$ ‘split’ ⇒ *bhi⟨**ná**⟩t-ti* ‘split⟨PRS⟩-3SG’
b. $\sqrt{\textit{kr̥}}$ ‘make’ ⇒ *kr̥-**ṇó**-ti* ‘make-PRS-3SG’
c. $\sqrt{\textit{kṣi}}$ ‘destroy’ ⇒ *kṣi-**nā́**-ti* ‘destroy-PRS-3SG’

Similarly, in Latin the nasal infix appears only in imperfective verbal stems (“present”), never in perfective verbal stems (“perfect”).[3]

(7) Nasal-infix presents vs. “perfects” in Latin
  a. *fi⟨n⟩d-it* ‘split⟨PRS⟩-3SG’ vs. *fīd-it* ‘split:PRF-3SG’
  b. *ru⟨m⟩p-it* ‘break⟨PRS⟩-3SG’ vs. *rūp-it* ‘break:PRF-3SG’
  c. *vi⟨n⟩c-it* ‘win⟨PRS⟩-3SG’ vs. *vīc-it* ‘win:PRF-3SG’

Nasal-infix forms are also found in Hittite and the Anatolian languages. The Anatolian languages are the oldest attested IE languages, and the Anatolian branch is standardly reconstructed as the first to have split off from PIE, as in (8). Therefore, Anatolian sometimes displays unique archaic patterns not found in the other (“Nuclear”) IE languages.

(8) Proto-Indo-European (PIE)
  Anatolian Proto-Nuclear-Indo-European (PNIE)

The Anatolian languages lack the Present vs. Aorist opposition seen throughout the NIE languages. In Hittite, the nasal infix is instead associated with a transitivity opposition, deriving transitive/causative stems from unaffixed intransitive stems, as illustrated in (9). While this function is not apparent in most of the nasal-infix forms in the NIE languages, we will show in Section 6 that historical traces of it are detectable. As such, we will argue that this transitivizing function is original to the nasal infix in PIE, and holds the key for understanding its infixal positioning in and of itself.

(9) Derived nasal-infix stems in Hittite:
  a. *ḫark-zi* [χárk-t͡si] ‘die-3SG’
    ⇒ *ḫar⟨ni⟩k-zi* [χár⟨ni⟩k-t͡si] ‘destroy-3SG’
  b. *ištark-zi* [istárk-t͡si] ‘get.sick-3SG’
    ⇒ *ištar⟨ni⟩k-zi* [istár⟨ni⟩k-t͡si] ‘make.sick-3SG’

4. Morpheme order and the Mirror Alignment Principle

A complete analysis of the nasal infix ought to encompass both its morphophonological properties, namely its infixal positioning in contrast to other affixes’ suffixal positioning, as well as its morphosyntactic properties, properly delimiting its functions in the context of other verbal morphemes. We present such an analysis here. Our analysis is couched within Zukoff’s (2023) MIRROR ALIGNMENT PRINCIPLE (MAP) framework. This approach relates the order of morphemes to hierarchical morphosyntactic structure by means of a rank-

[3] Note that Latin has leveled the paradigms of its nasal-infix stems to the allomorph in */⟨n⟩/, originally appropriate to pre-tonic position, namely, the plural inflected forms. While Sanskrit robustly retains the allomorphic alternation, this sort of leveling is seen in most of the other languages (cf. Hitt. /⟨nin⟩/).

ing of alignment constraints. We briefly describe the MAP framework in Section 4.1, and then summarize Zukoff’s (2023) analysis of Arabic prefix/infix alternations in Section 4.2. We then lay out our MAP analysis of PIE infixation in Section 5.

4.1 The Mirror Alignment Principle

Zukoff (2023) introduces the Mirror Alignment Principle as a reliable means of implementing Baker’s (1985) “Mirror Principle” generalization: “Morphological derivations reflect syntactic derivations (and vice versa).” In other words, there is a strong tendency cross-linguistically for the linear order of morphemes (which is what Baker means by *morphological derivations*) to align with hierarchical morphosyntactic structure/constituency (which is what Baker means by *syntactic derivations*). The Mirror Alignment Principle (10) is an interface algorithm that captures the Mirror Principle, but will also accommodate seeming exceptions. It relates morphosyntactic structure to morphophonological derivation by means of the ranking of alignment constraints, dictated by hierarchical structure:

(10) **Mirror Alignment Principle (MAP):**
If terminal node α asymmetrically c-commands terminal node β, then the alignment constraint referencing α dominates the alignment constraint referencing β.

