



A Phonology-Morphosyntax Interface Explanation of the “Nasal Infix” in (Proto-)Indo-European

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Roadmap

- ▶ Introduction
- ▶ Infixation in Indo-European
- ▶ PIE infixation and the Mirror Alignment Principle
- ▶ Morphosyntax of the PIE nasal infix
- ▶ Conclusions & discussion



The puzzle of the PIE nasal infix

(1) PIE $^*/ju\langle né \rangle g-ti/$ 'yokes' ($\Leftarrow$ $^*\sqrt{yewg}$ 'yoke')

- The Proto-Indo-European (PIE) nasal infix $^*/\langle ne \rangle/$ in (1) poses a puzzle with (at least) two distinct pieces:
 - (i) **Morphophonological:** How do we explain the (unique) **infixal positioning** of nasal infix?
 - (ii) **Morphosyntactic:** How do we explain the **disparate attested functions** of the nasal infix?



The puzzle of the PIE nasal infix

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 - (i) **Morphophonological:** How do we explain the (unique) **infixal positioning** of nasal infix?
 - (ii) **Morphosyntactic:** How do we explain the **disparate attested functions** of the nasal infix?
- Our analysis provides an integrated solution to both questions:
 - Using Zukoff’s (2023) “Mirror Alignment Principle,” we derive its unique infixal positioning **from** its unique morphosyntactic properties.



Verbal stem formation in PIE

(2) Fundamental aspectual opposition in PIE verb

	Root	Present		Aorist
a.	*√g ^{wh} en 'smash, kill'	*/g ^{wh} én-ti/ (simplex) > Skt. <i>hán-ti</i> 'kill:PRS-3SG'	⇒	*/g ^{wh} ég ^{wh} ne-t/ (derived) > Gk. <i>é-pephne</i> -Ø 'PTC-kill:AOR-3SG'
b.	*√g ^w em 'come'	*/g ^w m-sk ^j é-ti/ (derived) > Skt. <i>gá-ccha-ti</i> 'come-PRS-3SG'	⇐	*√g ^w ém-t (simplex) > Skt. <i>á-gan</i> -Ø 'PTC-come:AOR-3SG'

- Traditionally, the PIE verbal system is thought to be organized around an aspectual opposition between “Present” and “Aorist” stems.
- Each verbal root forms a simplex stem that is aspectually either (2a) Present or (2b) Aorist.
- Verbal stems of the opposite aspectual value are derived via (overt) affixation.



Present stem formation in PIE

(3) Present stem-building affixes

	Affix	Aorist root	Derived Present stem	
a.	* /-skʲé/	* √prekʲ ‘ask’	* /pṛkʲ-skʲé-ti/ ‘ask-PRS-3SG’	> Lat. <i>po-sci-t</i> , Skt. <i>pṛ-cchá-ti</i>
b.	* /'-e/	* √dejkʲ ‘show’	* /déjkʲ-e-ti/ ‘show-PRS.3SG’	> Lat. <i>dīc-i-t</i> , Goth. <i>ga-teih-i-þ</i>
c.	* /-jé/	* √mer ‘die’	* /mṛ-jé-tor/ ‘die-PRS-3SG’	> Skt. <i>mri-yá-te</i> , Lat. <i>mor-i-tur</i>
d.	* / <u>RED</u> -/	* √deh ₃ ‘give’	* / <u>dé</u> -deh ₃ -ti/ ‘PRS-give-3SG’	> Gk. <i>dí-dō-si</i> , Skt. <i>dá-dā-ti</i>
e.	* /⟨né⟩/	* √jewg ‘yoke’	* /ju⟨né⟩g-ti/ ‘yoke:PRS-3SG’	> Lat. <i>iu⟨n⟩gi-t</i> , Skt. <i>yu⟨ná⟩k-ti</i>

- Many Present stem-building suffixes are reconstructible for PIE, e.g., (3a–c).
- However, only one prefix (3d) and one ⟨infix⟩ (3e) are reconstructible.



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- Lone prefix in (3d) is a reduplicant, which is independently reconstructible in various verbal stem formations (Keydana 2006, Zukoff 2017, i.a.) and in certain nouns (Lundquist & Yates 2018), hence not unusual here.



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- Lone prefix in (3d) is a reduplicant, which is independently reconstructible in various verbal stem formations (Keydana 2006, Zukoff 2017, i.a.) and in certain nouns (Lundquist & Yates 2018), hence not unusual here.
- But ⟨infix⟩ in (3e) is **unique** in PIE morphology.



