A Morphologically-based Optimality-theoretic Analysis of Modern Standard Arabic Broken Plural*

Dr. Balqis I. G. Rashid (Prof.)   **Zina Mahmood Shakir**
The Dept. of English
The College of Education for Human Sciences
The University of Basrah

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الخلاصة:

عنيت ظاهرة جمع التكسير في اللغات السامية عامة وفي اللغة العربية خاصة بإهتمام اللغويين الذين طالما حاولوا تفسيرها بطريقة تحليلية ومفهومة. يقدم مكارثي (2000) وعلى وفق نظريته التطريزية في علم العروض بعضاً من أهم الفرضيات التي تُساعد على تحليل الظاهرة على وفق النظرية التفاضلية اللغوية. ويشترط مكارثي أن الفرق بين المفرد والجمع هو بوحدة وزن إضافية تُضاف الى موقع معين في صيغة الجمع. تعرض هذا الدراسة وبناءاً على فرضيات مكارثي تحليلاً لتركيب جمع التكسير على وفق النظرية التفاضلية اللغوية

Abstract

Broken Plural (henceforth BP) phenomenon in Semitic languages in general and in Arabic in particular, has always been interesting to linguists who tried their best to tackle it in a comprehensive analytical way. McCarthy (2000), within Prosodic Circumscription, presents pre-Optimality Theoretic (henceforth OT) assumptions of BPs in Classical Arabic. He stipulates the difference between singulars and plurals in an extra mora (μ) added to a specific locus in the plural form. This study, based on McCarthy's assumptions, presents an OT analysis of the morphological process of BP in Modern Standard Arabic (henceforth MSA).

<u>Keywords:</u> Optimality Theory, Modern Standard Arabic, Broken Plural, Plural of Paucity, Plural of Multitude, Prosodic Circumscription.

* The present study is based on an M.A. study conducted by the first author and supervised by the second one.

1. **Introduction**:

The Arabic BP is one of the most complicated morphological processes in Semitics. It always presents a particular challenge to the theory advocated in the given study (McCarthy, 2000: 173). The challenge, here, is how to work on a phenomenon that calls on the full power of a serial derivation in the traditional

models like BP within a constraint-model theory like OT. In other words, traditional accounts of Arabic BP are inadequate and sometimes unexplainable. These accounts often use either massive amount of CV-shapes or complicated inviolable rules to attempt at giving a comprehensive understanding of BP formation.

2. The Phonology of MSA:

2.1 MSA:

For practical purposes, Arabic might be divided into three main varieties though there may be other classifications and divisions for Arabic (see Owens 2006). These varieties are: a) Classical Arabic, b) Modern Standard Arabic, and c) Colloquial Arabic.

Within Colloquial Arabic there are the different dialects and vernaculars used in everyday life, like Iraqi Arabic, Egyptian Arabic *etc*.

In the 19th century, MSA emerged at time when Arabic was gaining the status of the 'official' language in the Arab world, alongside with the emergence of 'Arab nationalism' (Suleiman, 2011: 51-52). Modernism and the revolutionary developments of the age, and the scientific progress also contributed to the modernity of MSA. Thus, MSA is in use in contemporary literature; in writing and formal speaking; in political, academic, religious, and official associations; and in the mass media, newspapers, radio and TV, and the internet (Aoun et al, 2010). It is only acquired at school; not all speakers of Arabic have an 'equal command' of the standard dialect and their colloquial dialect.

More than 60 years ago, the term 'Modern Standard Arabic' was used to refer to the unified language used by all Arabs in the Arab world. It appeared as a reaction to the vernaculars and dialects used in separate countries in the Arab Land. So, it is an attempt to unify the Arab people with one official language. It is not a departure from CA, as scholars at al-Azhar claimed (cf. Van Mol, 2003: 30-31).

2.2 Consonants and Vowels:

MSA has thirty five structural phonemes; they are three short vowels, three long vowels, two semi vowels, and twenty seven consonants (Omar, 1997:313). The three short vowels are: /i/ , /u/ , and /a/ . The three long vowels are: /i:/ , /u:/ , and /a:/ . The two semi vowels are /y/ and /w/. The following chart sums up the consonantal inventory as extracted from the IPA (International Phonetic Alphabet) transcription to represent the Arabic data:

	Bilabial	Labio-dental	Dental	Alveolar	Palatal	Velar	Uvular	Pharyngeal	glottal
Stops	b			d t ṭ		k j	q		ʔ
Fricatives		f	θ ð ḍ	s z ṣ ẓ	š		x g	ʕ ħ	h
Nasals	m			n					
Liquids				l r					
Glides	w				y				

Emphatic, also phonetically known as pharyngealized sounds, are represented in this chart with a dot underneath them /Ç/.

2.3 Syllable Structures:

Syllables in Arabic do not start with a vowel (Al-Bekkosh1992: 77, Ryding 2005: 36). Words like ʔumm , ʔabb , and ʔislām start with a glottal stop (hamza) which is a consonant in Arabic. A consonant at the beginning of the syllable is obligatory. However, the syllable may or may not end with a consonant.

Syllables in Arabic are of three main structures ((Shaheen, 1980: 40); (Al-Bekkosh, 1992: 78-79); and (Ryding, 2005: 36), among others). They are:

a) Short Open Syllable: CV. For example, ka/ta/ba كَ/تَ/بَ (he wrote).

b) Long Open Syllable: CVV. For example, kaa/tib كَا/تب (writer).

c) Short Close Syllable: CVC. For example, kaa/tib كَا/تب (writer)

d) Long Closed Syllable: CVVC. For example, daal/liin ضَال/لين (lost)

e) Long Closed Syllable (heavy): CVCC. For example, birr برّ (obedient)

f) Long Closed Syllable (extra heavy) : CVVCC. For Example, ma/haamm مَـ/هَامّ (duty)

In MSA, syllables are not allowed to have a consonant-cluster of more than two consonants. A three-consonant cluster is not licensed. Also, the first foot of the word must be of one-consonant syllable. Two- consonant cluster is also banned from the beginning of the syllable, unless it takes the final position of a word in the pausal form like /waqt/, /nahr/ *etc.*

Moraic Theory is used in this article to study syllable-structure in Arabic. Within Moraic Theory, syllable-structure in MSA is treated as follows: heavy syllables which either have the shape Cvv , CvvC, CvvCC or CvCC are represented as bimoraic (contain two moras, μμ). The first strong mora must only

be a vowel *i* , *a* or *u*. The second weak mora can be any consonant or the second half of a long vowel. Light syllables which either have Cv or CvC are represented as monomoraic (contain one mora, μ). In the case of the light syllables, the mora is only a vowel (McCarthy & Prince 1990a/b; 1996; McCarthy, 2000).