In the MAP framework, morpheme order is computed in a parallel Optimality Theoretic (Prince and Smolensky 1993/2004) phonological derivation. When two (or more) morphemes are oriented toward the same edge, they will compete for positioning at that edge. This competition between morpheme-specific instances of gradient alignment constraints (McCarthy and Prince 1993) is resolved through ranking, dictated by the MAP. The schema for these alignment constraints is given in (11):

(11)
a. **ALIGN-*x*-L:** Assign one violation * for each segment that intervenes between the left edge of the word and the left edge of the morpheme that expones *x*.
b. **ALIGN-*x*-R:** Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of the morpheme that expones *x*.

4.2 Zukoff’s (2023) MAP analysis of infixation in Arabic

Zukoff (2023) motivates the MAP in part through an analysis of prefix/infix alternations in Arabic’s verbal system, focusing on reflexives and causatives. We summarize part of this analysis here, as it will form the basis of our account of the nasal infix in PIE.

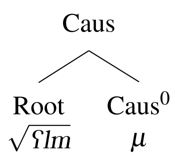
Arabic has two distinct causative constructions, as illustrated with the root $\sqrt{\text{ʕlm}}$ ‘know’ in (12). The Form II causative (12a), which is built by doubling the second root consonant — analyzed by Zukoff and others as mora infixation — tends to have a more idiomatic/lexicalized meaning related to causativity or transitivity. The Form IV causative (12b), which is built with a prefixal /ʔ-/, typically has a canonical causative meaning.

(12) Different types of Arabic causatives

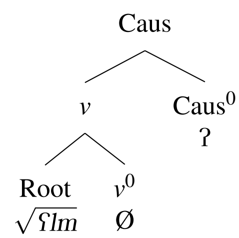
$\sqrt{\text{ʕlm}}$ ‘know’	⇒	a.	Form II:	*ʕallam-*	‘teach’
		b.	Form IV:	*ʔaʕlam-*	‘inform’ (≈ ‘make know’)

This difference in meaning suggests a difference in structure (cf. Marantz 1997, Arad 2003). Zukoff (2023) proposes that the Causative head in Form II merges as a sibling to the root (13). This structural adjacency permits greater idiomaticity. On the other hand, the Causative head in Form IV merges in a higher position, one that asymmetrically c-commands the root (14). Specifically, there is a null *v* head between Caus^0 and Root. The non-adjacency between Caus^0 and Root accounts for the more transparent semantics, since Caus^0 is not syntactically close enough to Root to develop a lexicalized meaning.

(13) Form II: *ʕallam-* ‘teach’



(14) Form IV: *ʔaʕlam-* ‘inform’



The MAP can generate distinct ordering patterns for the causative morpheme in the two constructions from the distinct syntactic position of Caus^0. In Form IV (14), Caus^0 asymmetrically c-commands Root, which triggers the MAP to establish the ranking ALIGN-CAUS-L ≫ ALIGN-ROOT-L. This yields prefixation ([*ʔaʕlam-*]), because the Causative exponent needs to be closer to the left edge than the Root. In Form II (13), Caus^0 *does not* asymmetrically c-command Root, which means that the MAP will fail to establish any ranking between those two alignment constraints. In this circumstance, a default preference (15) for left-alignment of the Root kicks in. This generates the opposite ranking, ALIGN-ROOT-L ≫ ALIGN-CAUS-L, which produces infixation ([*ʕallam-*]) because the ordering preferences are reversed.[4]

(15) **Default ranking:** In the absence of a MAP-determined ranking, ALIGN-ROOT *outranks* all other alignment constraints.

This analysis of the causative generalizes to the rest of the verbal system, such that the Arabic morphological system is broadly organized as follows: an infix is the *first* morphosyntactic head to combine with Root, but a prefix/suffix is *separated* from the Root by at least one intervening morphosyntactic head.