Roadmap

- ▶ Introduction
- ▶ Infixation in Indo-European
 - Phonology of PIE nasal-infix stems
 - Function(s) of the PIE nasal infix
- ▶ PIE infixation and the Mirror Alignment Principle
- ▶ Morphosyntax of the PIE nasal infix
- ▶ Conclusions & discussion



Infix stem formation in PIE

(4) Phonology of PIE nasal infix stems

a. $\ast\sqrt{\text{jewg}}$ 'yoke' $\Rightarrow \ast/\text{ju}\langle\text{né}\rangle\text{g-ti}/$ 'yoke:PRS-3SG' > Skt. *yu* $\langle\text{ná}\rangle$ *k-ti*, Lat. *iu* $\langle\text{n}\rangle$ *g-it*

b. $\ast\sqrt{\text{lejk}^w}$ 'leave' $\Rightarrow \ast/\text{li}\langle\text{né}\rangle\text{k}^w\text{-ti}/$ 'leave:PRS-3SG' > Skt. *ri* $\langle\text{ná}\rangle$ *k-ti*, Lat. *li* $\langle\text{n}\rangle$ *qu-it*

c. $\ast\sqrt{\text{k}^l\text{lew}}$ 'hear' $\Rightarrow \ast/\text{k}^l\langle\text{né}\rangle\text{w-ti}/$ 'hear:PRS-3SG' > Skt. *śr* $\langle\text{nó}\rangle$ *-ti*

- Infix combines esp. with roots that contain a (4a–b) post- or (4c) pre-nuclear sonorant.
 - Root /e/ is deleted and the adjacent sonorant consonant becomes syllabic.
 - The $\langle\text{infix}\rangle$ surfaces immediately before the final consonant of the root.
 - Schematically, $\ast\sqrt{\text{CReC}}, \ast\sqrt{\text{CeRC}} \Rightarrow \ast\text{CR}\langle\text{né}\rangle\text{C}$, where R is a sonorant consonant.



Infix stem formation in PIE

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a.	*√jewg ‘yoke’	⇒	*/ju⟨né⟩g-ti/	‘yoke:PRS-3SG’	> Skt. <i>yu⟨ná⟩k-ti</i> , Lat. <i>iu⟨n⟩g-it</i>
			*/ju⟨n⟩g-énti/	‘yoke:PRS-3PL’	> Skt. <i>yu⟨ñ⟩j-ánti</i> , Lat. <i>iu⟨n⟩g-unt</i>
b.	*√lejk ^w ‘leave’	⇒	*/li⟨né⟩k ^w -ti/	‘leave:PRS-3SG’	> Skt. <i>ri⟨ná⟩k-ti</i> , Lat. <i>li⟨n⟩qu-it</i>
			*/li⟨n⟩k ^w -énti/	‘leave:PRS-3PL’	> Skt. <i>ri⟨ñ⟩c-ánti</i> , Lat. <i>li⟨n⟩qu-unt</i>
c.	*√k ^l lew ‘hear’	⇒	*/k ^l ⟨né⟩w-ti/	‘hear:PRS-3SG’	> Skt. <i>śr⟨ṇó⟩-ti</i>
			*/k ^l ⟨n⟩w-énti/	‘hear:PRS-3PL’	> Skt. <i>śr⟨ṇ⟩v-ánti</i>

- Nasal infix alternates intraparametrically.
 - *[-né-] when stressed.
 - *[-n-] before stress-attracting inflectional endings.



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c.	*√k ^l lew ‘hear’	⇒	*/k ^l ⟨né⟩w-ti/	‘hear:PRS-3SG’	> Skt. <i>śṛ⟨ṇó⟩-ti</i>
			*/k ^l ⟨n⟩w-énti/	‘hear:PRS-3PL’	> Skt. <i>śṛ⟨ṇ⟩v-ánti</i>

- Nasal infix alternates intraparametrically.
 - *[-né-] when stressed.
 - *[-n-] before stress-attracting inflectional endings.
- Alternations preserved in Sanskrit, elsewhere (e.g., Latin) one allomorph was generalized.



Nasal infix as Present stem formant

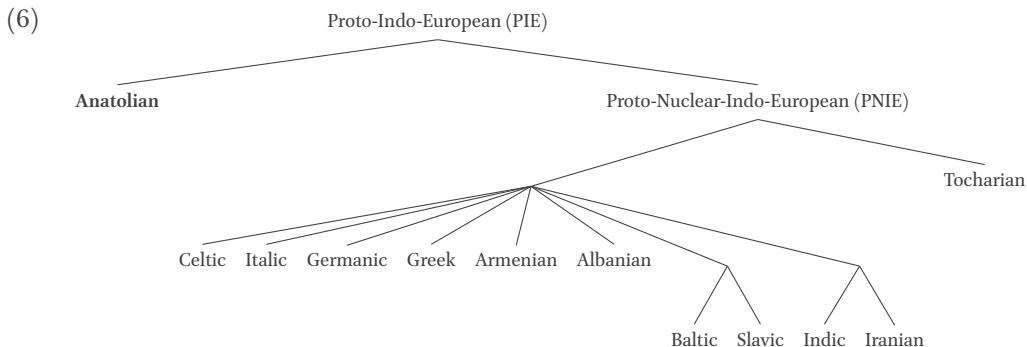
(5) Nasal infix in present stem formation:

	Aorist root	Nasal-infix Present	IE Present
a.	*√jewg ‘yoke’	*/ju⟨né⟩g-ti/ ‘yoke:PRS-3SG’	> Skt. <i>yu⟨ná⟩k-ti</i> , Lat. <i>iu⟨n⟩g-it</i>
b.	*√lejk ^w ‘leave’	*/li⟨né⟩k ^w -ti/ ‘leave:PRS-3SG’	> Skt. <i>ri⟨ná⟩k-ti</i> , Lat. <i>li⟨n⟩qu-it</i> ; Gk. <i>lí⟨m⟩panei</i>
c.	*√demh ₂ ‘tame’	*/dm⟨né⟩h ₂ -ti/ ‘tame:PRS-3SG’	> Gk. <i>dám⟨nē⟩-si</i> , OIr. <i>-dam⟨na⟩i-d</i>
d.	*√pleh ₁ ‘fill’	*/pl⟨né⟩h ₁ -ti/ ‘fill:PRS-3SG’	> Skt. <i>pr⟨ṇá⟩-ti</i> ; Arm. <i>l⟨n⟩ow-ē</i>

- Multiple IE branches support reconstructing nasal infix as **Present stem-forming affix**.
- Present stems (never Aorist) in Vedic Sanskrit and Ancient Greek are commonly formed with */⟨né⟩/ and its outgrowths (e.g., */-néw-/ << */-né-w-/).
- Nasal infix almost exclusively forms Present stems in Latin, Old Irish, and Classical Armenian (vs. “Perfect,” “Preterite,” Aorist).



Nasal infix in Anatolian



- Nasal infix functions differently in Hittite and other Anatolian languages.
- **Anatolian** branch was first to split off from the rest of IE languages.



Nasal infix in Anatolian

(7) Transitivity alternations in Hittite:

	Simplex stem/intransitive	⇒	Infix stem/transitive	
a.	<i>ḫark-zi</i> ‘die-3SG’ [χárk-ḫsi]		<i>ḫar⟨ni⟩k-zi</i> ‘destroy-3SG’ [χár⟨ni⟩k-ḫsi]	
b.	<i>ištark-zi</i> ‘get.sick-3SG’ [istárk-ḫsi]		<i>ištar⟨ni⟩k-zi</i> ‘make.sick-3SG’ [istár⟨ni⟩k-ḫsi]	

- Anatolian languages lack Present/Aorist aspectual stem contrast.
- Nasal ⟨infix⟩ mediates transitivity alternations in Hittite.



Nasal infix in Anatolian

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b.	<i>ištark-zi</i> 'get.sick-3SG' [istárk-ḫsi]		<i>ištar⟨ni⟩k-zi</i> 'make.sick-3SG' [istár⟨ni⟩k-ḫsi]	

- ★ Anatolian data raises the possibility that the nasal infix was **not (always) just a Present stem formant**.



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 - The Mirror (Alignment) Principle
 - The Mirror Alignment Principle and Arabic causatives
 - A MAP analysis of PIE infixation
- ▶ Morphosyntax of the PIE nasal infix
- ▶ Conclusions & discussion



The Mirror Alignment Principle (MAP)

- Zukoff 2023 introduces the Mirror Alignment Principle (below) as a reliable means of implementing Baker's (1985) **Mirror Principle** generalization:

Mirror Principle

Morphological derivations reflect syntactic derivations (and vice versa).

- In other words, linear order of morphemes ($\approx$ *morphological derivations*) very strongly tends to align with hierarchical morphosyntactic structure/constituency ($\approx$ *syntactic derivations*).
- The Mirror Alignment Principle is an interface algorithm that captures the Mirror Principle, but will also accommodate seeming exceptions.
 - It relates morphosyntactic structure to morphophonological derivation as follows:

Mirror Alignment Principle (MAP)

If a terminal node α asymmetrically c-commands a terminal node β , then the alignment constraint referencing α dominates the alignment constraint referencing β .



The Mirror Alignment Principle (MAP)

Mirror Alignment Principle (MAP)

If a terminal node α asymmetrically c-commands a 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 & Smolensky 1993/2004) phonological derivation.
 - Competition between morpheme-specific instances of gradient alignment constraints (McCarthy & Prince 1993) is resolved through ranking, dictated by the MAP.
 - The schema for these alignment constraints is given in (8):
- (8) 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 .



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.

