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⟨né⟩g-ti/ ‘yokes’ (⇐ *√yewg ‘yoke’)

- The Proto-Indo-European (PIE) nasal infix */⟨ne⟩/ 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^{wfi}en ‘smash, kill’	*/g^{wfi}én-ti/ (simplex) > Skt. *hán-ti* ‘kill:PRS-3SG’	⇒	*/g^{wfi}ég^{wfi}ne-t/ (derived) > Gk. *é-pephne-∅* ‘PTC-kill:AOR-3SG’
b.	*√g^{w}em ‘come’	*/g^{w}m̥-sk^{j}é-ti/ (derived) > Skt. *gá-ccha-ti* ‘come-PRS-3SG’	⇐	*√g^{w}ém-t (simplex) > Skt. *á-gan-∅* ‘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.	*/-sk^{j}é/	*√prek^{j} ‘ask’	*/pr̥k^{j}-sk^{j}é-ti/ ‘ask-PRS-3SG’	> Lat. *po-sci-t*, Skt. *pr̥-cchá-ti*
b.	*/ˊ-e/	*√dejk^{j} ‘show’	*/déjk^{j}-e-ti/ ‘show-PRS.3SG’	> Lat. *dīc-i-t*, Goth. *ga-teih-i-þ*
c.	*/-jé/	*√mer ‘die’	*/mr̥-jé-tor/ ‘die-PRS-3SG’	> Skt. *mri-yá-te*, Lat. *mor-i-tur*
d.	*/RED-/	*√deh$_3$ ‘give’	*/dé-deh$_3$-ti/ ‘PRS-give-3SG’	> Gk. *dí-dō-si*, Skt. *dá-dā-ti*
e.	*/⟨né⟩/	*√jewg ‘yoke’	*/ju⟨né⟩g-ti/ ‘yoke:PRS-3SG’	> Lat. *iu⟨n⟩gi-t*, Skt. *yu⟨ná⟩k-ti*

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

Present stem formation in PIE

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e.	*/⟨né⟩/	*√jewg ‘yoke’	*/ju⟨né⟩g-ti/ ‘yoke:PRS-3SG’	> Lat. *iu⟨n⟩gi-t*, Skt. *yu⟨ná⟩k-ti*

- 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.	*√jewg ‘yoke’	⇒	*/ju⟨né⟩g-ti/	‘yoke:PRS-3SG’	> Skt. *yu⟨ná⟩k-ti*, Lat. *iu⟨n⟩g-it*
b.	*√lejk^{w} ‘leave’	⇒	*/li⟨né⟩k^{w}-ti/	‘leave:PRS-3SG’	> Skt. *ri⟨ná⟩k-ti*, Lat. *li⟨n⟩qu-it*
c.	*√k^{j}lew ‘hear’	⇒	*/k^{j}l̥⟨né⟩w-ti/	‘hear:PRS-3SG’	> Skt. *śr̥⟨ṇó⟩-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 ⟨infix⟩ surfaces immediately before the final consonant of the root.
  - Schematically, *√CReC, *√CeRC ⇒ *CR̥⟨né⟩C, where R is a sonorant consonant.

Infix stem formation in PIE

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			*/ju⟨n⟩g-énti/	‘yoke:PRS-3PL’	> Skt. *yu⟨ñ⟩j-ánti*, Lat. *iu⟨n⟩g-unt*
b.	*√lejk^{w} ‘leave’	⇒	*/li⟨né⟩k^{w}-ti/	‘leave:PRS-3SG’	> Skt. *ri⟨ná⟩k-ti*, Lat. *li⟨n⟩qu-it*
			*/li⟨n⟩k^{w}-énti/	‘leave:PRS-3PL’	> Skt. *ri⟨ñ⟩c-ánti*, Lat. *li⟨n⟩qu-unt*
c.	*√k^{j}lew ‘hear’	⇒	*/k^{j}l̥⟨né⟩w-ti/	‘hear:PRS-3SG’	> Skt. *śr̥⟨nó⟩-ti*
			*/k^{j}l̥⟨n⟩w-énti/	‘hear:PRS-3PL’	> Skt. *śr̥⟨n⟩v-ánti*