(1) Syllable Weight in Word-initial Position

The following section presents BP patterns in MSA.

3. MSA Broken Plural Patterns:

3.1 Broken Plurals:

Arab Grammarians, like Abdulaal (1976: 27), Al-Anbari (1997: 54), and Tribiya (2003: 2, 82), and many others, define BP as a noun that refers to three or more things, and has a singular form, with which the same meaning and original root-consonants are shared.

The reason why it is called *broken* is that the plural form of the word does not look like its singular form. On the contrary to the sound -regular- plurals (Masculine Plural & Feminine Plural), the change takes place within the pattern of the word, i.e. it is internal, Aabdulaal (1976: 27), and (Ryding 2005: 128). Similar to a *broken plate*, arranging the original shape of the singular after pluralizing it is difficult. Ibn Yaish(1949) illustrates that it is called broken because its pattern is changed in comparison to its singular from, as if the singular pattern is broken into pieces and then rebuilt again in the plural form. Though the plate is still a plate after recreating it, yet it is not that same original plate that was broken.

Broken Plural, then, is a noun indicating three or more persons or things or an adjective describing such a noun. This plural does not retain the structure of its singular due to some internal changes that take place within the word.

3.2 Patterns of Broken Plural:

Semantically, there are two kinds of broken plurals recognized by the Arab grammarians, namely the plural of paucity, and the plural of multitude (Abdelaal: 1976, Al-Anbari: 1997, Tribiya: 2003, among others).

The plural of paucity expresses any number from three to ten, and the plural of multitude expresses any number from ten to infinity.

Semitic languages typically form triconsonantal roots. Arabic consists of three consonants called *radicals* together with certain vowels and sometimes prefixes or suffixes. To indicate patterns of words, Arab grammarians use the three consonants (f ʕ l – ف ع ل). The ف represents the first radical, the ع is the second and the ل is the third as: كلب "a dog" is said to be of the form فَعْل. Using the root (faʕal فعل) to represent the root of words is a common way in studies of Arabic grammar. Thus, the word *ħasan* follows the pattern faʕal, so that the f=ħ, ʕ=s, and l=n. And, the word *miṣbāħ* "light" follows the pattern mifʕaal, so that the f=ṣ, ʕ=b, and l=ħ. Accordingly, the two types of BP in MSA are represented by this way.

a. Plural of Paucity:

Arab grammarians agree that there are four patterns, or measures, of the plural of paucity. They denote an anonymous number between 3 and 10. They are:

1. **ʔafʕul** أفعُل (ʔaCCuC). For example: ʔarjul "feet", ʔakkuf "arms", ʔawjuh "faces".
2. **ʔafʕaal** أفعال (ʔaCCaaC). For example: ʔaħwāl "manners", ʔaqlām "pens", ʔamwāt "dead people".
3. **ʔafʕil-*at*** أفعِلة (ʔaCCiC-at). For example: ʔaksiya "dresses", ʔafʔida "hearts", ʔaħibba "lovers".
4. **Fiʕl-*at*** فِعْلة (CiCC-at). For example: gilm-*at* "slaves", jīr-*at* "neighbors", ʔixw-*at* "brothers".

b. Plural of Multitude:

Arab grammarians agree that there are at least sixteen patterns, or measures, of the plurals of multitude. They denote any unknown number from 10 to infinity. They are:

1. fuʕl فُعْل (CuCC). For example: bukm "deaf people", ħumr "reds", ṣumm "mute people".
2. fuʕul فُعُل (CuCuC). For example, kutub "books", ṣubur "patient people", rusul "messengers".
3. fuʕal فُعَل (CuCaC). For example, guraf "rooms", jumaʕ "Fridays", kubar "big things".

4. fiʕal فِعَل (CiCaC). For example, qitaʕ "pieces", ħijāj "evidences", ʕilal "reasons".

5. fuʕa-at فُعَاة (CuCa-at). For example, quḍa-at "judges", ruwa-at "reciters", huwa-at "fans".

6. faʕal-at فَعَلة (CaCaC-at). For example: katab-at "writers", barar-at "obeyers", ṭalab-at "students".

7. faʕlaa فَعْلى (CaCCaa). For example: mawtā "dead people", sakrā "drunk people", marḍā "sick people".

8. fiʕal-at فِعَلة (CiCaC-at). For example: dibab-at "bears", qiraṭ-at "earrings", diraj-at "drawers".

9. fuʕʕal فُعَّل (CuCCaC). For example: rukkaʕ "bowing people- in prayer", nuwwam "sleepers", ṣuwwam "fasters".

10. fuʕʕaal فُعَّال (CuCCaaC). For example: qurrāʔ "readers", ʕummāl "workers", ħurrās "guards".

11. fiʕaal فِعَال (CiCaaC). For example: rimāl "sands", θiyāb "clothes", biqāʕ "places".

12. fuʕuul فُعُول (CuCuuC). For example: funūn "arts", šukūk "doubts", juyūš "armies".

13. fiʕlaan فِعْلان (CiCCaaC). For example: jirðān "rats", dīdān "worms", gilmān "slaves".

14. fuʕlaan فُعْلان (CuCCaaC). For example: buldān "countries", rugfān "pieces of bread", qumṣān "shirts".

15. fuʕalaaʔ فُعَلاء (CuCaCaaʔ). For example: kuramāʔ "generous people", fuqarāʔ "poor people", ʔumarāʔ "princes".

16. ʔafʕilaaʔ أفعِلاء (ʔaCCiCaaʔ). For example: ʔaṭibbāʔ "doctors", ʔaqribāʔ "relatives", ʔaħibbāʔ "loved ones".

In this study, BP in MSA is morphologically analyzed within OT. The following section sheds light on the theory.