(9) Different types of Arabic causatives

$\sqrt{\text{film}}$ 'know' $\Rightarrow$	a.	Form II:	<i>ʕallam-</i>	'teach'
	b.	Form IV:	<i>ʔaʕlam-</i>	'inform' ($\approx$ 'make know')

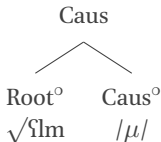
- Arabic has two distinct causative constructions:
 1. Form II causative (9a):
 - Marked by doubling the second root consonant, analyzed as mora **infixation**
 - Frequently has a highly idiomatic/lexicalized meaning
 2. Form IV causative (9b):
 - Marked by a **prefixal** /ʔ-/
 - Generally has a canonical causative meaning



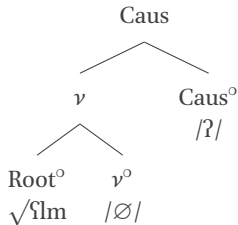
Zukoff's (2023) MAP analysis of infixation in Arabic

- Difference in meaning suggests a difference in structure (cf. Marantz 1997, Arad 2003):
 - Form II causative (10): Caus^o merges as a sibling to the root.
 - Structural adjacency permits greater idiomatcity.
 - Form IV causative (11): Caus^o merges in a higher, asymmetrically c-commanding position.
 - A null ν head between Caus^o and Root^o accounts for the more transparent semantics.
 - i.e., Caus is not syntactically close enough to Root to develop a lexicalized meaning.

(10) **Form II:** *ʕallam*- ‘teach’



(11) **Form IV:** *ʔaʕlam*- ‘inform’

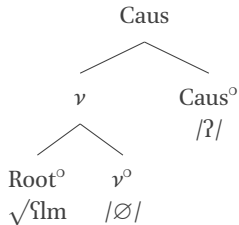




Zukoff's (2023) MAP analysis of infixation in Arabic

- The MAP can generate distinct ordering patterns for the causative morpheme from the syntactic position of Caus° :

(12) Form IV “high causative” (11) $\Rightarrow$ *prefixation* [ʔaʕlam-]



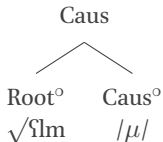
- When Caus° asymmetrically c-commands Root° :
 - The MAP generates the ranking $\text{ALIGN-CAUS-L} \gg \text{ALIGN-ROOT-L}$.
 - This yields *prefixation*: [ʔaʕlam-]



Zukoff's (2023) MAP analysis of infixation in Arabic

- The MAP can generate distinct ordering patterns for the causative morpheme from the syntactic position of Caus^o:

(13) Form II “low causative” (10) $\Rightarrow$ *infixation* [ʕallam-]



- When Caus^o **does not** asymmetrically c-command Root^o:
 - No ranking established by the MAP.
 - A **default** preference (14) for left-alignment of the Root kicks in.
 - This generates the ranking ALIGN-ROOT-L $\gg$ ALIGN-CAUS-L.
 - This yields **infixation**: [ʕallam-]

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



MAP analysis of PIE infixation

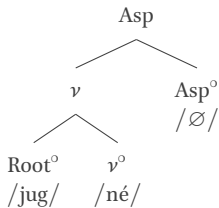
- Using this analysis as a model, we can surmise that morphological systems can be organized as follows:
 - An infix is the first morphosyntactic head to combine with the Root
 - A prefix/suffix is separated from the Root by at least one intervening morphosyntactic head
- Applying this to the PIE aspectual system:
 - The nasal infix combines directly with a Root
 - Aspectual prefixes/suffixes (i.e., other Present/Aorist stem forming affixes) are separated from the Root by another head (possibly a null ν)



MAP analysis of PIE infixation

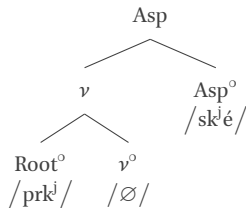
- Translating this directly leads us to the morphosyntactic structures in (15a) and (16a).
 - * We will motivate the labels on the morphosyntactic terminals in the following section.
- The MAP — coupled with a default preference for Root-alignment — correspondingly yields the rankings in (15b) and (16b).

