Word Stress Patterns in MSA: A Metrical-Based Analysis

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Abstract

Word stress in phonological theory has been received much attention in Arabic than any other language specifically the topic itself. One of these theories is the metrical phonology theory (henceforth MPT) which is proposed by Hayes (1995) and it has an important role in determining the stress placement of the word level in any language. For this reason, the current study attempts to analyze the primary stress patterns in Modern Standard Arabic (henceforth MSA) specifically the monosyllabic, disyllabic, and trisyllabic lexical words in the light of the principles and parameters of MPT like syllable quantity, foot inventory, directionally, and extrametricality and to see how this theory can account and predict about the correct stress placement in the word. There are some studies which investigate the metrical structure of primary word stress in MSA mainly in some of the Arabic variants but there is no such study analyzes and outlines in more in-depth the primary stress patterns of MSA particularly monosyllabic, disyllabic, and trisyllabic lexical words by using two metrical models: the tree and grid model. Hence, the present study tries to accomplish this gap and the data of this study are taken from a master thesis of Al-Sulaimaan (1986) **"A Study of Stress Patterns in English and Modern Standard Arabic"**. This study is value for those who specialists in phonetics and phonology specifically EFL/ESL learners since this study can help the learners to determine the correct placement of the word stress by applying the principles and parameters of MPT.

Keywords: *modern standard Arabic primary stress, metrical phonology; tree model; grid model*

1. Introduction

Arabic language is regarded as one of the official language for the most important states in the world. Although stress assignment in the spoken language of these states differs in respect to their social and geographical areas, the stress position in all the cases is the function of both syllable weight and syllable position (Watson, 2011).

Generally, some of the languages like Arabic and Finland are called stressless or fixed languages. Anyhow, Arabic is characterized as a fixed language and the stress in Arabic is not phonemic, i.e., it does not influence the meaning completely or change the class of the word and therefore, Arabic is regarded as one language that has a fixed stress since we can predict about the positions and levels of the stress (Al-Moosawy, 2007). In this way, the stress can direct us to the beginning and end of the words in connected speech, for instance, the stress always falls on the first syllable in the word ['kataba] (he wrote) whereas it falls on the second syllable in [ka'tabtu] (you pl. wrote) but it falls on the third one in the word [katab 'tuhu] (she wrote it), so in these examples, this does not mean that there is stress variation in the word but there is a fixed rule which is determined for each syllabic structure according to the constituent parts and syllabic succession of the word (Bishr, 1975). However, the current study analyzes the structure of word stress in terms of metrical phonology specifically using the two phonological models: metrical tree model and metrical grid model. The phonetic symbols used in this study which represent the Arabic word transcription are outlined as follows:

1. [ʔ] [ʔik.tib] (write-imperative)
2. [ʕ] [ʕa.lam] (flag)
3. [χ] [χa. ṭeer] (dangerous)
4. [ʃ] [ʃams] (sun)

5. [ṭ] [ṭib] (medicine)
6. [ṣ] [ṣa.deeq] (friend)
7. [ʤ] [ʤa.la.sa] (he sat)
8. [ħ] [ħa.li:b] (milk)
9. [Ɵ] [tim.Ɵa:l] (statue)
10. [ḍ] [ḍa:.baṭ] (officer)
11. [q] [qaa.la] (he said)

Other symbols are used in this study are as follows:

1. <> stands for extrametricality
2.(') stands for primary stress
3.(ᴗ) stands for light syllable
4. (—) stands for heavy syllable
5. (═) stands for superheavy syllable

2. Linear VS. Non-linear Phonology

English stress is regarded by most structuralists as an underlying feature of individual phonemes, and English is in fact treated as a "paradigm case of a language with a free stress" (Goyvaerts &pullum, 1975, 201; cited in Pater, 1992, 5). Chomsky and Halle in their book in (1968) The Sound Pattern of English (henceforth SPE) challenged this view by assuming that the stress patterns of words are derived by rule rather than being simply marked in the lexicon but even though, they do not completely encompass some important generalizations that are still used in the current approaches to the problem of defining the set of rules for English stress. For example, the stress placement of the nouns are discussed in SPE by starting with presenting the three classes of nouns. They are given in Table (1) (See Chomsky & Halle, 1968, 71):

Table 1. Three Classes of Nouns

America	aroma	agenda
Cinema	horizon	synopsis
Asterisk	corona	appendix
Analysis	angina	placenta

As Sampson (1975) maintains, Chomsky and Halle have taken into consideration only individual segments and not their syllabification in their explanation of these patterns of main stress. Thus, their set of rules is considered as "excruciatingly complex" (Ibid., 464). However, the main generalization was that for nouns with a final lax vowel, the penult vowel is stressed either if it is tense (column 2 above), or if it is lax and followed by more than one consonant (column 3) and the antepenult is stressed (column 1) when neither of these conditions is achieved, i.e, the penult vowel is lax and followed by only one consonant (Pater, 1992).

In addition, there are some works which deal with stress assignment in various dialects in Arabic like Abdo (1969), Johnson (1979) and some others who treated the stress in terms of segmental feature not the relative prominence relation among syllables. Consequently, the appearance of nonlinear approaches in the early years of the 70ts like auto-segmental and the metrical phonology was a reaction towards the SPE system by treating the stress assignment in terms of syllable rather than in segment (AL-Abdely, 2011). Accordingly, the main statement of auto-segmental phonology is that " phonological representations are composed of several parallel, independent tiers of segments: tones and phones" (Al-Bay, 2001, 7). In 2011, AL-Abdely adds that auto-segmental phonology reflects that tones and segments are separated out into tiers in which they are related to each other by correlating lines that may not cross. However, the most fundamental post-SPE phonology is the metrical approach since it can provide a new system of stress assignment which is based on trees with labeled nodes.