5. **Optimality Theory**:

OT as put forth by Prince & Smolensky (1993) and McCarthy & Prince (1993 a,b) is developed out of research on prosody, universal grammar, markedness theory, and the viewing of phonology as being constraint-oriented rather than rule-oriented. Basically, it was developed in phonology to replace the controversial rewrite rules. Its main assumption is that the grammar of language is governed by universal constraints that are violable. Therefore, well-formed (optimal) outputs are derived immediately from inputs through universal yet minimally violated constraints. Violability arises from conflicting constraints. In

OT, there are mainly two types of constraints: faithfulness and markedness constraints. While the former assures that outputs are as identical as possible to the inputs, the latter concentrates on well-formed outputs regardless of the inputs. OT is considered a departure from previous rule-based theories. Its main principles are: a) <u>Universality</u>: constraints are universal; b) <u>Violability</u>: constraints are violable; c) <u>Ranking</u>: constraints are ranked with respect to each other; d) <u>Inclusiveness</u>: only inclusive – conceivable- candidates are generated; and e) <u>Parallelism</u>: candidates are parallelly generated.

OT mechanism requires the generator "Gen" to generate all the conceivable and parallel candidates. These candidates, depending on the grammar of language, compete with each other. The one that best satisfies the universal higher-ranked constraint is the Optimal. The optimal candidate may violate other universal lower-ranked constraints; the violation should be to the minimum or else it is fatal and the candidate is out of competition.

Basically, in OT, there are two types of constraint: *Markedness Constraints* and *Faithfulness Constraints*. Markedness Constraints are structural requirements stated on the well-formedness of output forms (surface structure) irrespective of the input forms. They evaluate the form of the output candidate, favouring certain structural configurations (e.g., syllables with onsets, accusative objects) over others (e.g., syllables without onsets, dative objects) (McCarthy 2000: 13). They mainly depend upon language typology. Faithfulness Constraints are structural requirements stated on the well-formedness of output forms (surface structure) with respect to the input forms. Through them, inputs and output are as much identical as possible- identical in the sense that both have the same featural values. Thus, they allow the general requirement for linguistic forms to be realized as close as possible to their lexical 'basic forms' (Kager 2004: 5). Both types of constraints, namely markedness and faithfulness constraints, are needed. Though in contrast with respect to each other, they are both constructing grammar of language. If there are markedness constraints only, simple output forms are expected all the time. And, if there are faithfulness constraints only, there is no linguistic generalization whatsoever.

The coming section presents the main theoretical assumptions adopted in this study.

5. **Theoretical Assumptions**:

The main assumptions presented here are inspired by McCarthy & Prince (1986), and McCarthy (2000).

In MSA, the vast majority of derived nominals including BPs are *canonical* derivational nouns. McCarthy (1981, 374) and McCarthy & Prince (1998, 304-305) define canonical nouns as those nouns "that are truly integrated into the

morphological system, based on their ability to form broken plurals and other criteria". Thus, canonical nouns are either originally found in the system of the language, or borrowed from other languages and have the ability to be well-integrated into the language system, and so, they tend to go through the most complicated processes of that language. Other nominals, like most loan words, are non-canonical; they are not truly integrated into the language's morphological system. As a result, they tend to take the straightforward morphological processes like Sound Plural. However, canonical BPs are many and diverse.

The following examples represent the canonical morphological shapes of BPs in MSA.

Singular forms	*Plural forms*	*Gloss*
1. (CvC).Cv.C	**1. (Cv.Cv:).Cv.C**	
(maṣ).na.ʕ	(maṣa:).ni.ʕ	factories
(mas).ba.ħ	(masa:).bi.ħ	swimming-pools
2. (CvC).Cv.C-*at*	**2. (Cv.Cv:).Cv.C**	
(maħ).ba.r-*at*	(maħa:).bi.r	inkpots
(maħ).fa.ẓ-*at*	(maħa:).fi.ẓ	wallets
10. Cv.(CvC)	**10. Cv.(Cv:C)**	
ʔa.(sad)	ʔu.(su:d)	lions
ʕi.(ṭir)	ʕu.(ṭu:r)	perfumes
11. C₁vC₂	**11. C₁v.(C₂v:C₂)**	
xaṭ	xu.(ṭu:ṭ)	lines
ħad	ħu.(du:d)	boundaries

$11. C_1vC_2$ — $11. C_1v.(C_2v:C_2)$

From the morphological shapes examined before and pervious conclusions made by McCarthy & Prince (1990a) and McCarthy (2000), four general observations can be mentioned here:

1. The left-edge foot of the singulars is a moraic trochee that turns onto iambic when broken plural forms are shaped. Trochaic feet of (CvC) and (Cvv) become iambic (CvCv:) in forms (1-6) and (CvWv:) in forms (7). The 'typical' and most common used shape of BPs in MSA is an iamb.

2. Forms (8-11) are exceptional since they do not follow the typical mapping of BPs. The trochaic left-edge-foot singulars map other trochaic left-edge-foot plurals.

3. "The weight of the final syllable is preserved in the mapping from singular to plural" (McCarthy, 2000: 175). The final-syllable weight in forms (1-8) is identical; it is not affected by the changes happening to the first foot of the singulars.

4. The position of the epenthetic consonant ʔ and **w** in BPs depends on the number of the root-consonants in the singulars. If the first left-edge foot contains one root-consonant, the epenthetic consonant is attached to it, like in forms (7). And, if the first left- edge foot contains two consonants - Arabic disallows syllables of three-consonant cluster so the epenthetic consonant is automatically transferred to the second syllable under pressure from high-ranked morphological grounds of Arabic- the epenthetic consonant is attached to the following syllable, like in forms (6).

In keeping with the overall aims of this study, and to simplify the discussion within Arabic morphology, the researchers adopt the following assumptions:

1. Every syllable must start with a consonant. The consonant serves as the onset of that syllable.

2. The onset is linked to the nuclear mora- a vowel, forming CV- moraic sequences.

3. The final consonant, or a cluster of two consonants, is extrametrical; it is not participating in the prosody of the stem of the word as a whole. It serves as the onset of an incomplete syllable.

Thes data are analyzed in terms of OT in section 6.

6. <u>Data Analysis:</u>

In OT, McCarthy (2000: 175) stipulates the length of the broken plural forms to be preserved from the length of their singulars. This typical process of BP formation is a consequence of the faithfulness constraint $\text{DEP}_{\text{oo}}\text{-}\mu$ (no epenthetic mora) which works against the markedness constraint $\text{MAX}_{\text{oo}}\text{-}\mu$ (no deleted mora).

(12) $\text{MAX}_{\text{oo}}\text{-}\mu$ Every μ in output_1 has a correspondent μ in output_2. (McCarthy, 2000:159)

This constraint requires an additional mora to be added to the plural forms. It is violated when BP forms have fewer moras than its singulars.