- (15) a. Nasal infix structure
 */ju⟨né⟩g-ti/ ‘yoke:PRS-3SG’



- b. “Default” ranking for *né*:
 ALIGN-ROOT-R $\gg$ ALIGN-*né*-R

- (16) a. Aspectual suffix structure
 */prk^j-sk^jé-ti/ ‘ask-PRS-3SG’



- b. MAP ranking for *sk^jé*:
 ALIGN-*sk^jé*-R $\gg$ ALIGN-ROOT-R_{19/36}



MAP analysis of PIE infixation

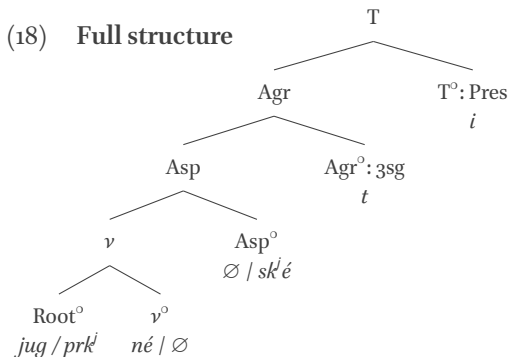
- Unlike the Arabic case, the relevant affixes in PIE are all right-oriented.
 - This is self-evidently true of Aspectual (and agreement/tense) suffixes.
 - It is also true of the infix, which tucks in behind the rightmost/final consonant of the Root.
- This means that each alignment constraint must be an ALIGN-*x*-R constraint (17).
 - This includes the ALIGN-ROOT constraint, whose right-orientation will be significant for the analysis.

- (17)
- a. **ALIGN-*né*-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of *né*.
 - b. **ALIGN-*skʲé*-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of *skʲé*.
 - c. **ALIGN-ROOT-R**: Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of the Root.

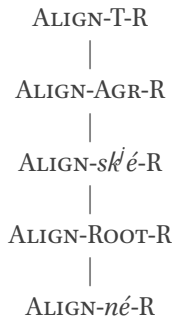


MAP analysis of PIE infixation

- We use whole word forms for our tableaux, namely 3SG.PRS forms (ending in *-t-i*).
- The full morphosyntactic structure for PIE verbs is as in (18).
- The MAP + default ranking yields the total alignment ranking in (19).



(19) Alignment ranking for full structure





MAP analysis of PIE infixation

- The ranking from (19) generates infixation of *né* if $\text{ALIGN-}né\text{-R} \gg \text{CNTG-ROOT}$ (20).
- This is demonstrated in the tableau in (21).

(20) **CONTIGUITY-ROOT:** Assign one * for each string that intervenes inside of the Root.

(21) Derivation of Infixation: *[ju⟨né⟩k-t-i]

/jug, né, t, i/	ALIGN-T-R	ALIGN-AGR-R	ALIGN-ROOT-R	ALIGN- <i>né</i> -R	CNTG-ROOT
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		*	**	****!*	



MAP analysis of PIE infixation

- The high ranking of ALIGN-T-R and ALIGN-AGR-R ensures that *né* cannot be further to the right than T ([i]) and Agr ([t]), respectively.
- This rules out candidates like (21a,b) where *né* has migrated further to the right.

(21) Derivation of Infixation: *[ju⟨né⟩k-t-i]

/jug, né, t, i/	ALIGN-T-R	ALIGN-AGR-R	ALIGN-ROOT-R	ALIGN- <i>né</i> -R	CNTG-ROOT
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		*	**	****!*	



MAP analysis of PIE infixation

- The ranking $\text{ALIGN-ROOT-R} \gg \text{ALIGN-}né\text{-R}$ explains why it is better to have the Root's right edge closer to the right (21d) than it is to have $né$'s right edge closer to the right (21c).
 - This ranking followed from $né$'s low structural position via the interplay between the MAP and the language's default preference for Root-alignment.

(21) Derivation of Infixation: *[ju⟨né⟩k-t-i]

/jug, né, t, i/	ALIGN-T-R	ALIGN-AGR-R	ALIGN-ROOT-R	ALIGN- $né$ -R	CNTG-ROOT
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		*	**	****!*	



MAP analysis of PIE infixation

- The gradient definition of the alignment constraints explains why *né* tucks in immediately before the root-final consonant (21d):
 - Retracting any further (21e,f) induces gratuitous violations of ALIGN-*né*-R.
- In order for (21d) $\succ$ (21f) (the prefixation candidate): ALIGN-*né*-R $\gg$ CNTG-ROOT.
 - This is because infixation induces a violation of CNTG-ROOT.

(21) Derivation of Infixation: *[ju⟨né⟩k-t-i]

/jug, né, t, i/	ALIGN-T-R	ALIGN-AGR-R	ALIGN-ROOT-R	ALIGN- <i>né</i> -R	CNTG-ROOT
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		*	**	****!*	



MAP analysis of PIE infixation

- Because $-sk^j\acute{e}$ (and the other Aspectual affixes) are merged higher in the tree, the MAP ranks their alignment constraints above ALIGN-ROOT-R.
- This results in their realization as suffixes following the root: (22c) $\succ$ (22d).

