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**Augmentation and Reduction Domains in Arabic:
The Role of Identity**

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This paper addresses the domain of augmentation (consonant gemination and vowel lengthening) and reduction (syncope) processes in Arabic. A close examination of the distribution of these two processes reveals an interesting asymmetry: while syncope applies indiscriminately to any morphological constituent, gemination and vowel lengthening are restricted to affixal material. This paper offers an explanatory analysis within Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993) which reduces this observation to correspondence constraints enforcing faithfulness of output to input on the one hand, and prosodic similarity among morphologically-related words within the same paradigm on the other (McCarthy and Prince 1995).

Augmentation and reduction cases to be discussed are drawn from a number of Arabic dialects. After a brief overview of Correspondence Theory in Section (1), Section (2) examines the application and domain of augmentation; Section (2.1) discusses augmentation which involves length alternation affecting vowels and consonants of penultimate syllables with the effect of maximizing penultimate stress. These cases include dative /l/ gemination in Saudi and Levantine, interfix gemination in Omani, and vowel lengthening in Libyan. Augmentation is viewed as a consequence of output-to-output correspondence relation governed by an Output-Output Identity Constraint (IDENT OO). Section (2.2) explains the failure of stem-internal augmentation. I propose that this case of underapplication which results in the absence of paradigm leveling within the base and the nominative suffix is attributed to the Faithfulness constraint Ident IO which requires preservation of the prosodic identity of the morphological base. Affixes, on the other hand, are structurally underspecified in the IR inputS, hence maximizing the penultimate stress pattern does not jeopardize satisfaction of Ident. Section (3) deals with the second set of cases involving reduction which appearS on the surface to violate faithfulness. I argue in Section (3.2) that: (i), outputs with syncopated /i/ do not violate Ident IO because syncope involves failure to parse RV to a mora, prosodic structure remaining intact, and (ii), failure of IDENT OO (output-to-output correspondence) which (leads to paradigmatic inconsistency) is inevitable under the influence of two higher-ranked prosodic constraints prohibiting syllable-final HIGH vowels with parsed place (McCarthy 1993), and requiring all coda consonants to be independently moraic. Finally, I show in Section (4) that OT fares better than alternative rule based theories in the analysis of augmentation and reduction. Stipulations needed in serial treatments to avoid overgeneration fall out automatically from appropriate constraint interaction.

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1. IDENT Within Correspondence Theory

In McCarthy and Prince (1995) which lays out the basics of Correspondence Theory, correspondence is defined as a relation between two sets of strings, given in (1a). This relation is governed by three constraint families given in (1b) (McCarthy and Prince 1995:17).

(1)

a. Correspondence

Given two strings S_1 and S_2 Correspondence is a relation R from the elements of S_1 to those of S_2 .

b. Correspondence Constraints

Max: Every segment in S_1 has a correspondent in S_2 , penalizes deletion.

DEP: Every segment in S_2 has a correspondent in S_1 , penalizes epenthesis.

IDENT(F): Correspondent segments in S_1 and S_2 have identical values for feature F.

These constraints are ranked with respect to other structural and alignment constraints within an OT grammar in a manner now familiar within the OT literature.

The third family of constraints, subsumed under IDENT, is the main focus of this paper. In their article, McCarthy and Prince propose IDENT as a regulatory constraint governing correspondence relation between the base and the reduplicant, and between inputs and outputs. The main proposal of this paper is to extend the role of Identity Constraints to independently-occurring words¹ within the same inflectional paradigm. Thus, inflected forms of the same stem must meet two Identity requirements: input-output identity which demands faithfulness between the inflected form and its input, and output-output correspondence which regularizes prosodic and metrical differences among all outputs of the paradigm. We need to determine which of the outputs constitutes the base to which all other outputs are compared. In Arabic, outputs within every inflectional paradigm exhibit two syllabic patterns depending on whether the suffix is consonant-initial, which I will refer to as C-outputs, or vowel-initial, V-outputs. Gen generates several outputs from each C-form and V-form which are then passed through the constraint hierarchy for evaluation. By the time the output-output Identity constraint is reached, only one C-output candidate would have survived the higher-ranked syllabic constraints, while several v-outputs still remain awaiting further evaluation. The surviving C-output then serves as the output base to which the remaining V-candidates are matched for the perfect correspondence relation. The following section which introduces the data will show how this interpretation of output-output correspondence works.