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

Infix stem formation in PIE

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			*/ju⟨n⟩g-énti/	‘yoke:PRS-3PL’	> Skt. *yu⟨ñ⟩j-ánti*, Lat. *iu⟨n⟩g-unt*
b.	*√lejk^{w} ‘leave’	⇒	*/li⟨né⟩k^{w}-ti/	‘leave:PRS-3SG’	> Skt. *ri⟨ná⟩k-ti*, Lat. *li⟨n⟩qu-it*
			*/li⟨n⟩k^{w}-énti/	‘leave:PRS-3PL’	> Skt. *ri⟨ñ⟩c-ánti*, Lat. *li⟨n⟩qu-unt*
c.	*√k^{j}lew ‘hear’	⇒	*/k^{j}l̥⟨né⟩w-ti/	‘hear:PRS-3SG’	> Skt. *śr̥⟨nó⟩-ti*
			*/k^{j}l̥⟨n⟩w-énti/	‘hear:PRS-3PL’	> Skt. *śr̥⟨n⟩v-ánti*

- Nasal infix alternates intraparadigmatically.
  - *[-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

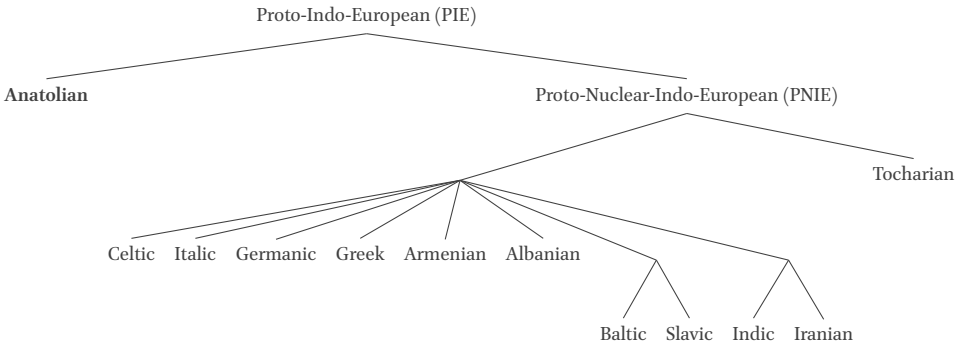
(5) **Nasal infix in present stem formation:**

	Aorist root	Nasal-infix Present	IE Present
a.	*√jewg 'yoke'	*/ju⟨né⟩g-ti/ 'yoke:PRS-3SG'	> Skt. *yu⟨ná⟩k-ti*, Lat. *iu⟨n⟩g-it*
b.	*√lejk^{w} 'leave'	*/li⟨né⟩k^{w}-ti/ 'leave:PRS-3SG'	> Skt. *ri⟨ná⟩k-ti*, Lat. *li⟨n⟩qu-it*; Gk. *lí⟨m⟩panei*
c.	*√demh$_2$ 'tame'	*/dm̥⟨né⟩h$_2$-ti/ 'tame:PRS-3SG'	> Gk. *dám⟨nē⟩-si*, OIr. *-dam⟨na⟩i-d*
d.	*√pleh$_1$ 'fill'	*/pl̥⟨né⟩h$_1$-ti/ 'fill:PRS-3SG'	> Skt. *pr̥⟨ná⟩-ti*; Arm. *l⟨n⟩ow-ē*

- 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

(6)



- 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.	*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’

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

Nasal infix in Anatolian

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b.	*ištark-zi* [istárk-t͡si]	‘get.sick-3SG’		*ištar⟨ni⟩k-zi* [istár⟨ni⟩k-t͡si]	‘make.sick-3SG’

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

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- Infixation in Indo-European
- PIE infixation and the Mirror Alignment Principle
  - 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 (≈ *morphological derivations*) very strongly tends to align with hierarchical morphosyntactic structure/constituency (≈ *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.