3. Metrical Phonology Theory

MPT emerged during the late seventies as part of nonlinear phonology. At first, the origin of the MPT belongs to Liberman's work (1975; cited in Al-Jarrah, 2002) on English word and phrasal stress. Later on, the English stress has treated within this framework and elaborated in Liberman and Prince (1977), Selkirk (1980) and Hayes (1981; cited in Dresher & Kaye, 1990). It is necessary to state that the general typology of stress systems was suggested in Halle and Vergnaud (1987; cited in Archibald, 1993) and Hayes (1981; cited in Dresher & Kaye, 1990) and it is totally based on the metrical theory (henceforth MT). Besides, this theory collaborates with its autosegmental counterpart to develop specific alternatives to the nonlocal devices of linear theory like the rule variables and abbreviatory conventions (Kager, 1996). According to Liberman's work, MT has viewed the stress as follows:

> Stress is not a phonemic feature of individual vowels in a word (as Earlier generative accounts, exemplified in Chomsky and Halle's Sound pattern of English, would have it), but that stress is a relative property to be captured in a hierarchical structure. Stress is conceptualized in terms of the relative prominence of syllables. A node is strong not by virtue of some inherent property, but because its sister node (in a binary branching structure) is weak. (Gills et al., 1995, 5)

The hierarchal organization of metrical structures is formally represented in terms of two models which are metrical trees and metrical grids. These two models are important to show the metrical structures hierarchically to account the phonetic and phonological differences between the stressed syllables and ordinary syllables. Therefore, this study sheds light on these two models and shows how the first one differs from the second model.

3.1 Metrical Tree

The segments in MP are grouped into syllables, syllables into metrical feet, feet into phonological words and words into larger units. In turn, the feet are organized into weak and strong (AL-Abdely, 2011). This is shown in Figure (1) in which (M) stands for a prosodic word and (F) stands for foot which contains syllables, 's' stands for strong and 'w' stands for weak:

Figure 1. The Structure of the Feet according to Metrical Phonology (Gills et al., 1995)

Gradually, in MP, the prominence in stress is determined by the strong/ weak feature rather than inherent phonetic realization because it is partially assigned by the relations between nodes in a branching tree where one node is strong and the other ones are weak and this shows that the strong node which is stronger than its weak sister node (see Hogg & McCully, 1987). In the same regard, AL-Abdely (2011) states that metrical tree provides the relative prominence of each constituents by labels of strong/weak (henceforth S/W) since it is composed of two syllables which are S-W or W-S and the constituent with S label has greater prominence than its sister constituent whereas the constituent with W label has less prominence than its sister constituent. See the following trees in (2) that represent the two words 'English' and 'behind' respectively (Ibid.):

Figure 2. The Tree Representation of the Words 'English & Behind'

It is clear that the two words 'English' and 'behind' are disyllabic words and in the word 'English', the first syllable is the strong syllable and the second syllable is the weak one whereas in the word 'behind', the first syllable is the weak one and it is the second syllable that attracts the stress which is the strong syllable (Ibid.). In (1996), Bradly further adds that the metrical trees can also be used to show the internal structure of words syllabically and to preserve the relative prominence between syllables in words that are multisyllabic. See the following figure (3) which represents the word 'execute':

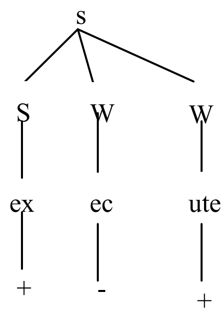

Figure 3. The Representation of the Internal Structure and Relative Prominence of the Word 'Execute'

We can see in the above example, the word 'execute' has three syllables in which the first and third one are strong but the first syllable is the more prominent than the third syllable because the first one is labeled by (S) and (+) marks while the third one is labeled by (S) and (-) marks and therefore, the first syllable attracts the primary stress since it is stronger than the third syllable (Ibid.).

Furthermore, another example is given by Pater (1992) to represent the metrical structure of the word 'decoration ' in the following diagram:

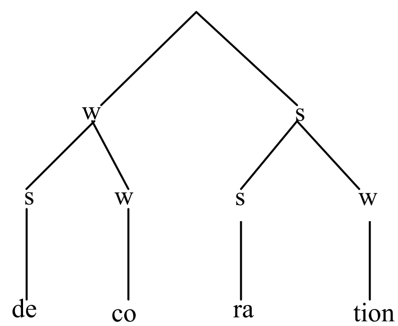

Figure 4. The Metrical Structure of the Word 'Decoration'

It is important to mention that metrical tree has been used by Arab researchers to analyze the stress patterns of some Arabic dialects like Palestinian Arabic by Abu-Salim (1981); Al-Bay (2001) and Iraqi Arabic specifically Hity Iraqi Arabic by AL-Abdely (2011).

3.2 Metrical Grid Model

The idea of grid began in Liberman (1975, cited in Al-Jarrah, 2002) and later on it is adopted by Liberman and Prince (1977); McCarthy(1979 a/b) and Hayes (1981; cited in Dresher & Kaye, 1990). They adopt the view that stress is an autonomous phonological reality that reflect the hierarchical organization of the rhythmic structure or grid and it is not an equivalent phonological feature to [nasal] (Ibid, 1977). However, the grid is an alternative way of expressing the internal metrical structures of words, phrases and sentences hierarchically as well as treating a phenomenon that is found in some languages involving English where stress moves to avoid stress clash (AL-Abdely, 2011). Hogg and McCully (1987) maintain that the metrical grid shows the information related to stress in a novel way and they also represent the whole account of grid levels in which the grid marks, stars, asterisks or Xs stand next to each in their respective columns.