(22) Derivation of Suffixation of $sk^j\acute{e}$ (and other Aspectual affixes): $*[prk^j-sk^j\acute{e}-t-i]$

/prk ^j , sk ^j é, t, i/	ALIGN-T-R	ALIGN-AGR-R	ALIGN-sk ^j é-R	ALIGN-ROOT-R	CNTG-ROOT
a. prk ^j -t-i-sk ^j é	*!*	*****		*****	
b. prk ^j -t-sk ^j é-j		**!*	*	*****	
c.  prk ^j -sk ^j é-t-i		*	**	*****	
d. pr<sk ^j é>k ^j -t-i		*	***!	**	*
e. p<sk ^j é>rk ^j -t-i		*	***!*	**	*
f. sk ^j é-prk ^j -t-i		*	*****!	**	



Roadmap

- ▶ Introduction
- ▶ Infixation in Indo-European
- ▶ PIE infixation and the Mirror Alignment Principle
- ▶ Morphosyntax of the PIE nasal infix
 - The nasal infix as a ν head
 - Cooccurrence of nasal infix and aspectual suffixes
 - MAP & the diachrony of the PIE nasal infix
- ▶ Conclusions & discussion



Predictions of the MAP analysis

- This analysis makes specific predictions about the morphosyntactic properties of the nasal infix and other IE Present-stem forming affixes.
 - (i) The nasal infix is the exponent of a different morphosyntactic category than the others.
 - (ii) Other Present markers are exponents of something that merges higher in the tree.



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 - If (i) is true, distinct morphosyntactic behaviors of the two classes should be detectable.
 - If (ii) is true, then the nasal infix should be able to co-occur with Aspectual suffixes.
- ↓ Looking across the Indo-European languages, we find that both predictions are borne out.



The nasal infix as a ν head

(23) Transitivity alternations in PIE verbal stems:

Simplex stem/intransitive	$\Rightarrow$	Infix stem/causative
a. $*/h_3\acute{e}rg\text{-}t/$ 'perished' > Hitt. <i>ḫark-ta</i> 'perished'	$\Rightarrow$	$*/h_3r\langle né \rangle g\text{-}ti/$ 'makes perish' > Hitt. <i>ḫar⟨ni⟩k-zi</i> 'destroys' (cf. Arm. <i>harkan-ē</i> 'hits, kills')
b. $*/(s)térɡ^{j\acute{h}}\text{-}t/$ 'got sick' > Hitt. <i>ištark-ta</i> 'got sick'	$\Rightarrow$	$*/(s)tr\langle né \rangle g^{j\acute{h}}\text{-}ti/$ 'makes sick' > Hitt. <i>ištar⟨ni⟩k-zi</i> 'makes sick' (cf. Skt. <i>tr⟨né⟩ḍhu</i> 'let him smash')
c. $*/p h_1\text{-}tó/$ 'became full' > Gk. <i>plē-to</i> 'became full'	$\Rightarrow$	$*/p \langle né \rangle h_1\text{-}ti/$ 'fills' > Skt. <i>pr⟨ṇá⟩-ti</i> 'fills'

- Anatolian data in (23) support reconstruction of nasal infix as a **transitivizer** of intransitive simplex verbal stems (Meiser 1993; cf. Clackson 2007; Lundquist & Yates 2018).
- Traces of this function detectable via comparison of other IE languages, e.g., (23c).



The nasal infix as a ν head

(24) Nasal infix in deadjectival derivation:

	Adjectival root	$\Rightarrow$	Nasal-infix/causative
a.	* $\sqrt{\text{sewh}_3}$ 'full' > Hitt. <i>šuw-uš</i> 'full'		* $/\text{su}\langle\text{né}\rangle\text{h}_3\text{-ti}/$ 'fills' > Palaic <i>šū⟨na⟩-t</i> 'filled'
b.	* $\sqrt{\text{pewh}_x}$ 'pure' > Lat. <i>pū-rus</i> 'pure', Mlr. <i>ú-r</i> 'fresh'		* $/\text{pu}\langle\text{né}\rangle\text{h}_x\text{-ti}/$ 'purifies' > Skt. <i>pu⟨nā⟩-ti</i> 'purifies'
c.	* $\sqrt{\text{prejh}_x}$ 'dear' > Skt. <i>priy-ás</i> , Av. <i>frii-ah</i> 'dear; own'		* $/\text{pri}\langle\text{né}\rangle\text{h}_x\text{-ti}/$ 'endears' > Skt. <i>pri⟨nā̃⟩-ti</i> 'pleases'

- Nasal infix exhibits similar function in derivation from adjectival roots, which is attested both in (24a) Anatolian and (24b–c) elsewhere in IE.
 - Adjectival roots lack simplex verbal stems (viz., unattested in IE).
 - (Present) stems formed from these roots by infixation have **causative** meaning.