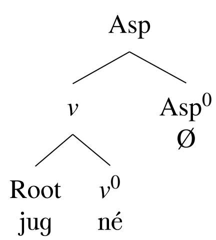
[4] The different exponents of the causative morpheme can be handled by positing allomorphy conditioned by morphosyntactic context, since the morphosyntactic contexts are distinct.

5. A MAP analysis of PIE infixation

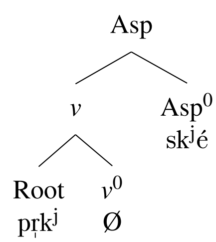
5.1 The MAP and PIE morphosyntax

We propose to apply this same reasoning to the PIE aspectual system, as follows: (i) the nasal infix combines directly with the Root; and (ii) the other aspectual Present/Aorist stem-forming affixes — all suffixes or prefixes — are separated from the Root by another head, namely, a null *v*. This leads us to the morphosyntactic structures in (16) and (17) for nasal-infix forms and other aspectual affixes, exemplified by the -*sk^jé* suffix, respectively. We identify the aspectual prefixes/suffixes as the exponents of true Aspect heads. Due to the distinct alignment behavior of the nasal infix, and the assertion of the MAP that morphemes with distinct ordering properties must belong to different morphosyntactic categories, we ascribe the category *v* to the nasal infix. The choice of *v* will be motivated further in Section 6.

(16) Verbalizing infix structure:
*/ju⟨né⟩g-ti/ 'yoke⟨PRS⟩-3SG'



(17) Aspectual suffix structure:
*/pr̥k^j-sk^jé-ti/ 'ask-PRS-3SG'



When we run these structures through the MAP, coupled with a default preference for Root-alignment (equivalent to the one Zukoff 2023 proposed for Arabic (15)), we generate the alignment-ranking difference we need in order to derive the distinction between infixation and suffixation. In (16) the *né* head (in v^0) stands in *symmetric* c-command with Root, so the MAP does not establish a ranking between ALN-RT-R and ALN-*né*-R. This indeterminacy is resolved by the default preference for Root-alignment, fixing the ranking in (18a), which will yield infixation. On the other hand, in (17) the MAP fixes the ranking of ALN-*sk^jé*-R over ALN-RT-R in (18b), since the *sk^jé* head (in Asp^0) *asymmetrically* c-commands Root. This yields suffixation in this case.

(18) Rankings for different verbal structures
a. "Default" ranking for *né* forms: ALN-RT-R $\gg$ ALN-*né*-R $\Rightarrow$ infixation
b. MAP ranking for *sk^jé* forms: ALN-*sk^jé*-R $\gg$ ALN-RT-R $\Rightarrow$ suffixation

Unlike the Arabic case, the relevant affixes in PIE are all right-oriented. This is self-evidently true of Aspectual (and agreement/tense) suffixes. It is also true of the infix, which tucks in behind the rightmost/final consonant of the Root. This means that each alignment constraint must be an ALIGN-*x*-R constraint (19). This includes the ALIGN-ROOT constraint, whose right-orientation will be significant for the phonological analysis.

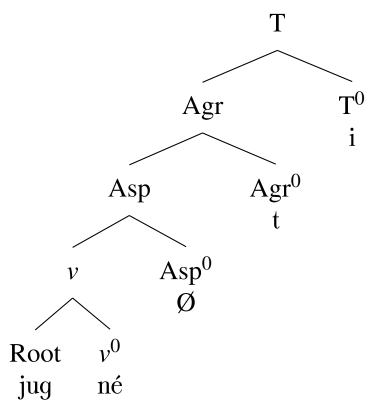
(19) a. **ALN-*né*-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of *né*.[5]

b. **ALN-*skʲé*-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of *skʲé*.

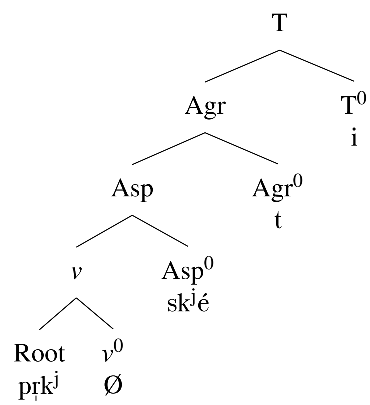
c. **ALN-RT-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of the Root.