Pater (1992) illustrates that the grid, unlike tree, can only show the prominence of the syllables rather than the groupings, or constituent structure of the syllables, i.e., 'foot structure' and an asterisk determines for each syllable and then an extra one for each of the 's' marks above it in the tree. The grid is represented in Figure (5) for the word 'decoration' as follows (Ibid.):

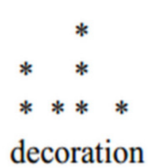

Figure 5. The Grid Representation of the Word 'decoration'

Clark and Yallop (1990) present an example 'Parramatta' to simplify the tree and grid and show how the tree can be converted into a grid by representing the entries at levels corresponding to the levels of the tree. The tree on the left below shows the stress pattern of the word 'Parramatta' in which the greatest stress on the third syllable and minimal stress on the second and fourth syllables and the tree can be planned to a grid, as represented on the right, where the x-entries agree to the nodes on the tree as seen in (6) below (Ibid.):

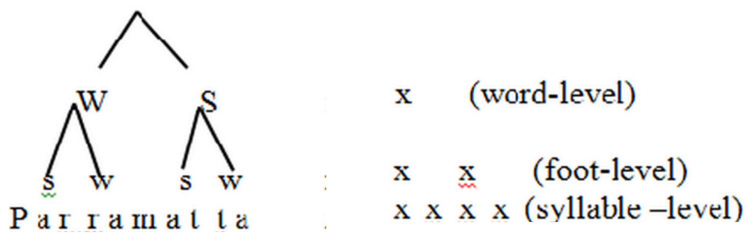

Figure 6. The Tree and Grid Representation of Stress Pattern of the word 'Parramatta'

Moreover, grid model is beneficial in showing the shifting in the stress. In the following example (7), the asterisks on line 0 indicate each potentially stress-bearing unit and stressed syllables have another asterisk on line 1 which have only secondary stress while syllables with another asterisk on line 2 are those with a primary stress (AL-Abdely, 2011):

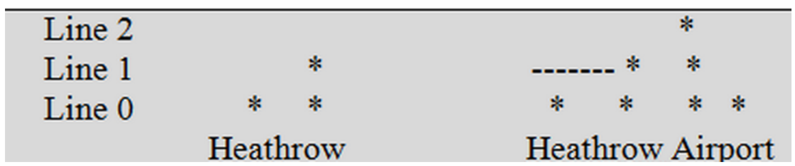

Figure 7. The Grid Representation of the Stress Shift

It is obvious that primary stress moves from second syllable in 'Heathrow' to the first syllable of the word 'airport' to be a secondary stress when the word 'airport' is linked with the word 'Heathrow' and the aforementioned example shows further how the metrical grids can treat the stress clash by moving the stress position as well as representing the rhythmic beats in a particular utterance (Ibid.). Moreover, metrical grids can be represented vertically and horizontally dimensions in which a grid stands for the relative prominence vertically and rhythm horizontally. On the same line, Kager (1996) adds that this can not be achieved by using metrical trees as they do not reflect rhythmic beats and the height of each column marks the stress level of syllable at its base and the higher column will represent the more prominent syllable than others. Consider the following examples that illustrate the vertical and horizontal dimensions of a grid as in (8) (Ibid.):

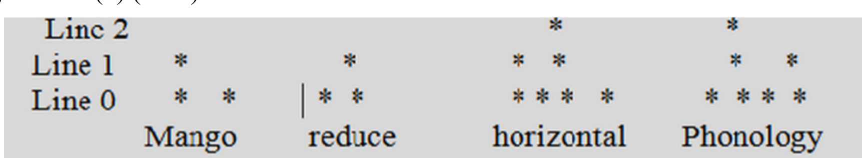

Figure 8. The Vertical and Horizontal Dimensions of a Grid Representation

In brief, trees mark hierarchy, constituency, and stress while grids mark hierarchy without constituency which are used to compute rhythm and consequently, trees use the notion that stress is purely relational and in the same time grids also mark substantive levels (Dresher, 1996)**.**

4. The Internal Structure of the Syllable in Arabic

In Arabic, the internal structure of the syllable is classified into onset and rhyme (henceforth O and R Respectively). In MSA, like in all Arabic dialects (see Al-Anani and May, 1978; Holes, 1995) for their Classical Arabic and (Abu-Mansour, 1990) for Mekkan Arabic, the syllable must contain an O that is composed of only one consonant immediately located in front of the nucleus (henceforth N) and R which is further classified into N and Coda(henceforth C). In this vain, AL-Jarrah (2002, 49) represents the structure of the syllable as it is composed of O (which is weak) and R (which is strong), See the following:

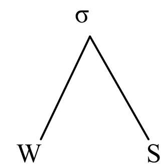

Figure 9. The Arabic Structure of the Syllable

Gradually, the rhyme contains the strong syllable which is the nucleus with any vowel and consonant that follow it which is regarded as the weak syllable (Ibid., 50). See the following:

a) light syllables b)heavy Syllables

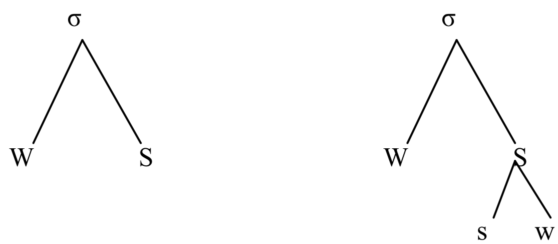

Figure 10. Light and Heavy Syllables in Arabic

Moreover, the syllable must contain an onset which means that there is no syllable that begins with a vowel and words can contain onset without coda, i.e., codas are optional like in the syllable structure CVV of the word [fi:] (in) (Al-Bay, 2001, 36), see the following Arabic examples:

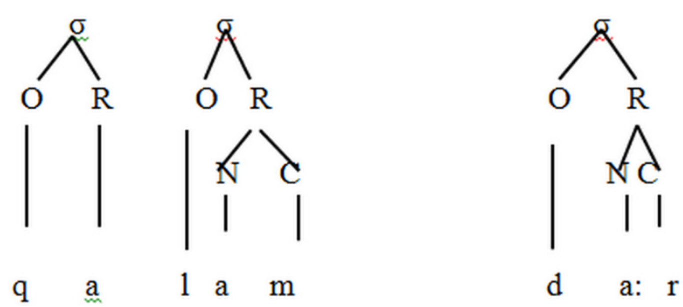

Figure 11. The Internal Structure of the Two Arabic Words [qalam] 'pen' and [da:r] 'house'

It is worth to mention that there are two important factors for assigning the stressed and unstressed syllables in Arabic: (1) the internal structure of the syllable particularly 'weight', and (2) the position of the stressed syllable and its relative to all other syllables in the same word (Abu Salim, 1980). Mainly, the internal structure of the syllable in Arabic has six kinds of syllables which are classified mainly into three categories: light, heavy, and superheavy (Al-Jarrah, 2002).