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- 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**

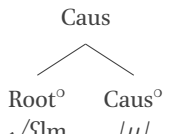
√ʕlm 'know'	⇒	a.	Form II:	*ʕallam-*	'teach'
		b.	Form IV:	*ʔaʕlam-*	'inform' (≈ 'make know')

- 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

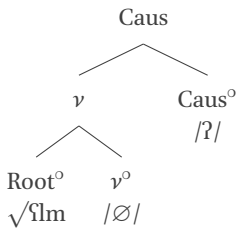
Zukoff's (2023) MAP analysis of infixation in Arabic

- Difference in meaning suggests a difference in structure (cf. Marantz 1997, Arad 2003):
  - Form II causative (10): Caus° merges as a sibling to the root.
    - Structural adjacency permits greater idiomaticity.
  - Form IV causative (11): Caus° merges in a higher, asymmetrically c-commanding position.
    - A null *v* head between Caus° and Root° 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'



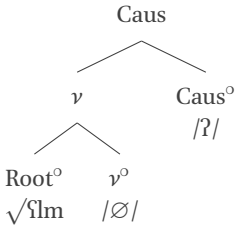
(11) **Form IV:** *ʔaʕlam-* 'inform'



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$^{\circ}$:

(12) **Form IV** "high causative" (11) ⇒ ***prefixation*** [ʔaʕlam-]

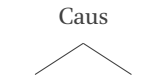


- When Caus$^{\circ}$ asymmetrically c-commands Root$^{\circ}$:
  - The MAP generates the ranking ALIGN-CAUS-L ≫ ALIGN-ROOT-L.
  - This yields ***prefixation***: [ʔaʕlam-]

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°:

(13) **Form II** "low causative" (10) ⇒ ***infixation*** [ʕall**a**m-]



- When Caus° **does not** asymmetrically c-command Root°:
  - 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 ≫ ALIGN-CAUS-L.
  - This yields **infixation**: [ʕall**a**m-]

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

MAP analysis of PIE infixation

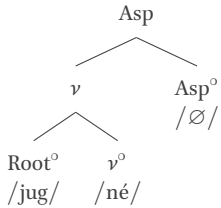
- Using this analysis as a model, we can surmise that morphological systems can be organized as follows:
  - An infix is the first morphosyntactic head to combine with the Root
  - A prefix/suffix is separated from the Root by at least one intervening morphosyntactic head

- 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 *v*)

MAP analysis of PIE infixation

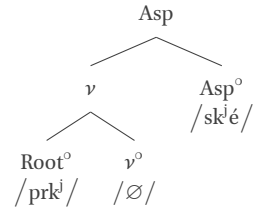
- Translating this directly leads us to the morphosyntactic structures in (15a) and (16a).
  - We will motivate the labels on the morphosyntactic terminals in the following section.
- The MAP — coupled with a default preference for Root-alignment — correspondingly yields the rankings in (15b) and (16b).

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



b. "Default" ranking for *né*:
ALIGN-ROOT-R ≫ ALIGN-*né*-R

(16) a. Aspectual suffix structure
*/pr̥kʲ-skʲé-ti/ 'ask-PRS-3SG'



b. MAP ranking for *skʲé*:
ALIGN-*skʲé*-R ≫ ALIGN-ROOT-R

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*.

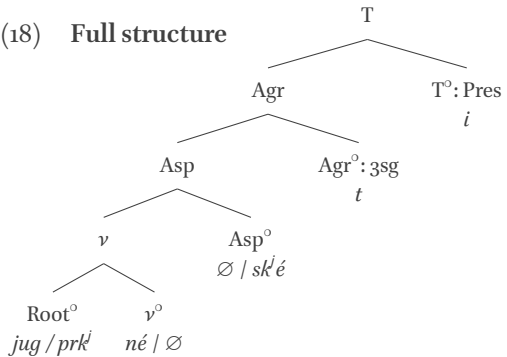
b. **Align-*skʲé*-R:** Assign one violation * for each segment that intervenes between the right edge of the word and the right edge of *skʲé*.

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.

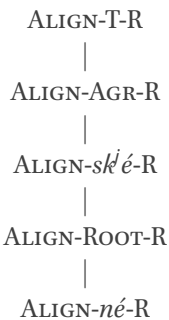
MAP analysis of PIE infixation

- 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).

(18) **Full structure**



(19) **Alignment ranking for full structure**



MAP analysis of PIE infixation

- The ranking from (19) generates infixation of *né* if ALIGN-*né*-R ≫ 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-*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 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-*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 ranking ALIGN-ROOT-R ≫ ALIGN-*né*-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) ≻ (21f) (the prefixation candidate): ALIGN-*né*-R ≫ 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-*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

- Because *–sḱʲé* (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) ≻ (22d).

