Arabic Nonconcatenative Morphology and the Syntax-Phonology Interface

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1. Introduction

This poster develops a new integrated analysis of the phonological and syntactic properties of nonconcatenative morphology in (Classical/Modern Standard) Arabic. The account centers around an algorithm for sub-word linearization at the syntax-phonology interface, here termed the **"Mirror Alignment Principle" (MAP)**. The MAP determines the ranking of Alignment constraints (McCarthy & Prince 1993) in the phonological component based on asymmetric c-command relations in the syntax. Using the MAP, we can **predict** the exact position of all morphemes/segments in an Arabic verbal form based on their syntactic functions and structures without any recourse to templates (cf. McCarthy 1981).

2. Puzzle

The Arabic verbal system is divided into **"Forms"**: morphosyntactic categories associated with a *phonological shape* (CV "template") and a range of *morphosemantics* (frequently idiomatized).

Reflexive /t/ recurs across multiple Forms, sometimes as an **"infix"**, sometimes as a **"prefix"**.

(1) Forms with Reflexive (to √*ktb* 'write')

Infixal	VIII	Reflexive	(ʔ*i*)k**t**ataba
Prefixal	V	Refl + Causative	**t**akattaba
	VI	Refl + Applicative	**t**akaataba
	X	Causative + Refl	(ʔ*i*)s**t**aktaba

This distribution is not solely phonotactic:
- Form VIII could be prefixal: *taktaba, *takataba
- Form V could be infixal: *kattattaba, *(ʔ*i*)kttattaba

3. Generalization

Previous phonological accounts (McCarthy 1981, Ussishkin 2003, Tucker 2010) had to stipulate the special behavior of Form VIII. However, there is a **syntactic generalization** about this (morpho-) phonological distribution these analyses missed:

1. When Refl co-occurs with (and scopes over) another verbal derivational morpheme, e.g. Caus or Appl (cf. 10–11), it is **prefixal**.
2. When it is the only verbal derivational morpheme, it is **infixal**.

If we can directly relate syntactic structure to phonological behavior, then we can use this generalization to account for the apparent idiosyncrasy of the Reflexive.

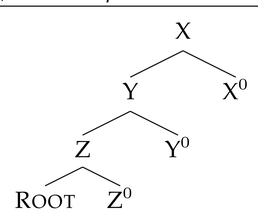
4. Proposal

(2) **The Mirror Alignment Principle (MAP):**

If a terminal node α asymmetrically c-commands a terminal node β, then Align-α dominates Align-β.

(3) Align-α-L/R: *Assign a violation if material intervenes between the L/R edge of (the phonological exponent of) α and the L/R edge of the word* [evaluated gradiently]. (cf. McCarthy & Prince 1993)

(4) *Complex Head* / *C-Command Relations & MAP-determined Ranking*



- X^0 asymmetrically c-commands Y^0, Z^0, and Root
  ⇒ Align-X ≫ Align-Y, Align-Z, Align-Root
- Y^0 asymmetrically c-commands Z^0 and Root
  ⇒ Align-Y ≫ Align-Z, Align-Root
- Z^0 and Root *symmetrically* c-command each other
  ⇒ No MAP-determined ranking between Align-Z and Align-Root

Total ranking: Align-X ≫ Align-Y ≫ Align-Z, Align-Root

(5) /X,Y,Z,Root/	Aln-X-L	Aln-Y-L	Aln-Z-L	Aln-Rt-L
☞ a. X-Y-Z-Root		*	**	***
☞ b. X-Y-Root-Z		*	***	**
c. X-Z-Y-Root		**!	*	***
d. Y-X-Z-Root	*!		**	***

Language-specific factors (e.g. default rankings) will apply to resolve under-determined rankings like Align-Z *and* Align-Root *where necessary.*
⇒ *Arabic employs a specific strategy (see 8) that is applicable across the system.*

Linearization is enacted in an OT (Prince & Smolensky 1993) phonological component *by Alignment*:
- Morphology provides an unordered set of morphemes for the phonological input.
- The MAP provides a ranking of Alignment constraints in Con based on the syntactic structure.
- Eval selects the output candidate which is most harmonic with respect to Con, i.e. the ordered ranking of Alignment constraints, Faithfulness constraints, and Markedness constraints

The MAP allows us to predict the position of all segments in an Arabic verbal form, including infixes and peripheral affixes, based on their syntactic functions and structures, in conjunction with phonotactics and other phonological considerations. Conversely, in the face of ambiguous syntactic evidence, the phonological analysis can shed light on the syntax.

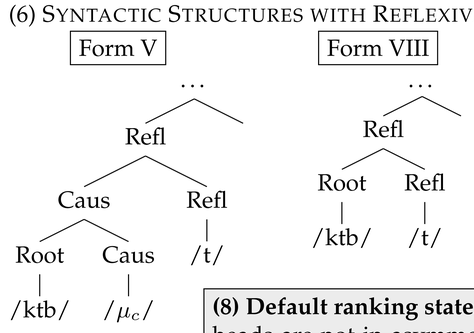
This framework, illustrated here for Reflexive and Causative, allows for an integrated syntactic and phonological analysis of the entirety of the Arabic verbal system. *The remainder of the system is sketched in (10–11). For details of the phonological analysis, see Zukoff (2016)* [http://web.mit.edu/szukoff/www/pdfs/MAP_Arabic.pdf].

