Arabic Nonconcatenative Morphology and the Syntax-Phonology Interface[*]

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1 Introduction

- This paper 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 recourse to templates (cf. McCarthy 1981).[1]

2 Puzzle

- The Arabic verbal system is divided into **"Forms"**: morphosyntactic categories associated with

  · a particular *phonological shape* (CV "template")
  · a range of *morphosemantics* (frequently idiomatized)

- Reflexive /t/ recurs across multiple Forms, sometimes as an **"infix"** (1a), sometimes as a **"prefix"** (1b).

(1)   FORMS WITH REFLEXIVE (to √*ktb* 'write')

a. **Infixal**	VIII	Reflexive	(*ʔi*)*kt̲ataba*
	V	Refl + Causative	*t̲akattaba*
b. **Prefixal**	VI	Refl + Applicative	*t̲akaataba*
	X	Causative + Refl	(*ʔi*)*st̲aktaba*

- This distribution is not solely phonotactic:

  · Form VIII could have been prefixal: **t̲aktaba*, **t̲akataba*
  · Form V (for example) could have been infixal: **kat̲attaba*, **(ʔi)kt̲attaba*

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[1]See Kastner (2016) for recent work in a similar vein on nonconcatenative morphology in Modern Hebrew.

3   Generalization

- Previous phonological accounts had to stipulate the special behavior of Form VIII.

    · McCarthy (1981): "Eighth Binyan [= Form] flop", morpheme-specific re-association rule
    · Ussishkin (2003): /t/ is not the same morpheme across forms, different Alignment ranking with respect to ALIGN-ROOT for different morphemes
    · Tucker (2010): Reflexive /t/ in Form VIII indexed to different Alignment constraint, ranked differently with respect to ALIGN-ROOT

- However, there is a **syntactic generalization** about this (morpho)phonological distribution that these analyses missed:

(2)   Syntactic generalization about Reflexive[2]

    a.   When Reflexive co-occurs with (and scopes over) another verbal derivational morpheme, e.g. Causative or Applicative (cf. (12)–(13)), it is **prefixal**.
    b.   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.

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4   Proposal: The Mirror Alignment Principle

- I'll implement this generalization by making a new proposal for how *sub-word linearization* operates.
- The crux of the proposal is an interface statement that translates hierarchical syntactic relations into phonologically-interpretable information (i.e. rankings of ALIGNMENT constraints):

(3)   **THE MIRROR ALIGNMENT PRINCIPLE (MAP):**
        If terminal node α asymmetrically c-commands terminal node β (in the output of the syntactic/ morphological component), then ALIGN-α dominates ALIGN-β (in the phonological component).

- I assume classic Alignment constraints (McCarthy & Prince 1993), defined schematically in (4):

(4)   ALIGN-α-LEFT/RIGHT:
        Assign a violation if material intervenes between the Left/Right edge of (the phonological exponent of) α and the Left/Right edge of the word.

    ∘   Alignment constraints must be evaluated gradiently.
    ∘   I assume only *same-edge* Alignment.

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[2]It is unclear if we should really be referring to this morpheme as "Reflexive", as it doesn't lead to consistent argument structure alternations typical of reflexives. All that is important is that the /t/ morpheme that shows up in multiple Forms is the exponent of the same morphosyntactic terminal (whatever that happens to be) and is in the hierarchical relations with Root that I claim it to be.

- In this proposal, linearization is enacted in an Optimality Theoretic (Prince & Smolensky 1993/2004) 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.
  · GEN produces a candidate set consisting of all possible morpheme orders.
  · 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 operation of this system is illustrated in (5)–(6):

(5)   Schematic Example

Complex Head	*C-Command Relations & MAP-determined Ranking*

X
 	
Y X^0
 	
Z Y^0
 	
ROOT Z^0
	• 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

(6)   Tableau for schematic derivation

/X,Y,Z,ROOT/	ALIGN-X-L	ALIGN-Y-L	ALIGN-Z-L	ALIGN-ROOT-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 (9)) that is applicable across the system.