¹ Benua (1995) also proposes extension of correspondence relation to independently occurring outputs to account for various truncatory phenomena. In her proposal, the truncated form bears an output-output correspondence to its base, which in turn bears an identity relation to its input. In my proposal, both outputs in an inflectional paradigm which stand in a correspondence relation bear an identity relation to their common input.

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2. Augmentation and Penultimate Stress

The dialects represented in this paper have a uniform stress pattern which assigns stress to the penultimate syllable unless the final syllable is heavy, or the penult itself is light. In the following section we will look at three cases of augmentation where gemination or lengthening has the effect of triggering penultimate stress by augmenting the size of the syllable. I show that augmentation in these cases cannot be reduced to simple syllabic well-formedness constraints since well-formed syllable structure can be maintained without recourse to gemination, but at the expense of generating an inconsistent syllabic and consequently stress pattern. Uniform stress, which is achieved by ensuring perfect prosodic correspondence among morphologically related words, is therefore the main motivation for augmentation.

2.1 Augmentation: Output-Output Identity

The best known case of augmentation involves gemination of dative /l/ in Levantine and Saudi. In the two dialects, the dative marker /l/ geminates if it falls between a consonantal and a vocalic affix. This situation arises when a verb stem is amalgamated with the agreement marker /u/ '1/2SG'. Vowel-initial object clitics which induce /l/-gemination are: /-i/ '1S', /-ak/ '2MS', /-ik/ '2FS', and /-u/, '3MS'. The following forms from Levantine are representative of this process.

(2) Levantine	<u>input</u>	<u>output</u>	<u>gloss</u>
	katab-t-l-i	katabt ^l illi	'You wrote to me'
	šuf-t-l-u	šuft ^l illu	'I/You saw for him'
	ʔamal-t-l-ik	ʔamalt ^l ilik	'I did for you-f'
	tarjam-t-l-ak	tarjamt ^l ilak	'I translated for you-m'

Dative /l/ geminates regularly when preceded by two consonants. However, it is well known that Arabic dialects rectify instances of prohibited triconsonantal clusters by inserting an epenthetic vowel before or after the medial consonant, *katabt^lillu* or *katabt^lillu* (Broselow 1980, Selkirk 1981, Itō 1989). Epenthesis in an output like *katabt^lillu* is sufficient to ensure satisfaction of the relevant structural constraints such as ONSET, which requires each syllable have an onset, and *COMPLEX, which prohibits complex syllables. Thus, the nongeminated output *katabt^lillu* is expected to fare better in the evaluation process than the geminated *katabt^lillu*. Gemination of /l/ in such cases then, cannot be motivated by syllabic well-formedness constraints alone. This mysterious phenomenon becomes clear once various outputs within the dative paradigm are taken into consideration.

In Levantine and Saudi, as well as other dialects, augmenting dative /l/ with a consonantal suffix generates a four consonant cluster syllabified by epenthesis between the second and third consonant, and the resulting penultimate syllable bears stress:

(3)	katabt ^l ilha	katabt ^l ina	katabt ^l ihum
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The forms in (3) are the only outputs generated by GEN which emerge successfully after being evaluated by the main constraints ONSET, *COMPLEX, SYLL-BIN, and DEP-IO. Arabic is an epenthesis rather than a deletion language, which attests to the low ranking of DEP-IO. Moreover, Arabic is a quantity sensitive language which requires quantitative distinction for stress assignment. This is achieved by requiring codas be independently moraic to ensure syllable bimoraicity. I will refer to this constraint as SYLL-BIN. ONSET is undominated in all dialects. This gives the partial ranking in (4a). Some possible candidates generated from /katab-t-l-ha/ are evaluated in (4b).

(4)

a. ONSET >> SYLL-BIN >> DEP-IO >> *COMPLEX

b. Candidates	ONSET	SYLL-BIN	DEP-IO	*COMPLEX
ka.tab.t q.l.q.ha		*!	**	
ka.ta.b q.t q l.ha		*!	**	
☞ ka.tab.t q l.ha			*	

Amalgamating the dative particle with a vocalic clitic yields three outputs evaluated in (5).