1)Light syllable is composed of a consonant followed by a short vowel (CV) like [kataba] 'he wrote'.

2)A heavy syllable is composed of either a consonant is followed by two vowels (CVV) like [mustaʃfaa] 'hospital' or a consonant is followed by a short vowel and consonant (CVC) like [muʕallim] 'teacher'.

3)A superheavy syllable is composed of a consonant followed by one or two vowels followed by one or two consonants:

a) CVVC [yasʔaluun] 'they ask' consonant +long vowel +consonant
b) CVVC [yawm] 'day' consonant +diphthong +consonant
c) CVCC [ʔakalt] 'she ate' consonant +short vowel +double consonant
d) CVCC [barq] 'thunderbolt' consonant +short vowel +consonant +consonant

e) CVVCC [ʃaabb] 'young' consonant +long vowel +double consonant

However, the position of stressed syllable as its relation to other syllables can be determined by three categories: stress on the ultimate, stress on the penult, or stress on the antepenult (Mitchell, 1960). Another category must be mentioned according to Harris (2007), open syllable and closed syllable are two kinds of the syllables in which the first one ends in a vowel and the second syllable ends in a consonant. In addition, the open syllable has a non-branching rhyme, i.e., the R has N but not C and a closed syllable has a branching rhyme, i.e., R has both N and C.

5. Metrical Parameters with Reference to MSA

There are five parameters (henceforth Ps) which have an important role in determining the stress assignment according to MP, these are summarized with reference to Arabic language as follows:

P1: Binary and Unbounded Feet (henceforth B & U)

Feet may be binary, unbounded, in which the first one is composed of, at most, two members in which one of them is strong and the other one is weak whereas unbounded feet is composed of any number of members which are one strong and any number of weak. The third kind of the foot is called degenerate foot which contains only one syllable, consider figure (12) below (Archibald (1993):

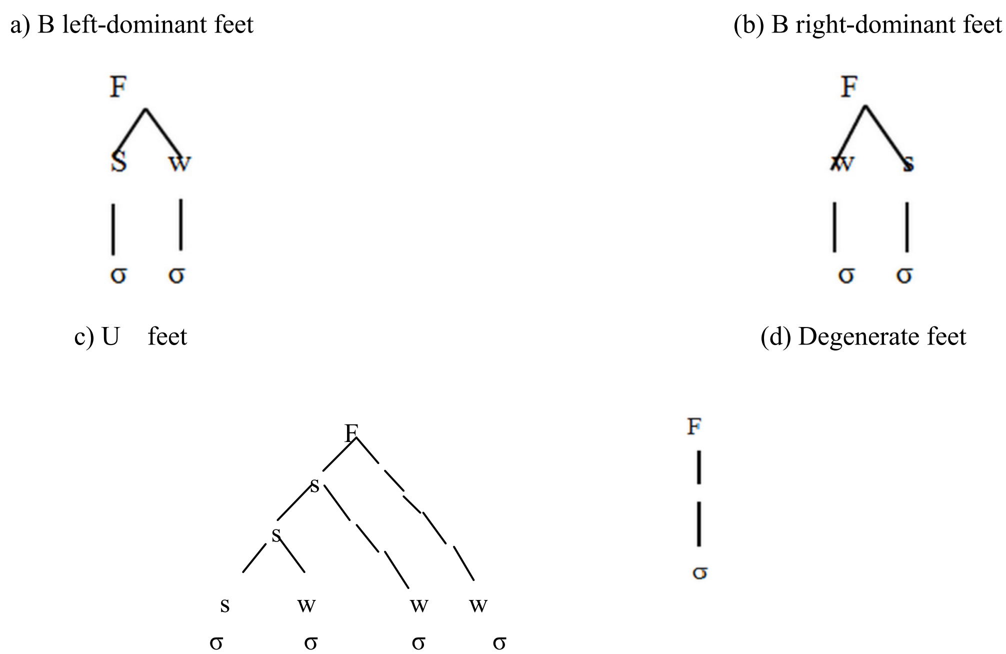

Figure 12. The Four Kinds of the Feet

In Arabic, feet are binary and it allows no more than two elements, i.e., two syllables or subsyllables (moras) must have a direct dominance under a feet node (AL-Abdely, 2011). Likewise, AL-Jarrah (2002) states that in Arabic the foot contains two moras, the first of which is stronger; and any single heavy syllable constitutes a metrical unit or foot by itself, therefore two light syllables (LL) or one heavy syllable can constitute a possible foot in Arabic. The following diagram shows how the pairs of light syllables form the foot construction of the word [ʔadwiyatuhu] (his medicine):

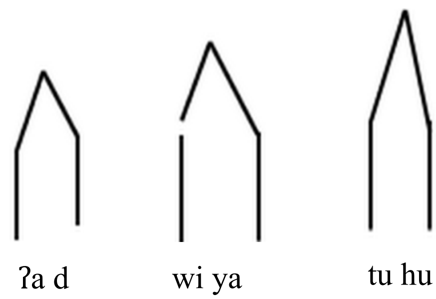

Figure 13. The Foot Construction in Arabic (AL-Jarrah, Ibid.)