> **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 phono-tactics and other phonological considerations.** Conversely, in the face of ambiguous syntactic evidence, the phonological analysis can shed light on the syntax.

- In the remaining sections, I will illustrate how this framework derives the infix vs. prefix distinction for different types of Reflexives and Causatives.
- In general, this approach allows for an integrated syntactic and phonological analysis of the entirety of the Arabic verbal system.

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

(7)   ALIGNMENT IN FORMS V & VIII

   i. *Derivation of Form V*:

/t, μ_c, ktb, a, a/	ALIGN-REFL-L	ALIGN-ROOT-L
☞ a. <u>t</u>akat$_c$taba		**
b. *(ʔi)*k<u>t</u>at$_c$taba	*!	

   ii. *Derivation of Form VIII*:

/t, ktb, a, a/	ALIGN-ROOT-L	ALIGN-REFL-L
a. <u>t</u>aktaba	*!	
☞ b. *(ʔi)*k<u>t</u>ataba		*

- The MAP provides a solution for the apparent paradox:
  - · **The two types have different syntactic structures** (shown in (8)),
  - · **Therefore, the MAP generates *distinct Alignment rankings*** (as required in (7)).

⇒ Alignment rankings can differ across phonological derivations.

(8)   SYNTACTIC STRUCTURES WITH REFLEXIVE
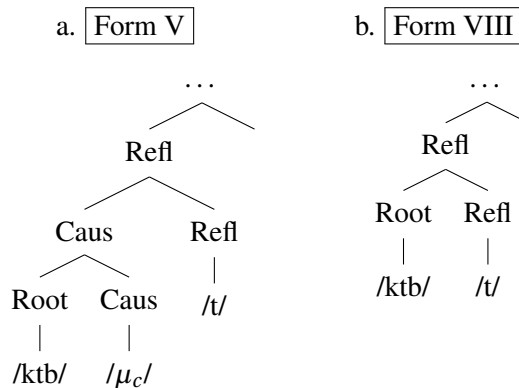
- In Form V, Refl *asymmetrically c-commands* Root.

⇒ Therefore, the MAP generates the ranking ALIGN-REFL-L ≫ ALIGN-ROOT-L, which is required to derive the prefixal behavior of /t/.

- In Form VIII, on the other hand, Refl and Root stand in *symmetric c-command*.

⇒ Since the MAP only asserts rankings based on asymmetric c-command, the ranking between ALIGN-REFL-L and ALIGN-ROOT-L is underdetermined.

∘ **Stipulation**: Across the board in Arabic, this indeterminacy is resolved by the principle in (9):

(9)   **Default ranking statement for Arabic:**
        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 resolves the ranking for Form VIII as ALIGN-ROOT-L ≫ ALIGN-REFL-L, which is required to
derive the infixal behavior of /t/.

• The application of this default ranking in cases of indeterminacy accounts for infixal behavior across the
system, including in Form II below.

6   Analysis of Causative

• Arabic has two types of basic causatives (cf. Wright 1896, *a.o.*): Form II & Form IV

(10)   Causatives of root √ʕlm 'know'
        a.   Form II ʕal$_c$lama 'teach' (infixal /μ_c/)
             ⇒ *Form II has a fairly wide range of transitivizing semantics, including causative*
        b.   Form IV ʔaʕlama 'inform' (≈ 'make know') (prefixal /ʔ/)
             ⇒ *Form IV has fairly consistent causative semantics*

• The syntax in (11) captures both the semantic properties and the ordering properties:
   · Form II = root-selecting causative
   · Form IV = *v*P-selecting causative (*v* has a null exponent)