(5)

Candidates	ONSET	SYLL-BIN	DEP-IO	*COMPLEX
a. ka.tabt.lu				*
b. ka.ta.b qt.lu			*	
c. ka.tab.t q l.lu			*	

Given the partial hierarchy established, the three candidates tie on ONSET and SYLL-BIN. DEP-IO then selects the output with a complex syllable which should emerge as the winner. The persistence of gemination before all vocalic suffixes shows that a higher ranked constraint outranking both DEP-IO and *COMPLEX plays a role in the evaluation of the three candidates. I propose that this constraint is the Output-Output Identity Constraint, IDENT-OO(SYLL), which governs the correspondence relation between consonantal and vocalic suffixed outputs. The success of the geminated form can now be understood as a means of regularizing the dative paradigm by providing a perfect correspondence between outputs with vocalic affixes to those with consonantal affixes, hence making penultimate stress uniform throughout the entire paradigm.² This is achieved by evaluating the identity of correspondence elements, in this case syllables, in both outputs. IDENT-OO(SYLL) demands quantitative identity between corresponding syllables in the output pair. The following table shows the results of evaluating the correspondence relation in terms of syllable identity between the three outputs *katabitllu*, *katabtlu* and *katabitlu* on the one hand and *katabitlha* on the other.

² The same analysis accounts for the geminated allomorph of the instrumental morpheme /b/ in Saudi, as in *malee-t-b-u* > *maleetabbu* 'I filled with it-F' which corresponds syllabically to *maleetabha*. (See Abu-Mansour (1991) for data).

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(6)	Output 1 k a . t a b . t i . l . h a μ μμ μμ μ	Output 2 ↻ k a . t a b . t i . l . l u μ μμ μμ μ k a . t a b . t . l u μ μμμ μ k a . t a . b i . t . l u μ μ μμ μ	Comments Perfect correspondence. Mismatch in the number of syllables. Mismatch in weight of antepenult.
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The augmented form *katabtillu* provides a better correspondence to *katabtilha* than the nonaugmented outputs and is therefore the optimal candidate.

Another case exemplifying penultimate stress regularization via gemination comes from Omani. In Omani, the third person singular inflection of the active participle is formed by infixing the morpheme /in/ between the active participle and the pronominal suffix.³ The following forms are from Shaaban (1977:58 ff.):

(7)	Omani		
	Input	Output	Gloss
	a. nasyaan-ha taarik-hum	nasyaanɪnha taarkɪnhum	'he has forgotten her' 'he is leaving them'
	b. samɪaan-u taarik-u saariq-u	samɪaanɪnnu taarkɪnnu saarɪnnu	'he is listening to him' 'he is leaving him' 'he has robbed him'

Omani syllable structure is similar to that of Levantine in that ONSET is undominated, syllables are optimally bimoraic, DEP-IO is violated to ensure satisfaction of MAX-IO, and complex syllables are sometimes permitted. In addition, Omani, like many dialects, prohibits medial open syllables with high vowels, which will be ascribed to the constraint NO-VPLACE which bans a vowel with a parsed high-place from occurring syllable finally (McCarthy 1993).⁴ This constant outranks *COMPLEX since deletion of a syllable final high vowel results, in many instances, in generating a trimoraic complex syllable. It also outranks DEP-IO because Omani is one of the dialects which shows the "syncope feeding epenthesis" pattern where deletion of a syllable final high vowel feeds preconsonantal epenthesis, /kalb-it-u/ > *ka.lib.tu* not **kal.bi.tu* "his dog-F". In OT terms, this syncope/epenthesis interaction is derived by ranking NO-VPLACE above DEP-IO. No ranking holds between NO-VPLACE and SYLL-BIN since they are never in conflict. Satisfaction of SYLL-BIN entails satisfaction of NO-VPLACE and vice versa.

Appending a consonantal affix to the active participle yields two possible outputs, *saa.ri.qin.ha* which is faithful to the input but contains a syllable-final parsed vocalic root node, and the optimal *saar.qin.ha* which satisfies NO-VPLACE but violates MAX-IO.

³ Shaaban (1977:86) suggests that /in/ may be a remnant of the genitive marker of Standard Arabic.

⁴ In McCarthy's proposal, NO-VPLACE blocks both high and low vowels from occupying non final open syllables, hence the cooccurrence of raising and syncope in Beduin dialects. To account for other dialects which syncope high vowels but allow low vowels in open syllables the constraint must be relativized.