(13) $\text{DEP}_{\text{oo}}\text{-}\mu$ Every μ in output_2 has a correspondent μ in output_1. (McCarthy, 2000: 159)
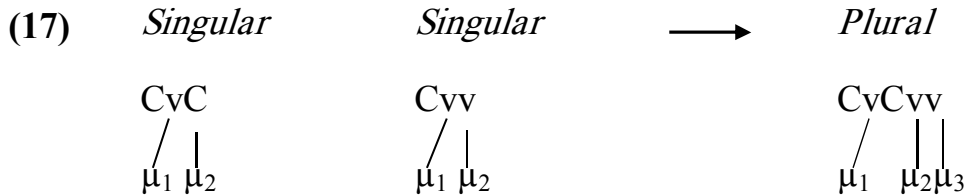
This constraint requires an identical length of both of the singular and its plural. It is violated when an extra mora is attached to the plural form.

However, he (2000: 181) argues that both $\text{DEP}_{\text{oo}}\text{-}\mu$ and $\text{MAX}_{\text{oo}}\text{-}\mu$ are too general; the added-μ is "infixed into a *particular* position in the stem" (emphasis added). The infixed mora appears in a 'consistent' locus: at the end of the second

syllable. Then it is better captured by a more specified faithfulness constraint, namely Positional Faithfulness constraints family identified by Beckman (1997, 1998).

Beckman (1998:1) asserts that some positions of the word are privileged to receive special faithfulness treatment. Among the so privileged positions, she argues, are stem-initial and stem-final syllables. As a result, any addition or deletion in the word does not take place in these privileged positions, *i.e*, the added μ, though formally a suffix, is forced into a stem-medial position. In that way, stem-initial and stem-final positions remain faithful in the singulars and their plural forms; they are high-ranked. Positional Faithfulness constraints that capture the identical weight of the final syllable of BPs in MSA are:

(14) $\text{M}_{\text{AX}_{\text{OO}}}\text{-}\sigma_F (\mu)$ Every μ in the final σ of output$_1$ has a correspondent μ in the final σ of output$_2$. (Al-Aghbari, 2004: 59)

This constraint forbids the deletion of moras in the final syllable of the BP forms when the final syllable of their singulars is long; weight is preserved.

(15) $\text{D}_{\text{EP}_{\text{OO}}}\text{-}\sigma_F (\mu)$ Every μ in the final σ of output$_2$ has a correspondent μ in the final σ of output$_1$. (Al-Aghbari, 2004: 59)

This constraint prevents the addition of moras in the final syllable of the BP forms when the final syllable of their singulars is short. Again, weight is retained.

Because singulars of BPs in MSA are trochaic and of the shape CvC or Cvv, the majority of them form a typical iambic plurals of the shape CvCvv. In this way, the difference between the singular and plural forms lies in an extra mora. McCarthy (2000) specifies the position of the added μ to the end of the second syllable. Al-Aghbari (2004: 59-60) specifies the position of the added μ to the "first foot at the left-edge" of BPs. Thus, the added μ lies in the first foot at the left- edge at the end of the second syllable of the word. The following prosodic structure illustrates the point:

(16) (a) *Singular forms*   ⟶   (b) *Broken Plural forms*

The prosodic hierarchy in (16 a,b) shows a prosodic word of two feet each of which contains two syllables. Each syllable is bimoraic. The only difference is

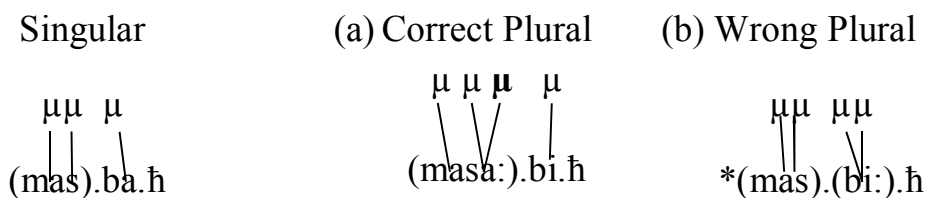that the first foot at the left edge of the plural word contains an extra mora at the end of the second syllable.

(17)   *Singular*   *Singular*   ⟶   *Plural*

CvC   Cvv   CvCvv

$\mu_1\ \mu_2$ $\mu_1\ \mu_2$ $\mu_1\ \ \mu_2\mu_3$

So, as $\text{MAX}_{OO}\text{-}\sigma_F\ (\mu)$ and $\text{DEP}_{OO}\text{-}\sigma_F\ (\mu)$ work on weight preservation

in the BPs final syllable, another constraint that works on added mora is needed. Al-Aghbari (2004: 59-60) adopts the following faithfulness constraint.

(18) $\text{DEP}_{OO}\text{-}F_1\ (\mu)$ Every μ in the first F of output$_2$ has a correspondent μ in the first F of output$_1$.

This constraint militates against adding a mora to the first foot of the plural forms. It is violated when BPs surface with an extra mora as in the following representations.

(19)

     Singular   (a) Correct Plural   (b) Wrong Plural

             $\mu\mu\ \ \mu$ $\mu\ \mu\ \boldsymbol{\mu}\ \ \mu$ $\mu\mu\ \ \mu\mu$

        (mas).ba.ħ   (masa:).bi.ħ   *(mas).(bi:).ħ

(20)

     Singular   (a) Correct Plural   (b) Wrong Plural

       $\mu\mu\ \ \mu\mu$ $\mu\ \mu\mu\ \ \mu\mu$ $\mu\mu\mu\mu\ \ \mu$

     (baq).(ši:).š   (baqa:).(ši:).š   *(baqa:).(ši).š
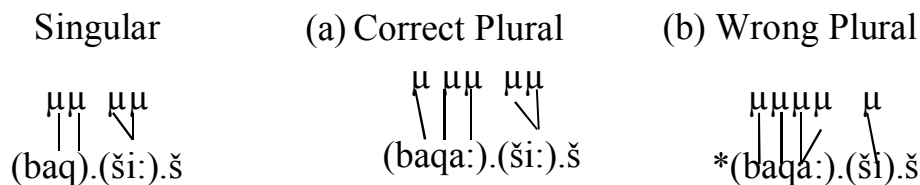
The correct form in (19a) receives the added μ within the first foot at the left edge of the second syllable, while the wrong form in (19b) receives the added μ within the second foot at the left edge of the second syllable. If the process is following McCarthy's general assumption about the locus of the added μ: at the end of the second syllable, then both forms (19a, b) are correct. However, forms in (19b) and (20b) contradict McCarthy's other assumption that BP forms preserve the weight of the final syllable of the word. Also, form (20a) receives the added μ

within the first foot at the left edge of the second syllable and retains the weight of the final syllable. In OT terms, all this is translated as follows: forms in (19a,b) and (20a,b) obey the constraints $MAX_{OO}\text{-}\mu$, and $MAX_{OO}\text{-}\sigma_F(\mu)$ and violate $DEP_{OO}\text{-}\mu$, and $DEP_{OO}\text{-}\sigma_F(\mu)$. But, $DEP_{OO}\text{-}\mu$, and $DEP_{OO}\text{-}\sigma_F(\mu)$ are too general; they may result in wrong forms. In this case, Positional Faithfulness constraint $DEP_{OO}\text{-}F_1(\mu)$ should also be obeyed. $DEP_{OO}\text{-}\sigma_F(\mu)$ and $MAX_{OO}\text{-}\sigma_F(\mu)$ outrank the other constraints. The following tableaux illustrate this.