Once these constraints and rankings are furnished by the MAP, the actual order of the exponents is determined in the phonological evaluation. We now present this phonological analysis in full. To better illustrate the nature of the system, we use whole word forms for our tableaux, namely 3SG.PRS forms (ending in *-t-i*). The full morphosyntactic structure for PIE verbs, according to our analysis, is given in (20) and (21), for the two respective types of verbs of interest. Since the morphosyntactic heads involved always occur at consistent positions in the structure, we can posit a total ranking of constraints across derivations, shown in (22).

(20) Verbalizing infix full structure:
*/ju⟨né⟩g-ti/ 'yoke:PRS-3SG'



(21) Aspectual suffix full structure :
*/pr̥kʲ-skʲé-ti/ 'ask-PRS-3SG'



(22) **Total alignment ranking:**
ALN-T-R ≫ ALN-AGR-R ≫ ALN-*skʲé*-R ≫ ALN-RT-R ≫ ALN-*né*-R

5.2 The phonological derivation

The ranking from (22) generates infixation of *né* if, additionally, ALN-*né*-R ≫ CNTG-RT (23). This is demonstrated in the tableau in (24).

(23) **CONTIG-ROOT:** Assign one * for each string that intervenes inside the Root.

[5]This constraint is properly ALIGN-*v*-R, referring to the morphosyntactic category rather than the exponent. The same goes for ALIGN-*skʲé*-R, which ought to be ALIGN-ASP-R, applying equally to all members of the class. We use the exponent-oriented naming convention to increase interpretability.

(24) Derivation of infixation for *né*: *[ju⟨né⟩k-t-i][6]

/jug, né, t, i/	ALN-T-R	ALN-AGR-R	ALN-RT-R	ALN-*né*-R	CNTG-RT
a. juk-t-i-né	*!*	***	****		
b. juk-t-né-j		**!*	****	*	
c. jug-né-t-i		*	***!*	**	
d. ☞ ju⟨né⟩k-t-i		*	**	***	*
e. i⟨né⟩wk-t-i		*	**	****!	*
f. né-juk-t-i		*	**	****!*	

The high ranking of ALN-T-R and ALN-AGR-R ensures that *né* cannot be further to the right than T ([i]) and Agr ([t]), respectively. This rules out candidates like (24a,b) where *né* has migrated further to the right. The ranking ALN-RT-R ≫ ALN-*né*-R explains why it is better to have the Root's right edge closer to the right (24d) than it is to have *né*'s right edge closer to the right (24c). This ranking follows from *né*'s low structural position via the interplay between the MAP and the language's default preference for Root-alignment.

The gradient definition of the alignment constraints explains why *né* tucks in immediately before the root-final consonant (24d): retracting any further to the left (24e,f) induces gratuitous violations of ALN-*né*-R relative to (24d). Lastly, in order for the desired infixation candidate (24d) to beat the prefixation candidate (24f), it must be the case that it is more important to satisfy the alignment preferences of *né* than it is to avoid a discontiguous root, which results from infixation. This confirms and motivates the ranking ALN-*né*-R ≫ CNTG-RT.[7]

As discussed above, because *sk^{j}é* (and the other Aspectual affixes) are merged higher in the tree than *né*, the MAP ranks their alignment constraints — here, ALN-*sk^{j}é*-R— above ALN-RT-R. This is responsible for their realization as suffixes following the root: (25c) ≻ (25d).

(25) Derivation of suffixation for *sk^{j}é* (and other Aspectual affixes): *[pr̥k^j-sk^{j}é-t-i]

prk^j, sk^{j}é, t, i	ALN-T-R	ALN-AGR-R	ALN-*sk^{j}é*-R	ALN-RT-R	CNTG-RT
a. pr̥k^j-t-i-sk^{j}é	*!**	****		*****	
b. pr̥k^j-t-sk^{j}é-j		**!*	*	*****	
c. ☞ pr̥k^j-sk^{j}é-t-i		*	**	*****	
d. pr̥⟨sk^{j}é⟩k^j-t-i		*	***!	**	*
e. p⟨sk^{j}é⟩rk^j-t-i		*	***!*	**	*
f. sk^{j}é-pr̥k^j-t-i		*	****!*	**	

[6] Candidates reflect regular process application, e.g., obstruent voicing agreement, sonorant vocalization.