The nasal infix as a ν head

(25) Summary: nasal infix as transitivizer:

a.	$*/p_l h_1-t\acute{o}/$ ‘became full’ > Gk. <i>plē-to</i> ‘became full’	$*/p_l \langle né \rangle h_1-ti/$ ‘fills’ (= (23c)) > Skt. <i>pr⟨ṇā⟩-ti</i> ‘fills’
b.	$*/\sqrt{p}ewh_x$ ‘pure’ > Lat. <i>pū-rus</i> ‘pure’, Mlr. <i>ú-r</i> ‘fresh’	$*/pu \langle né \rangle h_x-ti/$ ‘purifies’ (= (24b)) > Skt. <i>pu⟨nā⟩-ti</i> ‘purifies’

- Neither behavior in (25) is accounted for if nasal $\langle \text{infix} \rangle$ is just a Present formant.
- Meiser (1993) therefore argues that the transitivizing function of nasal infix is “original” and that its use as a Present stem formant was a later innovation.



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b.	$*/\sqrt{p}ewh_x$ ‘pure’ > Lat. <i>pū-rus</i> ‘pure’, Mlr. <i>ú-r</i> ‘fresh’	$*/pu \langle né \rangle h_x-ti/$ ‘purifies’ > Skt. <i>pu⟨nā⟩-ti</i> ‘purifies’	(= (24b))

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⇒ Nasal infix was “originally” an exponent of ν .



Cooccurrence with Aspect markers

(26) Cooccurrence of $*/\langle né \rangle/$ and $*/-sk^jé/$ in Hittite verbal stems:

- | | | | |
|----|---|---|---|
| a. | <i>har</i> $\langle ni \rangle$ <i>k-zi</i> ‘destroy-3SG’
[χár $\langle ni \eta \rangle$ k-ṫsi] | ⇒ | <i>har</i> $\langle nin \rangle$ <i>ki-ške-zzi</i> ‘destroy-IPFV-3SG’
[χár $\langle ni \eta \rangle$ ki-sk:e-ṫsi] |
| b. | <i>šar</i> $\langle ni \rangle$ <i>k-zi</i> ‘compensate-3SG’
[sár $\langle ni \eta \rangle$ k-ṫsi] | ⇒ | <i>šar</i> $\langle nin \rangle$ <i>ki-ške-zzi</i> ‘compensate-IPFV-3SG’
[sár $\langle ni \eta \rangle$ ki-sk:e-ṫsi] |
-

- If nasal infix expones ν , it should be able to cooccur with Aspectual suffixes.
- In Hittite the nasal $\langle infix \rangle$ cooccurs with $-ške$ (< PIE $*/-sk^jé/$) in the formation of “imperfective” stems, e.g., (26) (cf. Hoffner & Melchert 2008).



Cooccurrence with Aspect markers

(26) Cooccurrence of $*/\langle n\acute{e} \rangle/$ and $*/-sk^j\acute{e}/$ in Hittite verbal stems:

-
- | | | | |
|----|--|---------------|--|
| a. | <i>har</i> $\langle ni \rangle$ <i>k-zi</i> ‘destroy-3SG’ | $\Rightarrow$ | <i>har</i> $\langle nin \rangle$ <i>ki-ške-zzi</i> ‘destroy-IPFV-3SG’ |
| | [χár $\langle ni\eta \rangle$ k-ḫsi] | | [χár $\langle ni\eta \rangle$ ki-sk:e-ḫsi] |
| b. | <i>šar</i> $\langle ni \rangle$ <i>k-zi</i> ‘compensate-3SG’ | $\Rightarrow$ | <i>šar</i> $\langle nin \rangle$ <i>ki-ške-zzi</i> ‘compensate-IPFV-3SG’ |
| | [sár $\langle ni\eta \rangle$ k-ḫsi] | | [sár $\langle ni\eta \rangle$ ki-sk:e-ḫsi] |
-

- In Hittite *-ške* is not a Present stem formant, since no Present/Aorist aspectual stem contrast exists in Anatolian.
- *-ške* is rather a modifier of lexical (/“situation”) aspect in Hittite (pluractional marker per Inglese & Mattioli 2020; cf. Dressler 1968).



Cooccurrence with Aspect markers

(26) Cooccurrence of $*/\langle \text{né} \rangle/$ and $*/-\text{sk}^j\text{é}/$ in Hittite verbal stems:

-
- | | | | |
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- *-ške* is rather a modifier of lexical (/“situation”) aspect in Hittite (pluractional marker per Inglese & Mattioli 2020; cf. Dressler 1968).
 - $\Rightarrow$ *-ške* expones an inner Aspect head above $\langle \text{infix} \rangle$ in ν (cf. Yates & Gluckman 2020).
 - $\Rightarrow$ This may have been the “original” function of PIE $*/-\text{sk}^j\text{é}/$.