P2: Direction of Tree construction

The foot construction happens either from left-to-right or right-to-left (Gillis et al., 1995). Words are parsed into feet starting either from left-to-right like in Arabic or right-to-left like in English and the parsing of the words as a left-to-right or right-to-left is language specific (Hayes, 1989), see the following word [da.ra.sa] (he studied) as it starts parsing from left-to-right:

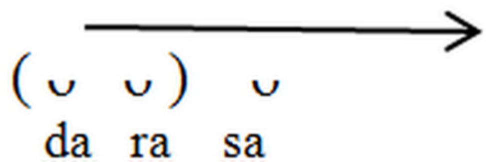

Figure 14. The Feet Parsing in the Word [da.ra.sa] (he studied)

P3: Foot Headedness or Construction

It is important to identify how the foot is constructed for purposes of stress placement. The foot is defined by Davenport and Durham (1998, 149) as "an organizing structure for combining syllables, or more precisely for combining stressed and unstressed syllables" and hence, the foot results from combination between the stressed and unstressed syllables. In (2008), Swain mentions that the headedness parameter specifies whether the language has right- or left-headed feet. According to Hayes (1995), stress is determined by constructing a layer of feet across a word and it is usually that one of the foot within the word stands out and then it determines main stress (Oostendorp, 2005). In this respect, Kager (1996,6) maintains that "there is a small universal inventory of foot types, and languages can only select types from this inventory" and there may be languages in which there is neither a clue for the metrical feet nor showing of how a particular syllable systematically stronger than its phonological neighbors .

However, Hayes (1995) summarizes the typology of the languages into two types. The first one is called iambic languages which have the right dominant and permit the following feet (LL), (LH), (H) and (L) if the language permits degenerate feet ('L' stands for a light syllable and 'H' stands for a heavy syllable). On the contrary, trochaic languages have the left dominant which are further categorized into two types: moraic trochees and syllabic trochees in which the first ones are QS that permit the following feet: (H), (LL), and (L) if the language permits degenerate feet and conversely, the second trochees are QI which permit any disyllabic foot and monosyllabic if the language permits degenerate feet (Ibid.). A language with metrical feet selects either iambic or trochaic feet and the two types of the foot are not allowed in one language (see Oostendorp, 2005). See the following diagram in (15) that shows the syllabic trochaic, moraic trochaic and moraic iamb respectively and the symbols (x) and (.) stand for a strong and light foot (Ibid.):

(a) Syllabic Trochee	(b) Moraic Trochee	(c) Moraic lamb
(x .)	(. x)	(. x)
(σ σ)	(μ μ)	(μ μ)

Figure 15. Mora Representation in the Typology of the Languages

However, Arabic language like other Arabic dialects is the one that needs trochaic rhythm in which the stress is located on the first element and hence Arabic language constructs moraic trochee feet that maximally involves of two moras (two light syllables or one single heavy syllable) which means that the only possible foot construction in Arabic is the moraic trochees (see Al-Bay, 2001; AL-Abdely, 2011).

P4: Quantity Sensitivity (QS)

Languages differ according to whether they are either QS or insensitive (henceforth QI) with respect to stress assignment. In many languages, it is noticed that the heavy not light syllable that attracts stress and hence as already mentioned heavy syllable is the one that has commonly branching rhyme whereas the light syllable has a non-branching rhyme. It is usually the languages that contain such difference, i.e., heavy and light syllables (between the weights of syllables) are called QS languages whereas the languages that don't have such difference are called QI languages (Harris, 2007). Besides, the syllable in QI languages can happen with or without branching rhymes but the distinction between these kinds of syllables has no relation to the placement of stress (Ibid.).

Interestingly, Arabic is the one that is regarded QS language like all variants of Arabic since it distinguishes between the heavy and light syllables (AL-Abdely, 2011; AL-Jarrah, 2002). QS languages are the ones which are based on syllable weight in determining stress location and this can be done using moras. It is important to mention that stress assignment is described by Prague school (Jakobson, 1971) in terms of what is called moras rather than syllables since the use of mora is essential in determining the stress assignment not only in indicating the segmental length and syllable weight but also in indicating syllabification (Al-Bay, 2001). However, this type of syllable-internal structure is formalized by Hyman (1975) and it is further developed by Hayes in (1989) to distinguish between the syllables in the words. Besides, in moraic model, the mora measures the weight of the syllable in which the light syllable involves one mora (monomoraic) whereas heavy syllable involves two moras (biomoraic) and superheavy involves three moras (Hegberg, 2006).

As far as the Arabic language is concerned, AL-Jarrah (2002) assigns the use of mora is essential to tackle stress assignment since it can show the difference between the heavy and light syllable and Arabic has all the three kinds of syllable, i.e., light, heavy, and superheavy syllable and therefore the light syllable consists of one mora and the heavy syllable consists of two moras while the superheavy syllable involves three moras. The following are the three kinds of the syllable which are represented by tree and grid model in (a), (b), and (c) respectively where the underlined represents the rhymes of the syllable and (μ), (*) stand for the mora in tree and grid model respectively (Ibid.):

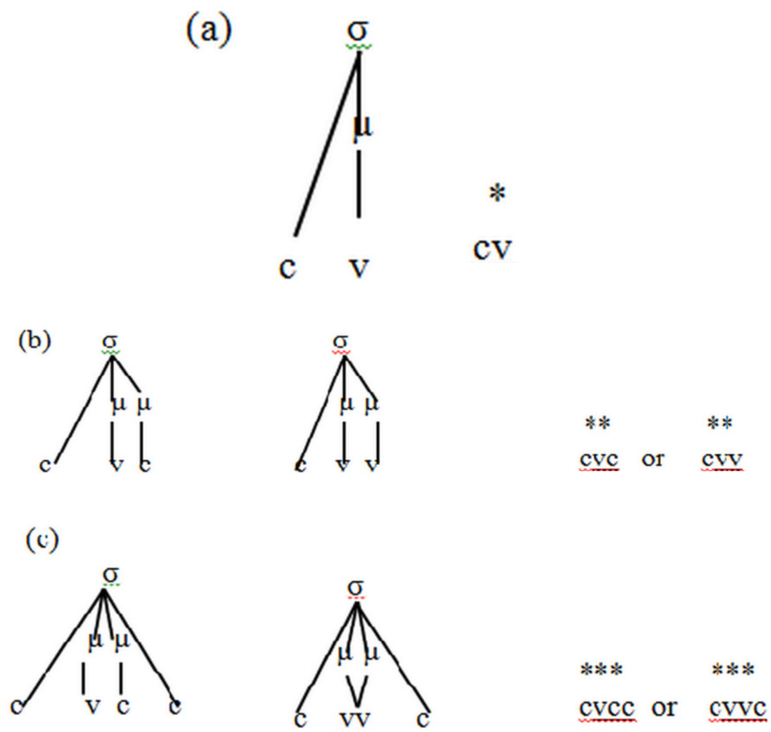

Figure 16. The Representation of Mora in the Three Kinds of Arabic Syllable by Tree and Grid Model