Tableau (1)

/(mas).ba.ħ /+μ	$DEP_{OO}\text{-}\sigma_F(\mu)$	$DEP_{OO}\text{-}F_1(\mu)$
☞ a. (masa:).(bi).ħ		*
b. (mas).(bi:).ħ	*!	

Tableau (2)

/(baq).(ši:).š/+μ	$MAX_{OO}\text{-}\sigma_F(\mu)$	$DEP_{OO}\text{-}F_1(\mu)$
☞ a. (baqa:).(ši:).š		*
b. (baq).(ši).š	*!	

In tableau (1), candidate (a) satisfies $DEP_{OO}\text{-}\sigma_F(\mu)$ because the final-syllable weight of singulars and plurals is identical (ba) → (bi), and violates $DEP_{OO}\text{-}F_1(\mu)$ because the second syllable at the left-edge of the first foot is not identical to its singular correspondent (mas) → (masa:).

Candidate (b) violates $DEP_{OO}\text{-}\sigma_F(\mu)$ because the final-syllable weight of the singular and the plural is not retained (ba) → (bi:) and satisfies $DEP_{OO}\text{-}F_1(\mu)$ in (mas) → (mas). However, because $DEP_{OO}\text{-}\sigma_F(\mu)$ outranks $DEP_{OO}\text{-}F_1(\mu)$; candidate (a) is the optimal candidate and candidate (b) is out of competition: it fatally violates the higher-ranked constraint to satisfy a lower-ranked one.

In tableau (2), candidate (a) satisfies $MAX_{OO}\text{-}\sigma_F(\mu)$ because no mora is deleted from the final foot of the plural (ši:) → (ši:) and violates $DEP_{OO}\text{-}F_1(\mu)$ because of the weight of the first foot in the plural (baq) →   (baqa:). Candidate (b) violates $MAX_{OO}\text{-}\sigma_F(\mu)$ because the weight of the final syllable in the plural (ši:) → (ši) and satisfies $DEP_{OO}\text{-}F_1(\mu)$ in (baqa:) → (baqa:). Again, $MAX_{OO}\text{-}\sigma_F(\mu)$ outranks $DEP_{OO}\text{-}F_1(\mu)$. So, candidate (a) is the optimal and candidate (b) is out of competition.

The affixed μ is controlled by syllabic well-formedness constraints in the language; they govern which syllable structure is permitted and which is not (Al-Aghbari, 2004: 62). If the affixed μ at the first foot of the left-edge does not take place at the end of the second syllable then, it can possibly take a different loci in the foot, and as follows:

(21) CvC +μ

a. * μ+CvC   vCvC

b. * Cv+μC   CvvC

c. √ CvC+μ   CvCv

(21a) is not the correct structure of a syllable in Arabic. The mora is attached to the beginning of the syllable; the syllable starts with a vowel and that violates the constraint which requires all syllables begin with a consonant. (21b) is also a wrong structure of a syllable at the medial position. The mora is attached to the vowel and that makes a long vowel of two moras attached to another mora- the consonant (Prince & Smolensky, 2002:229). The overall structure consists of three moras and this violates the constraint which requires all syllables in Arabic to be maximally bimoraic. The last possible structure in (21c) is the correct one; it generates a foot of two syllables each of which with two moras. In OT terms, the constraints are as follows:

(22) O$_{NSET}$ *[$_\sigma$ V ('Syllables must have onsets.').   (Prince & Smolensky, 2002:17), (Kager, 2004: 95)

This constraint bans syllables that start with a vowel. It regulates syllables to start with a consonant.

(23) *3μ   No trimoraic syllables. (McCarthy & Prince, 1990a;b), (Kager, 2004: 268)

This constraint militates syllables with three moras. It is fatally violated when trimoraic syllables are generated.

It should be noted here that both **O$_{NSET}$** and ***3μ** are higher-ranked constraints; they are well-integrated within the Universal Grammar of Language. Accordingly, any violation to them is fatal.

Positional Faithfulness constraints **MAX$_{OO}$-σ$_F$ (μ)**, **DEP$_{OO}$-σ$_F$ (μ)**, and **DEP$_{OO}$-F$_1$ (μ)** interact with syllabic-wellformedness constraints **O$_{NSET}$** and ***3μ**. The following tableau presents this interaction.

Tableau (3)

(maħ).fa.ẓ-*at* + μ	MAX$_{OO}$-σ$_F$ (μ)	DEP$_{OO}$-σ$_F$ (μ)	ONSET	*3μ	DEP$_{OO}$-F$_1$ (μ)
a.(maħ).a. fi.ẓ			*!		
b.(maħa:).(fi:).ẓ				*!	*
☞ c. (ma.ħa:).fi.ẓ					*
d. (maħ).(fi:).ẓ		*!			
e. (maħa:).f.ẓ	*!				

Tableau (3) shows the interaction between syllabic wellformedness constraints and Positional Faithfulness constraints. The first four constraints are equally higher-ranked. The tableau emphasizes McCarthy's assumption that the locus of

the infixed mora is consistent: at the end of the second syllable of the first foot at the left-edge. Candidates a, b, d and f show a serious violation to higher-ranked constraints; none of them is the optimal output and they are all out of competition. Candidate (c), however, shows respect to the higher-ranked constraints and a minimal violation to a low-ranked constraint. The violation of candidate (c) is showing to $\text{DEP}_{OO}\text{-}F_1(\mu)$ is not important, therefore; it is the optimal output.