[7] Note that a comparable CONTIG-AFFIX constraint banning intrusion inside of affixes must be ranked *high* so as to avoid infixation into multi-segment suffixes.

5.3 Local conclusions

A MAP-based analysis can thus derive ordering differences between the nasal infix *né* and the other Aspectual suffixes, when combined with concrete claims about the morphosyntax of the morphemes involved. Specifically, we have claimed that *né* is the exponent of a different morphosyntactic head than the other Present stem-forming suffixes, and that it must merge lower in the tree. These claims make falsifiable predictions about the morphosyntactic behavior of the *né* morpheme. We will now show how those predictions, originally motivated by the ordering properties rather than something properly (morpho)syntactic, are borne out upon careful philological investigation of the attested languages.

6. Morphosyntax of the PIE nasal infix

As mentioned briefly in Section 3, we observe a difference in the function of the nasal infix between the Nuclear Indo-European (NIE) languages and the Anatolian languages: in NIE, the nasal infix marks imperfective aspect, but in the Anatolian languages, the nasal infix derives a transitive or causative verb stem from an intransitive one. We now show in depth how this manifests in the Anatolian languages, and how traces of this transitivizing function are still detectable in the NIE languages. On this basis, we conclude that the transitivizing function of the nasal infix is original, and should be reconstructed to PIE (in accordance with Meiser 1993).

6.1 Philological motivation

The first piece of evidence comes from intransitive–transitive verb pairs. The Hittite synchronic alternations between simplex intransitive stem and causative nasal-infix stem seen in (9) above are repeated in (26) with IE comparanda. In each case, the nasal-infix stem attests at least one reflex in an NIE language whose meaning can be reasonably viewed as deriving from an original causative. While we do not find these clear synchronic alternations in any of the NIE languages (suggesting this function is no longer productive), we can find at least one example attested via comparative evidence across languages. As shown in (27), the Greek simplex intransitive Aorist *plē̂-to* ‘became full’ corresponds to the Sanskrit transitive Present *pr̥⟨ṇā́⟩-ti* ‘fills’ (i.e., ‘causes to become full’), marked by the presence of the nasal infix. This is evidence that the transitivizing/causative function of the nasal infix is not an Anatolian development, but rather an inherited feature of PIE.

(26) Transitivity alternations among Hittite verbal stems

Intransitive simplex stem		**Causative nasal infix stem**
*/$h_3$érg-t/ > Hitt. *ḫark-ta* ‘perished’	⇒	*/h_3r̩⟨né⟩g-ti/ > Hitt. *ḫar⟨ni⟩k-zi* ‘makes perish’ (cf. Arm. *harka-nē* ‘hits, kills’)
*/(s)térg$^{\text{jɦ}}$-t/ > Hitt. *ištark-ta* ‘got sick’	⇒	*/(s)tr̩⟨né⟩g$^{\text{jɦ}}$-ti/ > Hitt. *ištar⟨ni⟩k-zi* ‘makes sick’ (cf. Skt. *tr̥⟨ṇé⟩ḍhu* ‘let him smash’)

(27) Transitivity alternations across NIE verbal stems

Intransitive simplex stem		**Causative nasal infix stem**
*/pl̩h_1-tó/ > Gk. *plễ-to* ‘became full’	⇒	*/pl̩⟨né⟩h_1-ti/ > Skt. *pr̥⟨ṇā́⟩-ti* ‘fills’

The same kind of evidence can be gleaned from nasal-infix stems like (28), which are derived from adjectival roots, i.e., IE roots that do not have simplex verbal stems. Importantly, all of these nasal-infix stems have transitive syntax and bear a detectable causative interpretation. The regularity of this correspondence across the IE languages suggests that it is inherited from PIE itself rather than the result of multiple independent innovations.