P5: Extrametricality

The notion of extrametricality has introduced by Liberman and Prince (1977) to treat the exceptional behaviors of closed syllables and the invisibility of peripheral elements to stress rules (Watson, 2011). Besides, extrametricality is regarded as a fundamental concept in MP since it has an important role in assigning the stress placement and indicating the extrametrical element in the word which must be 'invisible' to stress assignment (AL-Abdely, 2011). However, extrametricality is symbolized by (< >) notation and it can be used for a certain cases: First, the consonant, syllable, and foot are only considered as extrametrical in respect to the extrametrical constituents; second, the constituent is extrametrical when it occurs either left or right of its domain and the unmarked edge for extrametricality is the right one (Hayes, 1995).

In Arabic, Hayes (1995) assures that the rightmost consonant is analyzed as invisible to stress rules through extrametricality indicating that final CVC is equivalent in weight to non-final CV instead of specifying that CVC is light finally which are heavy non-finally and that CVCC and CVCV syllables are heavy finally which are superheavy non-finally, see the following :

Final	Non-final
CV	CV
CV<C>	CV
CVV	CVV
CVC<C>	CVC
CVV<C>	CVV

Accordingly, the quantity of the syllables in Arabic language can be summarized by tree diagrams as follows:

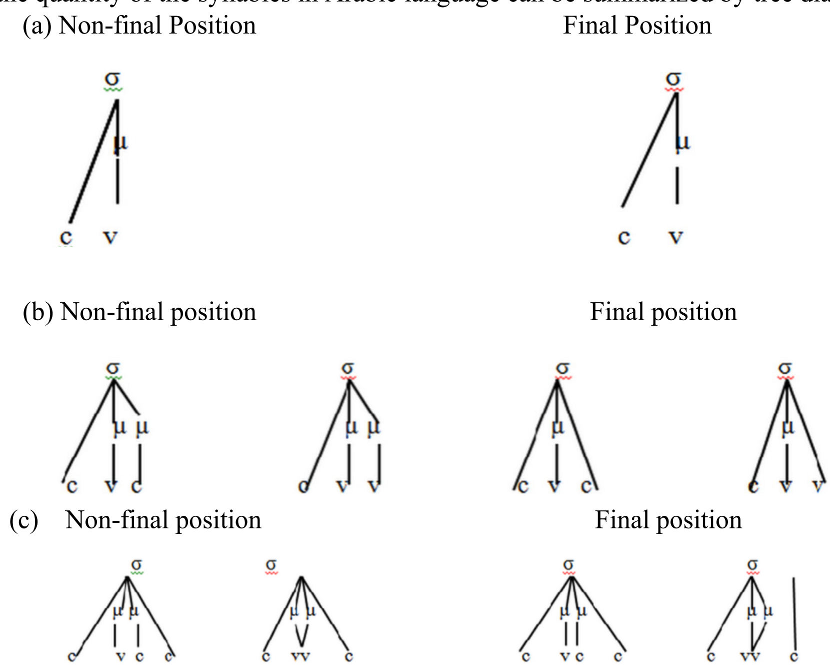

Figure 17. Extrametricality in Non-Final and Final Position of Light Syllable, Heavy Syllables and Superheavy Syllables

6. Metrical Primary Stress Patterns in MSA

Arabic syllable structure has been given intensive research for more than two decades and researchers like Al-Anani and May (1978), McCarthy (1979 a/b, 1980), Selkirk (1980), Abu-Salim (1980) and AL-Sulaimaan (1986) have argued upon the rules of stress in Arabic as follows:

1)Stress occurs on the last syllable of the word if it is superheavy /cvcc/ or /cvvc/ ,e.g ., [da'rast] (she studied) , [qɪ'ṭa:r] (train), [kɪ'ta:b] (book)

2)Stress occurs on the penult if it is heavy /cvc/ or /cvv/ and the final syllable is not superheavy, e.g., [yak'tubna] (they (fem.) write), [ju'huudun] (efforts)

3)Otherwise, stress the antepenult syllable, e.g., ['kataba] (he wrote), ['ʃadʒarah] (tree)

However, the stress patterns of MSA will analyze in the light of the aforementioned five parameters to identify the metrical rules of Arabic language and to see whether the metrical phonology theory can predict and generate the stress patterns rules in MSA correctly. Besides, this study is concerned specifically with analyzing only the monosyllabic, disyllabic and trisyllabic words.

6.1 Monosyllabic Lexical Words

Phonetically, words that have one-syllable are realized in the following two types:

1)	CVVC	['su:q]	(market)	['fi:l]	(elephant)
2)	CVCC	['dars]	(lesson)	['ʃarq]	(east)

By applying the metrical rules of stress according to Hayes (1995), the last consonant in a superheavy syllable must be regarded as extrametrical at the level of syllabification. See the following diagram (18) that shows the stress assignment of the two words ['su:q] (market) and ['dars] (lesson) using the tree model:

Figure 18. The Metrical Structure and Extrametricality of Monosyllabic Words

Consequently, the stress prominence in the above two words are shown in the following diagram (19) in which the final consonant is disregarded and the moraic foot is formed by remaining heavy syllables as bimoraic. This is described by x to show the location of the stress and it is surrounded by brackets to indicate the foot binary, see also (Al-Bay, 2001) for her analysis of Palestinian Arabic variant):

(x)		(x)	
su:	<q>	dar	<s>

Figure 19. The Bracketed-Grid Model of Monosyllabic Words

It is worth mentioning that degenerate feet, sub-minimal forms of moraic foot, are not possible in Arabic language which means that there is no light syllable words in Arabic language because these light syllables CV are not capable of constructing a foot (Ibid.).