In forms (6) and (7), trochaic singulars are mapped onto iambic broken plurals by the distribution of epenthetic consonants /**w**/ and /ʔ/ which work as an epenthetic glide and fills an empty position of an onset. The following representation illustrates the apotheosized glide.

(24) *Singular*   *Broken Plural*

   (Cv.Cv:).C-*at*   (Cv.Cv:).ʔv.C
                                       |
   (ša.ri:).ħ-*at*   (ša.ra:).ʔi.ħ

(25) *Singulars*   *Broken Plural*

   (Cv:).Cv.C   (Cv**w**vv).CV.C
                                          | V
   (qa:).le.b   (qawa:).li.b

In this type of BPs, the plural forms have four consonants while their correspondent singulars have only three, *i.e*, there is an additional consonant in the plurals. While /**w**/ fills the position of the onset of the second syllable, /ʔ/ fills the position of the onset of the third syllable. In form (24) and (25), the singulars differ only in the locus of the bimoraic syllable that is related to the second root consonant, and this is the reason why the epenthetic consonant /w/ appears in the second syllable and /ʔ/ appears in the third syllable.

The choice between epenthetic /ʔ/ in words like (ja.ra:). ʔi.m "crimes" and epenthetic /**w**/ in words like (qa.**w**a:).(ni:).n is made on phonological grounds (McCarthy & Prince, 1990a: 34) and (McCarthy, 2000: 175). This means that there is a strong relationship between the long vowel in the singulars and the epenthetic consonant in the plurals. This relationship is controlled by some faithfulness constraints, namely **NO-SPREAD**$_{OO}$ **(μ, SEG)** and **NO-DELINK**$_{OO}$**(μ, SEG)**.

(26) **NO-SPREAD**$_{OO}$ **(μ, SEG)**   Conservation between moras and segments is preserved in the output-output mapping.

This constraint bans spreading moras away from their segments. If the segment is attached to a certain mora in the singular, then it is attached to the same mora in the plural.

(27) NO-DELINK$_{OO}$ (μ, SEG)   There is no delink between moras and segments in output-output mapping.

This constraint militates delinking segments of certain moras to other moras. If the segment is spread in the output-output mapping, this constraint prevents attaching that segment to a mora other than its mora in the singular.

These two faithfulness constraints ensure the plural of, for example, (ša.ri:).ħ-*at* to be (ša.ra:).ʔi.ħ not * (ša.ʔa:).ri.ħ, and of (qaa:).la.b to be (qawa:).li.b not * (qala:).wi.b.

Again, epenthesis is the assertion of syllabic well-formedness at the expense of input faithfulness. The following prosodic representation is inspired by McCarthy (2000: 178).

(28) Correspondence relations in *šari:ħ-at → šara:ʔiħ, *šaʔa:riħ*

Singular   *Actual Plural*   *Failed Candidate*
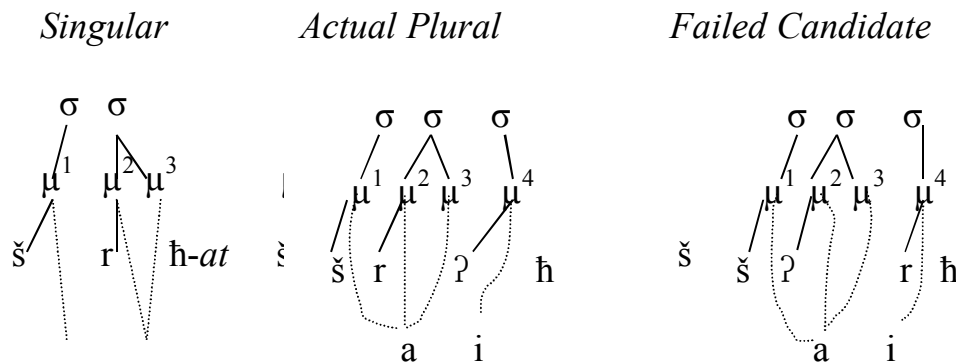
The problem with the failed candidate is that it has a kind of a reassociation in relation to the singular; the epenthetic /ʔ/ is attached to the second syllable as the onset instead of its original onset **r**, while in the actual plural it is attached to the third syllable as an onset. Onset **r** is violating the faithfulness constraint NO-DELINK$_{OO}$ (μ, SEG): it is attached to $μ^2$ in the singular while it is attached to $μ^4$ in the wrong candidate. The following tableau illustrates this representation.

Tableau (4)

šari:ħ-at +μ	DEP$_{OO}$-σ$_F$ (μ)	NO-DELINK$_{OO}$ (μ, SEG)
☞a. (ša.ra:).ʔi.ħ		
b. (ša.ʔa:).ri.ħ		*!

This tableau illustrates why candidate (b) is not the winning candidate: it violates the higher-ranked constraint that requires the segment /**r**/ to be attached to its mora (a:) not to the mora (i) of the other syllable. And, though it satisfies the higher-ranked constraint that requires final syllable preservation, yet candidate (b)

is out of competition because of its fatal violation to the equally higher-ranked constraint No-Delink$_{OO}$(μ, SEG).

The feminine suffix –at is not original in the word. It is just added to show word gender. Therefore, it is out of analysis. This is similar to McCarthy & Prince (1990a,b) and McCarthy (2000). Notably, singulars that end with a feminine suffix –at like šari:ħ-at and qabi:l-at, when forming plural forms, do not follow the main distinction between singulars and broken plurals: an extra mora. The same number of moras is realized in both their singular and plural forms. The coming representation clarifies this point.

(29) Moraic representation in šari:ħ-at → šara: ʔiħ
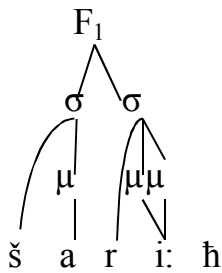
Singular   Broken Plural
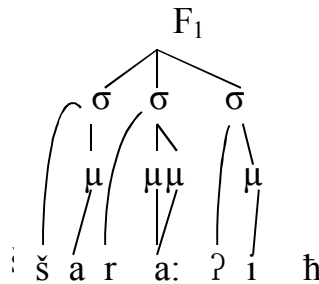
Because syllables must start with a consonant so as to begin with an onset, then, the higher- ranked constraint ONSET is much more important than a constraint that militates adding an extra consonant. The latter constraint is lower-ranked because it goes against a prominent constraint (McCarthy, 2000: 81).