(28) The nasal infix in deadjectival derivation

	Adjectival root		**Causative nasal infix stem**
a.	*$\sqrt{\text{sewh}_3}$ ‘full’ (> Hitt. *šuw-uš* ‘full’)	⇒	*/su⟨né⟩h_3-t/ > Palaic *šū⟨na⟩-t* ‘filled’
b.	*$\sqrt{\text{pewh}_\text{x}}$ ‘pure’ (> Lat. *pū-rus* ‘pure’, MIr. *ú-r* ‘fresh’)	⇒	*/pu⟨né⟩h_x-ti/ > Skt. *pu⟨nā́⟩-ti* ‘purifies’
c.	*$\sqrt{\text{prejh}_\text{x}}$ ‘dear’ (> Skt. *priy-ás*, Av. *frii-ah* ‘dear; own’)	⇒	*/pri⟨né⟩h_x-ti/ > Skt. *prī⟨ṇā́⟩-ti* ‘pleases’

The behaviors above would not be accounted for under the traditional view that the nasal infix functioned simply as a Present formant in the same way as the other Present-forming suffixes. This sort of evidence led Meiser (1993) to argue that the transitivizing function of the nasal infix is “original” and that its use as a Present-stem formant was a later innovation. We propose to explain this original transitivizing function by identifying *v* as the morphosyntactic category of the nasal infix. This contrasts with the category of the other Present-forming affixes, which are proper Aspectual morphemes.

If *né* truly belonged to a distinct category from the Present-forming suffixes, we might expect the two to be able to co-occur. This expectation is borne out in Hittite. As shown in (29), we observe transitive nasal-infix stems which are subject to further derivation by *-ške* [-skːe]), the Hittite reflex of PIE */-skʲé/. Synchronically, this morpheme is not a Present-stem formant, since no Present/Aorist aspectual stem contrast exists in Anatolian. Building on Dressler (1968), Inglese and Mattiola (2020) have argued that *-ške* is a pluractional marker (cf. Hoffner and Melchert 2024:421–7), thus a modifier of lexical (/“situation”) aspect in Hittite (cf. Hoffner and Melchert 2024:421–7). We can therefore treat *-ške* as an “inner” Aspect head above infixal *né* in *v* (cf. Yates and Gluckman 2020). In the same way that Hittite reflects the original function of PIE */né/, it appears also to be reflecting the original function of PIE */skʲe/, and perhaps the other NIE “Present” suffixes.

(29) Co-occurence of */⟨né⟩/ and */-sk^{j}é/ in Hittite verbal stems

	Causative nasal infix stem		**Causative nasal infix stem + *ške***
a.	*ḫar⟨ni⟩k-zi* ‘destroy-3SG’ [χár⟨niŋ⟩k-t͡si]	⇒	*ḫar⟨nin⟩ki-ške-zzi* ‘destroy-IPFV-3SG’ [χár⟨niŋ⟩ki-skːe-t͡si]
b.	*šar⟨ni⟩k-zi* ‘compensate-3SG’ [sár⟨niŋ⟩k-t͡si]	⇒	*šar⟨nin⟩ki-ške-zzi* ‘compensate-IPFV-3SG’ [sár⟨niŋ⟩ki-skːe-t͡si]

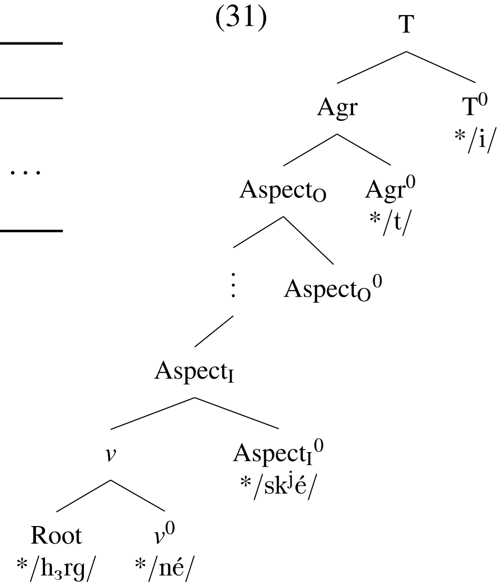
6.2 Morphosyntactic reconstruction

We propose that in PIE, the nasal infix was a *v* head with a transitivizing or causativizing function. This went hand-in-hand with the constraint ranking ALN-RT-R ≫ ALN-*né*-R, resulting in infixation of */⟨né⟩/ immediately interior to the right edge of the root. PIE morphemes like */-sk^{j}é/, which eventually became the Present-stem formants in NIE, were instead exponents of a very low aspectual projection (“inner aspect”, Asp_{I}), contributing lexical aspect. PIE, then, had no overt exponents of grammatical aspect (or “outer aspect”, Asp_{O}). Hence, the Hittite verb *ḫar⟨nin⟩ki-ške-zzi* ‘destroy-IPFV-3SG’ (29a) is a reflex of PIE */h_3r̥⟨né⟩g-sk^{j}é-ti/ ‘id.’, with the syntactic structure in (31).