5. Analysis of Reflexive

An Alignment analysis of the Reflexive requires an apparent ranking paradox (cf. Tucker 2010):
- Prefixal Forms (V,VI,X): Align-Reflexive-L ≫ Align-Root-L
- Infixal Form (VIII): Align-Root-L ≫ Align-Reflexive-L

The MAP provides a solution for the apparent paradox: the two types have different syntactic structures, so the MAP generates *distinct Alignment rankings*. (Alignment rankings can differ across phonological derivations.)

(6) Syntactic Structures with Reflexive



(7) Alignment in Forms V & VIII

V: /t, μ_c, ktb, a, a/	Align-Refl-L	Align-Root-L
☞ a. takat$_c$taba		*
b. (ʔ*i*)ktat$_c$taba	*!	

VIII: /t, ktb, a, a/	Align-Root-L	Align-Refl-L
a. taktaba	*!	
☞ b. (ʔ*i*)ktataba		*

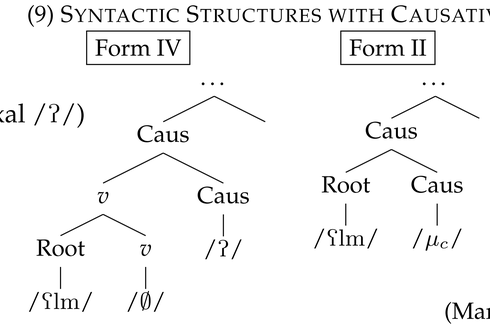
(8) Default ranking statement: When the MAP provides no ranking statement (i.e. when two heads are not in asymmetric c-command), Align-Root-L is top-ranked by default. This is responsible for the ranking Align-Root-L ≫ Align-Reflexive-L in Form V. This is applicable across the system, and accounts for a number of other patterns (incl. Form II below).

6. Analysis of Causative

Two types of causatives (cf. Wright 1896): √ʕlm 'know'
- Form II ʕal$_c$lama 'teach' (infixal /μ_c/)
  ⇒ *range of transitivizing semantics, incl. causative*
- Form IV ʔaʕlama 'inform' (≈ 'make know') (prefixal /ʔ/)
  ⇒ *consistent causative semantics*

The syntax in (9) captures both the semantic properties and the ordering properties:
- Form II = root-selecting causative
- Form IV = *v*P-selecting causative

(9) Syntactic Structures with Causative



(Marantz 1997)

Semantics: A root-selecting head should allow more idiomatic semantics than a non-root-selecting head.
- The root-selecting Caus head in Form II yields a wide range of semantics, as expected.
- The *v*P-selecting Caus in Form IV yields consistently causative semantics, as expected.

Ordering: The syntactic distinction creates an ordering distinction via the MAP.
- Form IV: Caus asymm. c-commands Root ⇒ Align-Caus-L ≫ Align-Root-L (prefixal ranking).
- Form II: Caus and Root are in symmetric c-command, so the MAP provides no ranking; the default ranking statement in (8) applies ⇒ Align-Root-L ≫ Align-Caus-L (infixal ranking).

7. The MAP & The Mirror Principle

Adopting the MAP approach brings nonconcatenative morphological processes under the umbrella of phenomena which can illustrate the Mirror Principle: "morphological derivations must directly reflect syntactic derivations (and vice versa)" (Baker 1985). By using *Alignment rankings* determined via phonological analysis, rather than just linear order, to infer the underlying word-internal structure, we can apply Mirror Principle reasoning to infer syntactic structure from surface morpheme order for any sort of morphological system, concatenative or otherwise.

8. Summary of Verbal System

(10)

Form	Perf. Act.	Syntactic structure
I	kataba	[*v* [Root]]
II	kat$_c$taba	[Caus [Root]]
III	ka**a**$_v$taba	[Appl [Root]]
IV	ʔaktaba	[Caus [*v* [Root]]]
V	takat$_c$taba	[Refl [Caus [Root]]]
VI	taka**a**$_v$taba	[Refl [Appl [Root]]]
VII	(ʔ*i*)**n**kataba	[Mid [*v* [Root]]]
VIII	(ʔ*i*)k**t**ataba	[Refl [Root]]
X	(ʔ*i*)s**t**aktaba	[Caus [Refl [*v* [Root]]]]

(11)

VDM Heads	Morphs		Forms
Applicative	/μ_v/		III, VI
Reflexive	/t/		V, VI, VIII, X
Middle	/n/		VII
v	/∅/		I, IV, VII, X
Causative	i. /μ_c/	(__[Root])	II, V
	ii. /ʔ/∼/s/	(elsewhere)	IV, X