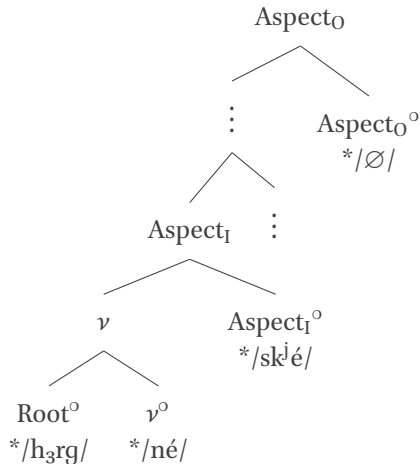


Diachrony of the PIE nasal infix

(27) Structure of PIE $*/h_3r\langle né \rangle g-sk^jé-ti/$ ‘perish:TR-IPFV-3SG’ (> Hitt. *ḫarninkiškezzi*):

• **Proposal:** Anatolian best reflects PIE verbal system.

- No stem-based (i.e., Present vs. Aorist) aspectual contrast.
- Nasal $\langle infix \rangle$ is a transitivizer, expones ν .
- $*/-sk^jé/$ (and other eventual Present stem markers) modify lexical aspect, expone an inner Aspect projection above ν within verbal domain.
- Morpheme ordering is correctly predicted by MAP: infixation of $*/\langle né \rangle/$, suffixation of $*/-sk^jé/$.

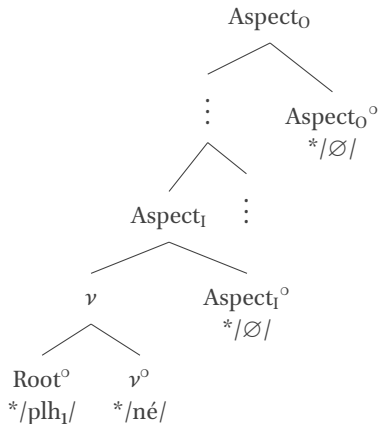




Diachrony of the PIE nasal infix

(28) Structure of PNIE $*/pl\langle né \rangle h_1-ti/$ ‘fill:PRS-3SG’ (> Skt. *prñāti*):

- **Proposal:** Present/Aorist aspectual contrast emerges after the departure of Anatolian from rest of IE (cf. Strunk 1994).
 - $*/-sk^j é/$ (and $*/'-e/$, $*/-j é/$) reanalyzed as Present stem formants, exponents of an outer Aspect projection associated with grammatical (“viewpoint”) aspect.
 - Nasal $\langle infix \rangle$ gets dragged into this system — reanalyzed as Present marker, but continues to merge in v^o as a morphological archaism (combining with $/\emptyset/$ in Asp_o^o).
 - MAP continues to predict (28) infixation of $*/né/$.

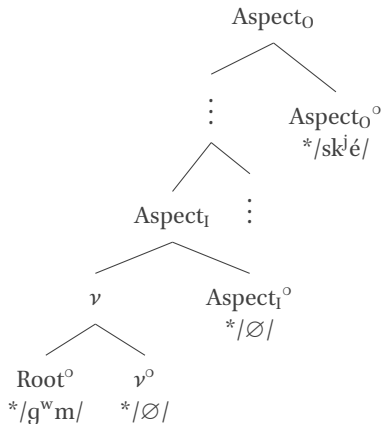




Diachrony of the PIE nasal infix

(29) Structure of PNIE $^*/g^w m-sk^j é-ti/$ ‘come-PRS-3SG’ (> Skt. *gá-ccha-ti*):

- **Proposal:** Present/Aorist aspectual contrast emerges after the departure of Anatolian from rest of IE (cf. Strunk 1994).
 - $^*/-sk^j é/$ (and $^*/'-e/$, $^*/-j é/$) reanalyzed as Present stem formants, exponents of an outer Aspect projection associated with grammatical (“viewpoint”) aspect.
 - Nasal ⟨infix⟩ gets dragged into this system — reanalyzed as Present marker, but continues to merge in v^o as a morphological archaism (combining with $/\emptyset/$ in Asp_o^o).
 - MAP continues to predict (28) infixation of $^*/né/$.
 - But (29) suffixation for other Present stem markers.





Roadmap

- ▶ Introduction
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Summary

- The MAP enables an integrated analysis of the phonology, morphology, and morphosyntax of the “Present”/“Aorist” aspectual opposition in PIE and its early daughter languages from both synchronic and diachronic perspectives.
 - The nasal infix */né/ was originally a transitivizing ν , 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.



Methodological implications

- 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/predictions about the morphosyntax.
 - These morphosyntactic hypotheses/predictions prompted philological scrutiny of attested forms, revealing confirmatory evidence.



Conclusion

Thank you!

- Special thanks to the members of the:
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 - UCLA PIES Graduate Seminar
 - Indo-European & Modern Linguistic Theory research group



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