(30) Morphosyntactic heads in PIE

Head	**Function**	**Exponent**
v	Transitivity	*⟨né⟩
Asp_{I}	Lexical aspect	*-sk^{j}é, *´-e, *-jé, …
Asp_{O}	Grammatical aspect	(none)

(31)

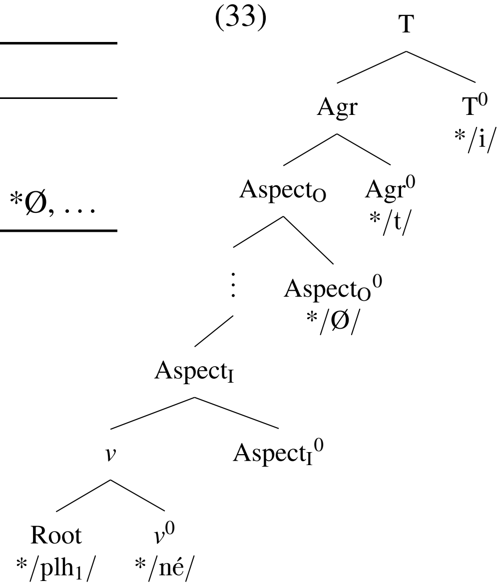


We further propose that, once the Anatolian languages branched off, the PNIE verbal system underwent a restructuring that introduced the Present–Aorist distinction reconstructible for PNIE (cf. Strunk 1994). At this stage, the lexical aspect-exponing Asp_{I} heads were reanalyzed as grammatical aspect-exponing Asp_{O} heads. In this respect, our proposal partially aligns with what Grestenberger (2022:14) calls the “standard analysis” of these suffixes, though we diverge from most previous scholars in situating this development between PIE and PNIE rather than between pre-PIE and PIE. We also differ in positing a different historical trajectory for the nasal infix */⟨né⟩/. We suggest that it remained a *v* head, as a sort of morphosyntactic archaism. That is, it continued to merge in v^0, a property that may have been supported by its infixal position. Nevertheless, it underwent semantic bleaching, losing its sense of causativity and becoming a generic verbalizer. Existing nasal-infix forms were incorporated into the Present–Aorist system as Present stems. Morphosyntactically, ⟨né⟩ would thus obligatorily co-occur with a null Asp_O head.[8] Hence, the structure of a verb like Vedic *pr̥⟨nā́⟩-ti* 'fills' from (27) would be inherited from PNIE */pl̥⟨né⟩h_1-ti/, with the structure in (33).

(32) Morphosyntactic heads in PNIE

Head	**Function**	**Exponent**
v	Transitivity	*⟨né⟩
Asp_I	Lexical aspect	(none)
Asp_O	Grammatical aspect	*-sk^{j}é, *´-e, *-jé, *Ø, ...

(33)



7. Conclusion

The MAP enables an integrated analysis of the phonology, morphology, and morphosyntax of the Present–Aorist opposition in PIE and its early daughter languages from both synchronic and diachronic perspectives. The nasal infix */né/ was originally a transitivizing *v*, while the other Present-forming affixes were markers of lexical Aspect. This lower structural position of */né/ was responsible for it surfacing as an infix rather than a prefix or suffix, like the true Aspect markers.

This approach also demonstrates the utility of attacking a problem simultaneously from multiple analytical modalities. The (morpho)phonological ordering peculiarities of the nasal infix prompted an analysis in terms of (morpho)phonological alignment constraints. Using an interface algorithm like the MAP (Zukoff 2023) generated hypotheses and predictions about the morphosyntax. These morphosyntactic hypotheses and predictions prompted philological scrutiny of attested forms, revealing confirmatory evidence.

[8] This incongruity with the rest of the system may help explain the propensity for reanalysis of the nasal infix into novel suffix forms through resegmentation (see Section 3 above).

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