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Correspondence regulated via syllable identity derives the former in all cases. The latter incurs one IDENT-OO(SYLL) violation due to the quantitative mismatch of the penult.

2.2. Augmentation of the Base

Interestingly, augmentation cases found in the dialects involve lengthening of affixal vowels and consonants only. Segments of bare stems are never lengthened or geminated, even when lengthening creates the potential for the desirable penultimate stress and provides the perfect correspondence.

(11)

He _ It-F	He _ It-M		Gloss
katábha	kátabu	*katábbu	'wrote'
fatáhha	fátahu	*fatáħhu	'opened'

A similar asymmetry is also found in the nominative paradigm, *kataábna* 'we wrote' vs. *kátabu* 'they wrote'. IDENT-OO(SYLL) which governs output-output correspondence forces the selection of the augmented candidate with penultimate stress over the nonaugmented output with antepenultimate stress. Yet we find that output-output identity underapplies thus exempting the final syllable of the stem from augmentation which ultimately results in a stress asymmetry in the nominative and accusative paradigms.

As stated in Section (1), each output within an inflectional paradigm must meet two requirements: faithfulness to its input, and correspondence to another output in the paradigm for prosodic and metrical regularization. Input-output faithfulness demands preservation of the quantitative properties of the stem. Finite verb stems are composed of a light or heavy base complemented by an invariably light suffix (McCarthy and Prince 1990:40). That is, the first syllable in the stem may be monomoraic or bimoraic, while the suffix component is invariably monomoraic. Output-to-input faithfulness demands that outputs maintain the number of moras in the input without augmentation or reduction. Outputs where either syllable of the stem is augmented or reduced are nonoptimal, unless such augmentation or reduction is mandated by a higher ranked syllabic constraint. This shows that output-input identity outranks output-output correspondence. Geminating the stem-final consonant or lengthening the stem-final vowel in /katab-u/ to match it with *katábha* will alter the size of the stem's final syllable resulting in an IDENT-IO violation.

(12)

Candidate	ONSET	IDENT-IO	IDENT-OO(SYLL)
ka.tab.bu.		*!	
ka.taa.bu.		*!	
ka.ta.bu.			*

Yet the base for correspondence, *ka.tab.ha* itself contains an augmented syllable. This is inevitable since in quantity sensitive languages coda consonants must be independently moraic to provide the required weight distinction necessary for stress assignment. The constraint SYL-BIN which ensure bimoracity and which outranks IDENT-IO selects the augmented output *katábha* over a non-augmented output such as *katabħa*.

The demonstrated stem/affix asymmetry is thus an identity effect. Affixes which are not specified quantitatively in their inputs, hence no IO faithfulness requirements can be imposed, are free to lengthen to provide a perfect correspondence pattern.

3. Reduction

Unlike augmentation, reduction targets any segment external or internal to the stem. Because of the semantic independence of the consonantal root in Arabic, reduction processes are restricted to syncope. Syncope, which has been discussed extensively in the literature on Arabic dialects, deletes a short high vowel in double-sided open syllables (VC_CV). The case frequently cited to exemplify the operation of syncope is the case of the inflected forms of the perfective verb. In many dialects, inflection of verbs with a high stem vowel like /sirib/ 'drink' with the plural nominative affix /-u/ (e.g., Egyptian and Levantine), and /-aw/ (e.g., Iraqi and Gulf) renders a sequence of three open syllables [ʃi.ri.bu. exposing the medial /i/ as a target for deletion. Examples are presented in (13):

(13) Egyptian/Levantine

he	they	gloss
fʃim	fʃmu	'understood'
xʃir	xʃru	'post'
nʃim	nʃdmu	'regretted'

Other examples where /i/ is syncope in double-sided open syllables include the prefixal vowel /i/ of the person marker /yi/ when preceded by the present tense marker /bi/ and followed by a CV sequence as in /bi-yi-ʃuuf/ > biyʃuuf 'he sees', and the second vowel in the seventh and eighth binyanim when a vowel-initial suffix is concatenated, e.g., /bi-yi-n-biSiT-u/ > biyinbiʃtu 'they enjoy themselves'. I have not come across a dialect where syncope of a high vowel does not apply in this environment. Another example of medial high vowel syncope is the loss of the initial /i/ of the feminine marker /it/ which marks feminine nouns in a construct phrase after affixation of a vowel-initial suffix:

(14) Levantine

Input	Output	Gloss
a. madrasit-u	madrástu	'his school'
maktabit-u	maktábtu	'his library'
b. waziirit-u	wazírto	'his minister-F'
raʔiisit-u	raʔístu	'his president-F'

Finally, syncope also occurs in the feminine form of nominal and participial forms of the shape CVVCiC-a,⁵

(15) Levantine/Saudi

Input	Output	Gloss
kaatib-a	káatba	'writing-f'
saamiʒ-a	sáamʒa	'listening-f'

⁵ Lexicalized nominals are usually blocked from undergoing syncope thereby producing minimal pairs exhibiting /i/-/o/ alternation, e.g., [s-aa9ira] 'poet-f' vs. [s-aa9ra] 'feeling-f'; [kaatiba] 'author-f' and [kaatba] 'writing-f'; [Taaliba] 'student-f' and [Taalba] 'seeking-f'.

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The data in this section demonstrate the general application of reduction. Both stem (cf. 13,15) and affixal (cf. 14) high vowels are subject to deletion if they happen to be at the right edge of a nonfinal syllable. Recall from the discussion of the Omani geminating interfix case that one constraint on syllable structure in Arabic is the prohibition of high vowels in nonfinal open syllables, which translates as the constraint NO-VPLACE. NO-VPLACE blocks outputs with syllables ending in a vowel with parsed high place. Outputs with syllable-final vowels unparsed, or syncope in serialist terms, would be the response to NO-VPLACE. On the surface, this may appear to violate input-output identity since unparsing of a stem vowel may result in the loss of one of its moras. However, NO-VPLACE simply requires high vocalic root nodes be underparsed; the mora itself is still parsed by its syllable, and the quantitative properties of the stem are preserved. An underparsed high vowel then, satisfies NO-VPLACE without violating IDENT-IO.

(16)

Candidate	ONSET	NO-VPLACE	IDENT-IO	MAX-IO
fi.hi.mu.		*!		
☞ fih.<i>mu.				*

Thus, with one constraint ranking, we can provide an explanatory account of both augmentation and reduction. The domain of lengthening or gemination, triggered by output-output correspondence (IDENT-OO(SYLL)) is limited to affixal material whose input has no syllabic or moraic affiliation. Underapplication of augmentation is forced by input-output identity (IDENT-IO). By contrast, reduction may apply to word-internal as well as stem-internal open syllables, because underparsing in this case entails loss of segmental material, prosodic structure remaining intact. It remains to be seen if other languages with templatic morphology show similar rule distribution, lengthening rules restricted to affixes vs. unrestricted application of syncope. The general constraint hierarchy is given in (17).

- (17)
- ONSET >> SYL-BIN = NO-VPLACE >> IDENT-IO >> MAX IO >>
IDENT-OO(SYLL) >> DEP IO >> *COMPLEX

4. Derivational Approaches

The goals of this paper were twofold: First to explain the gemination and lengthening processes inexplicable under syllabic well-formedness conditions, and second, to account for the domain of augmentation and reduction processes. The two goals are unified under Correspondence. This section will discuss how derivational approaches fare in this regard.

In a rule approach, rules must apply sequentially, with each rule applying once in each cycle. The success or failure of rule application is determined solely by the underlying representation of the form. Yet to account for gemination in *katabillu*, for instance, information must be provided by another output of an independently derived form. Serial approaches cannot relate between two independently derived outputs; therefore, information necessary for the application of gemination cannot be accessed.

To account for augmentation processes under a derivational approach, cyclicity must be invoked to ensure proper application (Abu-Mansour 1990). By allowing any subset of the morphological word to form a cyclic domain, the suffix final segment can be

syllabified at an earlier cycle. Concatenation of a vocalic suffix at a later cycle forces the already syllabified segment to geminate, providing an onset for the newly created syllable.

This type of analysis, however, poses the question of whether a partial constituent like *katabil-* or *kaatibin-* may constitute a proper cyclic domain. Under correspondence, gemination is given a more coherent account.

Cyclicity can also explain rule underapplication in nonderived environments, thereby predicting failure of gemination to apply to the stem. However, we need a theory which predicts that while gemination is blocked in *katabu*, syncope applies in *fihimu*. Identity constraints which govern input-output and output-output correspondence correctly predicts the domain of each process.

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