(22) Derivation of Suffixation of *sḱʲé* (and other Aspectual affixes): *[pr̥kʲ-skʲé-t-i]

/prkʲ, skʲé, t, i/		ALIGN-T-R	ALIGN-AGR-R	ALIGN-*sḱʲé*-R	ALIGN-ROOT-R	CNTG-ROOT
a.	pr̥kʲ-t-i-skʲé	*!**	****		*****	
b.	pr̥kʲ-t-skʲé-j		**!*	*	*****	
c. ☞	pr̥kʲ-skʲé-t-i		*	**	*****	
d.	pr̥⟨skʲé⟩kʲ-t-i		*	***!	**	*
e.	p⟨skʲé⟩rkʲ-t-i		*	***!*	**	*
f.	skʲé-pr̥kʲ-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 *v* head
  - Cooccurence 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 *v* head

(23) **Transitivity alternations in PIE verbal stems:**

	Simplex stem/intransitive	⇒	Infix stem/causative
a.	*/h$_3$érg-t/ ‘perished’ > Hitt. *ḫark-ta* ‘perished’		*/h$_3$r̥⟨né⟩g-ti/ ‘makes perish’ > Hitt. *ḫar⟨ni⟩k-zi* ‘destroys’ (cf. Arm. *harkan-ē* ‘hits, kills’)
b.	*/(s)térg^{jh}-t/ ‘got sick’ > Hitt. *ištark-ta* ‘got sick’		*/(s)tr̥⟨né⟩g^{jh}-ti/ ‘makes sick’ > Hitt. *ištar⟨ni⟩k-zi* ‘makes sick’ (cf. Skt. *tr̥⟨ṇé⟩ḍhu* ‘let him smash’)
c.	*/pl̥h$_1$-tó/ ‘became full’ > Gk. *plê̂-to* ‘became full’		*/pl̥⟨né⟩h$_1$-ti/ ‘fills’ > Skt. *pr̥⟨ṇá⟩-ti* ‘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 *v* head

(24) **Nasal infix in deadjectival derivation:**

	Adjectival root	⇒	Nasal-infix/causative
a.	*√sewh$_3$ ‘full’ > Hitt. *šuw-uš* ‘full’		*/su⟨né⟩h$_3$-ti/ ‘fills’ > Palaic *šū⟨na⟩-t* ‘filled’
b.	*√pewh$_x$ ‘pure’ > Lat. *pū-rus* ‘pure’, MIr. *ú-r* ‘fresh’		*/pu⟨né⟩h$_x$-ti/ ‘purifies’ > Skt. *pu⟨nā́⟩-ti* ‘purifies’
c.	*√prejh$_x$ ‘dear’ > Skt. *priy-ás*, Av. *frii-ah* ‘dear; own’		*/pri⟨né⟩h$_x$-ti/ ‘endears’ > Skt. *pri⟨ṇā́⟩-ti* ‘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 *v* head

(25) **Summary: nasal infix as transitivizer:**

a.	*/pl̥h$_1$-tó/ ‘became full’ > Gk. *plê̂-to* ‘became full’		*/pl̥⟨né⟩h$_1$-ti/ ‘fills’ > Skt. *pr̥⟨n̥á⟩-ti* ‘fills’	(= (23c))
b.	*√pewh$_x$ ‘pure’ > Lat. *pū-rus* ‘pure’, MIr. *ú-r* ‘fresh’		*/pu⟨né⟩h$_x$-ti/ ‘purifies’ > Skt. *pu⟨n̥á⟩-ti* ‘purifies’	(= (24b))

- Neither behavior in (25) is accounted for if nasal ⟨infix⟩ 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.

The nasal infix as a *v* head

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- 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.

  ⇒ **Nasal infix was “originally” an exponent of *v*.**

Cooccurence with Aspect markers

(26) Cooccurence of */⟨né⟩/ and */-skʲé/ in Hittite verbal stems:

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]

- If nasal infix expones *ν*, it should be able to cooccur with Aspectual suffixes.
- In Hittite the nasal ⟨infix⟩ cooccurs with *–ške* (< PIE */-skʲé/) in the formation of “imperfective” stems, e.g., (26) (cf. Hoffner & Melchert 2008).

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- 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 & Mattiola 2020; cf. Dressler 1968).