(11)   SYNTACTIC STRUCTURES WITH CAUSATIVE
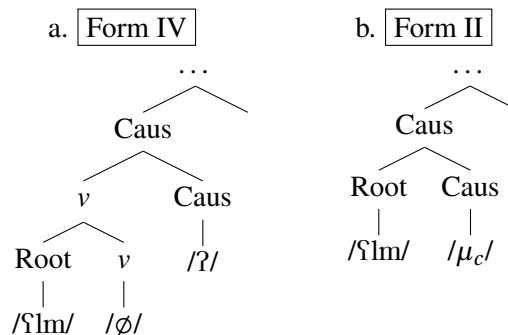
• ***Semantics***: A root-selecting head should allow more idiomatic semantics than a non-root-selecting head
(cf. Marantz 1997).
   · The root-selecting CAUS head in Form II yields a wide range of semantics, as expected.
   · The *v*P-selecting CAUS in Form IV yields consistently causative semantics, as expected.

• ***Ordering***: The syntactic distinction creates an ordering distinction via the MAP.
   · Form IV: CAUS asymmetrically c-commands ROOT.
        ⇒ The MAP generates the prefixal ranking ALIGN-CAUS-L ≫ ALIGN-ROOT-L.
   · Form II: CAUS and ROOT are in symmetric c-command, so the MAP provides no ranking.
        ⇒ The default ranking statement in (9) applies, generating the infixal ranking ALIGN-ROOT-L ≫
        ALIGN-CAUS-L.

7 Summary of Verbal System

- The analysis of the remaining verbal Forms is outlined in (12) and (13).
- The syntactic analyses posited here, coupled with a few additional morphophonological constraints/assumptions (e.g. Reflexive /t/ and Causative /ʔ/ must surface in prevocalic position), derive the full range of phonological structures in the core of the verbal system.

(12) Morphosyntactic structure of verbal Forms

Form	Perf. Act.	Syntactic structure	Alignment Ranking
I	*kataba*	[*v* [Root]]	(ALIGN-RT-L ≫ ALIGN-*v*-L)
II	*kat͟c͟taba*	[Caus [Root]]	ALIGN-RT-L ≫ ALIGN-CAUS-L
III	*kaa͟a͟v͟taba*	[Appl [Root]]	ALIGN-RT-L ≫ ALIGN-APPL-L
IV	*ʔaktaba*	[Caus [*v* [Root]]]	ALIGN-CAUS-L ≫ ALIGN-RT-L
V	*t͟akat͟c͟taba*	[Refl [Caus [Root]]]	ALIGN-REFL-L ≫ ALIGN-RT-L ≫ ALIGN-CAUS-L
VI	*t͟akaa͟a͟v͟taba*	[Refl [Appl [Root]]]	ALIGN-REFL-L ≫ ALIGN-RT-L ≫ ALIGN-APPL-L
VII	*(ʔi)n͟kataba*	[Mid [*v* [Root]]]	ALIGN-MID-L ≫ ALIGN-RT-L
VIII	*(ʔi)kt͟ataba*	[Refl [Root]]	ALIGN-RT-L ≫ ALIGN-REFL-L
X	*(ʔi)s͟t͟aktaba*	[Caus [Refl [*v* [Root]]]]	ALIGN-CAUS-L ≫ ALIGN-REFL-L ≫ ALIGN-RT-L

(13) Morphemes involved in verbal Forms

Syntactic Heads	Morphs		Forms
Applicative	$/\mu_v/$		III, VI
Reflexive	/t/		V, VI, VIII, X
Middle	/n/		VII
v	/∅/		I, IV, VII, X
Causative	i. $/\mu_c/$	(__[ROOT])	II, V
	ii. /ʔ/~/s/	(elsewhere)	IV, X

8 Conclusion

- The MAP approach offers new insights about the relationship between the verbal (morpho)syntax of Arabic and its (morpho)phonological system, and provides a more complete and consistent account of its phonological complexities and typological unusualness.

- Adopting the MAP approach brings nonconcatenative morphological processes under the umbrella of phenomena which can illustrate the Mirror Principle:

(14)   THE MIRROR PRINCIPLE (Baker 1985)
   "Morphological derivations must directly reflect syntactic derivations (and vice versa)."

- 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.

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