(30) Dep$_{OO}$- Glide Every glide in output$_2$ has a correspondent in output$_1$. (Al-Aghbari, 2004: 66)

This constraint is a faithfulness constraint that requires every glide in the plural to have a correspondent in the singular. It is outranked by the ONSET constraint when a consonant is added to fill the empty position of a consonant and form a Cv syllable. Tableau (5) represents this.

Tableau (5)

(qa:).le.b +μ	ONSET	Dep$_{OO}$-Glide
☞ a. (qa.wa:).li.b		*
b. (qa. a:).li.b	*!	

Candidate (a), in tableau (5), has an epenthetic glide in the position of the onset of the second syllable. So, it satisfies the higher-ranked markedness constraint ONSET and violates the lower-ranked faithfulness constraint Dep$_{OO}$-Glide; it is the

optimal output. Candidate (b), on the other hand, satisfies the lower-ranked constraint: the position of the onset of the second syllable is empty *i.e* the syllable is onsetless. However, this behaviour prevents the candidate from obeying the higher-ranked constraint and having an extra consonant. Therefore, candidate (b) loses the competition.

(8)   **(Cv).(Cv:).C**   **(CvC).(Cv:).C**

a. (ga).(za:).l   (giz).(la:).n   gazelles
b. (bi).(la:).d   (bul).(da:).n   countries

Back to form (8), the words in (a) and (b) have an extra consonant /**n**/ at the edge of the final syllable. This is because words in MSA must end with a consonant. The broken plural forms start with a trochaic foot of the shape CvC instead of a typical iamb. Therefore, the affixed μ in these shapes is in a form of a consonant not a vowel. McCarthy & Prince (1993a) stipulate forms in (8) to follow the syllabic wellformedness constraint **Final-C**.

(31)   Final-C   A prosodic word does not end in a vowel (McCarthy & Prince, 1993a: 176).

This constraint is a syllabic wellformedness constraint. It requires syllables to end with a consonant. It is violated when candidates surface with open ended syllables.

Constraint (31) is in conflict with another constraint. It outranks the constraint No-Coda.

(32)   No-Coda   *C]σ ('Syllables are open.') (Kager, 2004: 94).

This constraint requires that syllables must not end in a consonant, or coda. It is violated when a syllable ends with a consonant.

The interaction of these two constraints in forms like (8) is as follows:

Tableau (6)

(ga).(za:).l+μ	**Final-C**	**No-Coda**
☞a. (giz).(la:).n		*
b. (giz).(la:)	*!	

Tableau (6) shows that obeying the constraint Final-C and ending the syllable with a consonant as a coda is more important than not having a coda. And, because constraint (31) is grounded in the system of language, then, any violation to this constraint is a serious violation; the candidate is out of competition.

Also, forms in (8) follow one of the main assumptions that the weight of the final syllable is preserved. And, these forms have only long final syllables, so, when mapping them onto plurals, they retain the long weight in the final syllable

of BP forms. As such, they totally obey the higher-ranked constraint MAX_{OO}-σF. The length is preserved due to the added consonant /**n**/.

The interaction of thus far constraints in form (8) produces the coming tableau.

Tableau (7)

(bi).(la:).d+μ	ONSET	MAX_{OO}-σ$_F$(μ)	*3μ	Final-C	DEP_{OO}-σ$_F$ (μ)
☞ a.(bul).(da:).n					*
b. (bul).(da).n		*!			*
c. (ul).(da:).n	*!				*
d. (bu).(lda:).n			*!		*
e. (bil).a:.da:	*!			*	**

Tableau (7) illustrates the interaction of equally higher-ranked constraints ONSET, MAXOO-σF (μ), *3μ, and Final-C, and, a lower-ranked constraint DEP$_{OO}$-σ$_F$ (μ). Candidates (a-e) violate the lower-ranked constraint because it goes against the higher-ranked constraint MAX_{OO}-σ$_F$(μ). Candidate (b) fatally violates constraint MAX_{OO}-σ$_F$ (μ): the long syllable is not preserved in the plural form. Candidate (c) also flouts the higher-ranked constraint ONSET: its first syllable is onsetless. Candidate (d) violates the syllabic wellformedness constraint *3μ: the second syllable is trimoraic. And, while candidate (e) violates the higher-ranked constraints ONSET and Final-C, candidate (a) shows no serious violation. Therefore, candidate (a) is optimal.

Thus far, the constraints in tableau (7) outrank each other in the following way:

ONSET » MAX_{OO}-σF (μ) » *3μ » Final-C » DEP_{OO}-σF (μ).

(9)

CvCC-[at]	**Cv.(Cv:C)**	
nuqṭ-**at**	nu.(qa:ṭ)	dots
ħarf	ħu.(ru:).f	letters

In form (9), singulars contain only one foot plus an extrametrical consonant. The foot is a moraic trochee of the shape CvCC. When forming BP forms, these singulars collapse forming a typical iamb of the shape CvC. This means that the one-syllable singulars map onto two-syllable BPs. The singular's weight is heavy, i.e, trochaic or *even iamb* **H** while the BPs' weight is light followed by heavy, i.e, *typical iamb* **LH**. The mechanism of forming BPs of such singulars is following the pervious mentioned constraints. However, they are violating the preservation of the final syllable: the singular's final syllable- weight is short while the plural's ones is long, i.e, they violate DEP$_{OO}$-σ$_F$ (μ). Notice the following tableau.

Tableau (8)

(nuq). ṭ-*at* +μ	ONSET	MAX$_{OO}$-σ$_F$ (μ)	Final-C	DEP$_{OO}$-σ$_F$ (μ)
☞a.(nu).(qa:).ṭ				*
b. (nu).(qa).ṭ		*!		*
c. u.(qa:).ṭ	*!			*
d. (nuq).a:.ṭ	*!			*

Tableau (8) clarifies the interaction of faithfulness and syllabic wellformedness of constraints in mapping iambs from trochees. Candidate (b) obeys the higher-ranked constraints ONSET and Final-C but disobeys the other equally higher-ranked constraint MAX$_{OO}$-σ$_F$ (μ). Candidate (c) and (d), though obeying some higher-ranked constraints, they both fatally violate ONSET. As a result, all candidates are out of competition except for Candidate (a), the optimal candidate. Two more forms are remaining. The following analysis is of form (10).