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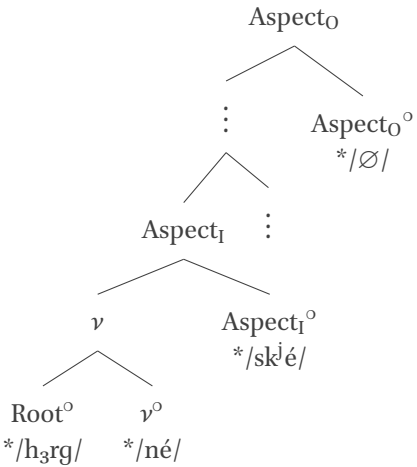
- *–ške* is rather a modifier of lexical (/“situation”) aspect in Hittite (pluractional marker per Inglese & Mattiola 2020; cf. Dressler 1968).
  - ⇒ ***–ške* expones an inner Aspect head above ⟨infix⟩ in *v*** (cf. Yates & Gluckman 2020).
  - ⇒ **This may have been the “original” function of PIE */-skʲe-/.**

Diachrony of the PIE nasal infix

(27) Structure of PIE */h_3r⟨né⟩g-sk^{j}é-ti/ 'perish:TR-IPFV-3SG' (> Hitt. *ḫarninkiškezzi*):

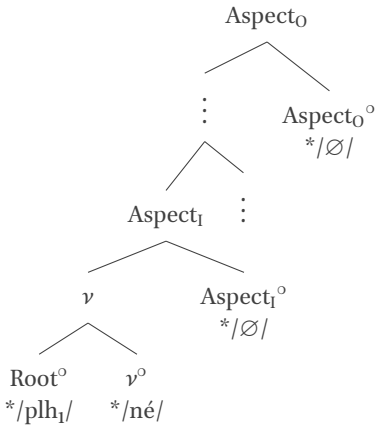
- **Proposal:** Anatolian best reflects PIE verbal system.
  - No stem-based (i.e., Present vs. Aorist) aspectual contrast.
  - Nasal ⟨infix⟩ is a transitivizer, expones *v*.
  - */-sk^{j}é/ (and other eventual Present stem markers) modify lexical aspect, expone an inner Aspect projection above *v* within verbal domain.
  - Morpheme ordering is correctly predicted by MAP: infixation of */⟨né⟩/, suffixation of */-sk^{j}é/.



Diachrony of the PIE nasal infix

(28) Structure of PNIE */pl̥⟨né⟩h$_1$-ti/ 'fill:PRS-3SG' (> Skt. *pṛṇáti*):

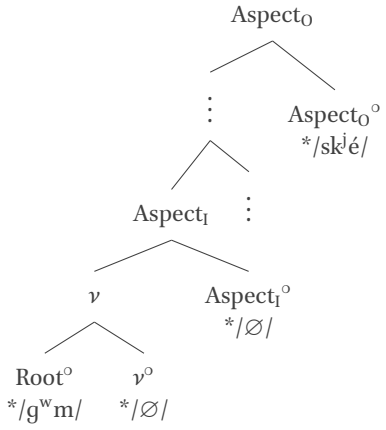
- **Proposal:** Present/Aorist aspectual contrast emerges after the departure of Anatolian from rest of IE (cf. Strunk 1994).
  - */-skʲé/ (and */ˊ-e/, */-jé/) reanalyzed as Present stem formants, exponents of an outer Aspect projection associated with grammmatical (/"viewpoint") aspect.
  - Nasal ⟨infix⟩ gets dragged into this system — reanalyzed as Present marker, but continues to merge in v° as a morphological archaism (combining with /∅/ in $\text{Asp}_{\text{O}}{}^{\circ}$).
  - MAP continues to predict (28) infixation of */né/.



Diachrony of the PIE nasal infix

(29) Structure of PNIE */gʷm̥-skʲé-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).
  - */-skʲé/ (and */′-e/, */-jé/) reanalyzed as Present stem formants, exponents of an outer Aspect projection associated with grammmatical (/“viewpoint”) aspect.
  - Nasal ⟨infix⟩ gets dragged into this system — reanalyzed as Present marker, but continues to merge in v° as a morphological archaism (combining with /∅/ in $\text{Asp}_{\text{O}}{}^{\circ}$).
  - MAP continues to predict (28) infixation of */né/.
  - But (29) suffixation for other Present stem markers.



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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 *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.

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:
  - UCLA Phonology Seminar
  - UCLA PIES Graduate Seminar
  - Indo-European & Modern Linguistic Theory research group

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