10. Cv.(CvC)   **Cv.(Cv:C)**

    ʔa.(sad)   ʔu.(su:d)   lions

    ʕi.(ṭir)   ʕu.(ṭu:r)   perfumes

Form (10) follows the analysis of form (9) except that singulars and BPs are both iambic. Singulars of the shape Cv.CvC which are **LL** are mapped onto a typical iambic BPs of the shape Cv.Cv:C which is **LH**. The adopted assumptions that singulars form iambic plurals and the difference between singulars and BPs lies in an extra mora are strictly obeyed. However, the assumption of weight preservation is violated when BPs surface with long vowels at the end of the second syllable despite the fact that their singulars' last-syllable weight is not. OT tableau in (9) illustrates these forms.

Tableau (9)

ʕi.(ṣir)+μ	ONSET	MAX$_{OO}$-σ$_F$ (μ)	Final-C	DEP$_{OO}$-σ$_F$ (μ)
☞a.(ʕu).(ṣu:).r				*
b. (ʕu).(tu).r		*!		*
c. (ʕu).(u:).r	*!			*
d. (ʕu:).(ṣu).r		*!		*

The previous tableau shows the interaction and conflict of the constraints in form (8) and other BPs of that follow the same mechanism. Candidates (b-d) are all wrong candidates because they all, and each on its own, dissatisfy a higher-ranked constraint. Candidates in (b, c, d) violate ONSET, and MAX$_{OO}$-σ$_F$ (μ) respectively. Candidate (a) is the only candidate in the tableau that obeys all the higher-ranked constraints and minimally violates constraint DEP$_{OO}$-σ$_F$ (μ) which is a lower-ranked constraint.

11.	C_1vC_2		$C_1v.(C_2v:C_2)$	
	xaṭ		xu.(ṭu:).ṭ	lines
	ħad		ħu.(du:).d	boundries

The last form to be tackled in this study is form (11).

The shapes in form (11) are interesting; the singular shapes of the form CvC, or moraic trochee is of three consonants. Notably, the last two consonants are geminated. The singular is originally xaṭṭ and ħadd. When such words are mapped onto BP forms, this gemination is split of the pattern. So, instead of having one foot of the shape CvC and an extra metrical consonant, the plural forms are realized as two feet of the shape $C_1v.(C_2v:C_2)$ in which one of the geminated consonants is in the position of the onset of the second foot and the other geminated consonant is the final extrametrical consonant. The plural form is still a typical iamb of a light syllable followed by a heavy syllable **LH**; however the mechanism these singulars follow to map onto BP is unique. To illustrate the mechanism, the following prosodic structure is presented.

(33) Prosodic Structure in *ħad → ħu.(du:).d* "boundries"

Singulars   *Broken Plurals*
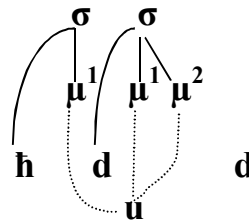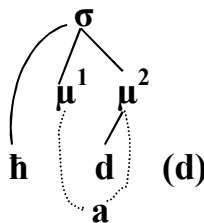
Group (33) illustrates that the consonant **d**, in singulars, belongs to the second mora in the first and only foot while, in plurals, it belongs to the first mora in the first syllable of the second foot. Also, the same consonant is used as an extrametrical consonant to prevent the words of having no coda.

In this way, substitution of medial gemination for vowel length is a primary mechanism relating the BPs to their singulars. This mechanism supports lengthening the final syllable to shape iambic plural forms.

All in all, and concerning the morphological process of BP formation in MSA, universal constraints of markedness and faithfulness are indeed workable to account for such a phenomenon. McCarthy's (2000) assumptions have paved the way for a well OT analysis. These assumptions do not work alone, *i.e*, the preservation of the final weight and adding an extra μ go hand in hand with the well-formedness constraints of the MSA. Well-formedness constraints, syllabic well-formedness constraints here, are ONSET, Final-C, No-Coda, and $*3\mu$. They interact with the other markedness and faithfulness constraints in the following hierarchy. The hierarchy accounts for the morphological processes in BPs MSA.

MAX_{OO}- σ_F (μ), {ONSET, **Final-C, No-Coda,** $*3\mu$}, {NO-SPREAD$_{OO}$(μ, SEG), NO-DELINK$_{OO}$(μ, SEG)}, MAX$_{OO}$ (μ), » DEP$_{OO}$-(μ), DEP$_{OO}$-Glide, DEP$_{OO}$-F_I(μ).

The overall hierarchy that accounts for the morphological phenomenon, namely BP, in MSA is:
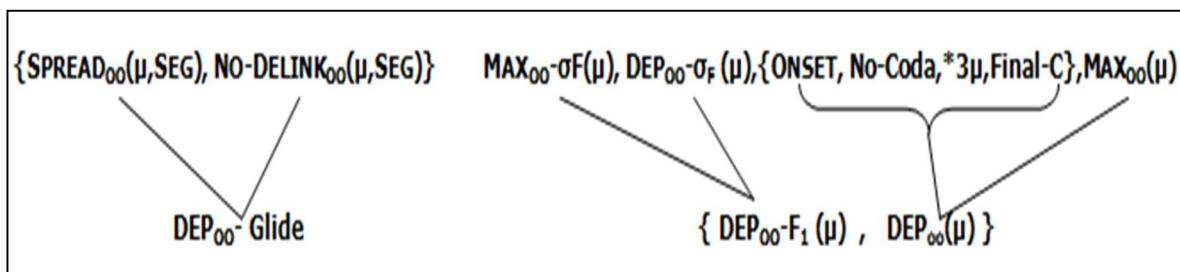
7. Conclusions:

In this paper, it is obvious that the focus of explaining the relationship between singulars and BPs in MSA is better captured and analyzed within OT in which Grammar is represented in terms of ranking constraints. BP as a kind of infixation is better studied within the OT approach to infixation by Prince & Smolensky (1993) and extended by McCarthy & Prince (1993/1995).

In this study, it is shown that the adopted assumptions of BPs iambicity, and last syllable preservation are correct: BP forms are typically iambic and the weight of their final syllable is retained. Also, it is proved that markedness constraints and faithfulness constraints interact with each other in a one unified hierarchy, and that single, unified hierarchy is all that is needed to account for a complicated phenomenon like BP in MSA.

In sum, BP in MSA is a regular plural. As evidence shows, mostly all nominals in MSA form BPs. This means that BP is the usual plural system and because the system is regular, then BP is regular. It is, as McCarthy (1993a) puts it, "the norm

rather than the exception". The only reason why it is misunderstood as irregular is because of the diversity and complexity it takes to form up to 30 different yet related measures. However, diversity of forms does not prove the regularity or irregularity of BP.

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