6.2 Disyllabic Lexical Word

Generally, the stress occurs on the first syllable regardless of its weight if the second syllable is not superheavy. The following syllable types of disyllabic words are possible in Arabic language:

1)	Light-Light	['ma.ta]	(when)	['sa.na]	(year)
2)	Light-Heavy	['saʔ.al]	(he asked)	['ʔa.mal]	(he worked)
3)	Heavy-Heavy	['mak.tab]	(office)	['ba:.ħiθ]	(scholar)
4)	Light-Superheavy	[ki.'ta:b]	(book)	[fa.'qa:r]	(poor)
5)	Heavy-Superheavy	[ṭa:.'wu:s]	(peacock)	[ṣa:.'ru:χ]	(rocket)

According to Liberman and Prince (1977), Hayes (1981), and Abu-Salim (1982), the first syllable of disyllabic words in (1), (2), and (3) is labelled as strong whereas the second one is weak, see the following tree diagram in the aforementioned three patterns:

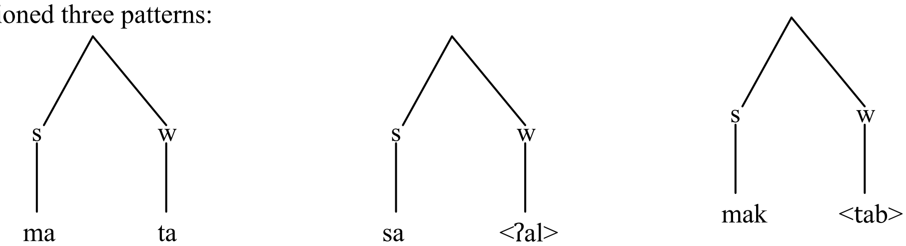

Figure 20. The Tree Structure of the Patterns (light-light), (light-heavy), and (heavy-heavy)

As for patterns (4) and (5), the right node is regarded as strong only if it is superheavy, i.e., it branches Liberman and Prince (1977), see the following diagram respectively:

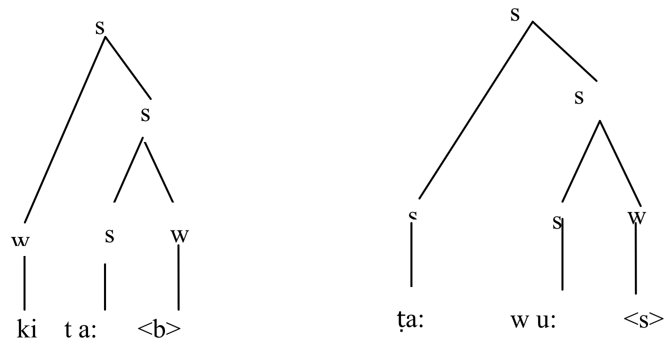

Figure 21. The Tree Structure of the Patterns (light-Superheavy) and (heavy-superheavy)

It is important to analyze the above groups in terms of principles and parameters of metrical phonology concerning foot construction, word layer construction (End Rule Right) and extrametricality. For the purpose of this study, the symbols (ᴗ), (—), and (═) are used for light, heavy and superheavy syllables respectively. First of all, as for the pattern light-light in (1), the pair of light syllables are formed by a moraic foot and hence the stress occurs on the first mora by applying trochaic rule, i.e., first syllable of ['mata], this can be described where in (a) (x) means strong and (.) means weak syllable which are surrounded by parentheses to show the foot boundary and (b) bracketed- grid model.:

(a)

(x	)
(x	.)
ma	ta

(b)

x		Line 2
(x	)	Line 1
(x	x)	Line 0
ᴗ	ᴗ	syllables
ma	ta	

Figure 22. The Bracketed-Grid Structure of Stress Assignment in the Word [ma.ta]

As regarding the second group light-heavy and third group heavy-heavy in (2) and (3) respectively, both those two words end with heavy syllable which must be treated as light rather than heavy to eliminate the possibility of having stressed in final position . Hence, this can be done by considering the final consonant as extrametrical in (2) and the final syllable as extrametrical in (3), then binary foot with prominence on the first syllable, i.e., left-headed foot (Abu-Salim, 1980; Al-Bay, 2002), see the following:

x			x		Line 2
(x	)		(x	)	Line 1
(x	x)	<l>	(x)	<tab>	Line 0
ᴗ	—		—	—	syllables
sa	ʔal		mak	tab	

Figure 23. The Bracketed-grid Structure of Stress Assignment in the Words [sa.ʔal] and [mak.tab]

Gradually, the last two groups light-superheavy and heavy-superheavy in (4) and (5) respectively, According to Hayes (1995, 126), "final C in CCXC is not syllabified at the initial stage: CVXC is analyzed as heavy syllable + stray consonant, while CVC is nalyzed as light syllable + extrametrical consonant", see the following:

CVX.C
CV<C>

Consequently, the last consonant in the two words [kita:b] and [ṭa:wu:s] is regarded as extrametrical to protect final foot from foot extrametricality, i.e., prevent the rightmost foot to be peripheral (Hogg and McCully, 1987). As for the word [kita:b], the first light syllable is skipped over by the rule priority clause principle which is used when there is a light syllable followed by heavy syllable to enforce strong prohibition on degenerate feet (Hayes, 1995), see the following:

	x			x		Line 2
(	x)		(	x)		Line 1
x	(x)	<b>	(x)	(x)	<s>	Line 0
ᴗ	=		—	=		syllables
ki	ta:b		ṭa:	wu:s		

Figure 24. The Bracketed-grid Structure of Stress Assignment in the Words [kita:b] and [ṭa:.wa:s]

To sum up, the stress patterns in MSA disyllabic words are summarized in Table (2) below:

Table 2. Primary Stress Patterns in MSA Disyllabic Lexical Words

Word pattern	Primary Stress Location	Metrical Rules	Examples
ˈLight-light	Initially	Form a moraic foot over the two light syllables with initial prominence	[ˈma.ta] (when)
ˈLight-heavy	Initially	-Mark final consonant Extrametrical - Construct two moraic feet from left-to-right	[ˈsa.ʔal] (he asked)
ˈHeavy-heavy	Initially	-Mark final syllable Extrametrical. --construct a moraic foot over the first heavy syllable.	[ˈmak.tab] (office)
Light-superheavy	Finally	-Mark final consonant extrametrical. -Apply Priority Clause Principle (Skip over first light syllable). -Construct a foot over the second Syllable. -Apply End Rule Right.	[ki.ˈta:b] (book)
Heavy-superheavy	Finally	-Mark final consonant Extrametrical. -Construct two moraic feet from left-to-right. -Apply End Rule Right.	[ṭa:.ˈwu:s] (peacock)

It seems throughout looking at the stress patterns of disyllabic words in MSA, the metrical theory can predict and generate the correct stress assignment in MSA disyllabic words: stress the ultimate if it is superheavy after performing consonant extrametricality and end rule right otherwise stress the penultimate after performing the consonant extrametricality in the pattern (light-heavy) and syllable extrametricality in the pattern (heavy-heavy) **.**

6.3 Trisyllabic Lexical words

The following syllable types of disyllabic words are possible in Arabic language:

1. Light-light-light [ˈka. ta. ba] (he wrote) [ˈda. ra. sa] (he studied)
2. Heavy-light-heavy [ˈʕa: .li. mun] (a scientist) [ˈna: .ʤi. hun] (successful)
3. Heavy-light-light [ˈmad. ra. sa] (school) [ˈmaʕ. da. ba] (banquet)
4. Light-light-heavy [ˈda. ra. sat] (she studied) [ˈʤa. la. sat] (she sit)
5. Light-heavy-heavy [wa.ˈzi:. run] (minister) [wu.ˈfu:.dun] (delegations)
6. Light-heavy-superheavy [di . ra: .ˈsa:t] (studies) [ba. sa: .ˈti:n] (orchards)
7. Heavy-light-superheavy [ṭa: . ʔi . ˈra:t] (planes) [ʕa: . mi . la:t] (workers (fem.)
8. Light-light-superheavy [ta. ma . Ɵi:l] (status) [ṣa. na. di:q] (boxes)

In the light of the principles and patterns of metrical phonology, the accurate analysis of the aforementioned patterns as follows:

Pattern (1): Light-light-light ˈᴗ ᴗ ᴗ [ˈka. ta. ba] (he wrote)

Scanning from the left-to-right, the moraic feet is formed over the first two light syllables and then the final light syllable marked as extrametrical with initial stress on the first syllable:

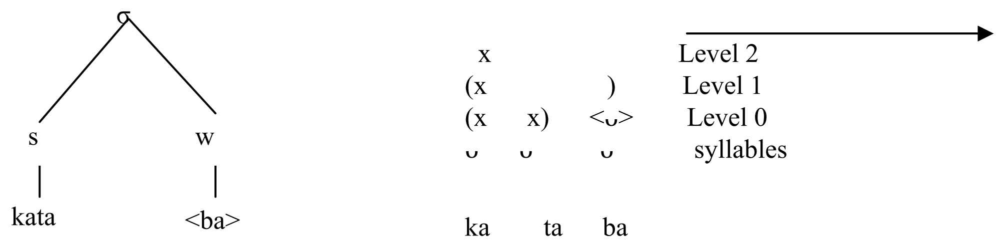

Figure 25. The Metrical Structure of Stress Assignment in the Word ['ka. ta. ba]

Pattern (2): Heavy-light-heavy '— ᴗ — ['ʕa: .li. mun] (a scientist)

In applying the metrical rules on the above pattern, we must start marking the last consonant as extrametrical and forming the moraic feet from left-to-right over the first heavy syllable and the last two light syllables with primary stress on the first syllable, see the following:

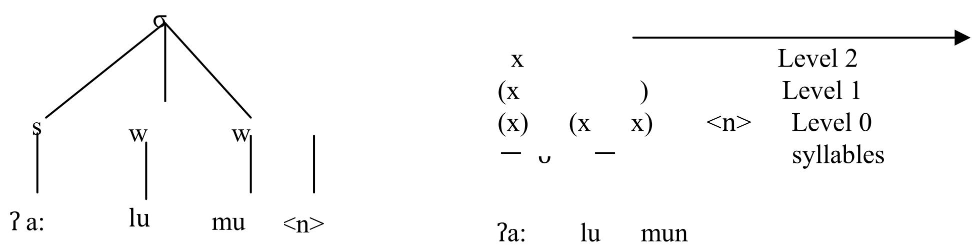

Figure 26. The Metrical Structure of Stress Assignment in the Word ['ʕa: .li. mun]

Pattern (3): Heavy- light-light '— ᴗ ᴗ ['mad. ra. sa] (school)

Analyzing these words according to metrical stress rules, it is noticed that there are two moraic feet are formed starting from left-to-right in the above pattern: the first one over the first heavy syllable and the second one over the two light syllables and the stress occurs on the first syllable after applying foot extrametricality as follows:

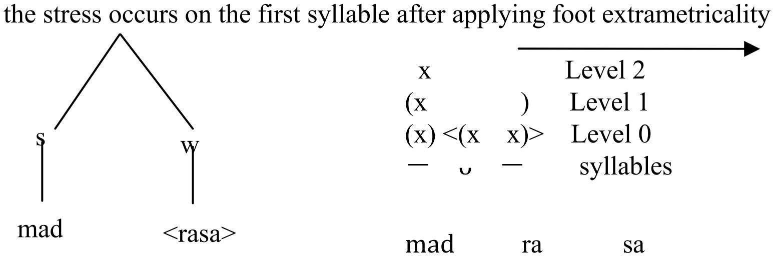

Figure 27. The Metrical Structure of Stress Assignment in the Word ['mad. ra. sa]

Pattern (4): Light-light-heavy ['da. ra. sat] (she studied)

The metrical rules applied on pattern (5) as the moraic feet is formed over the first two light syllables and then construct the final syllable as extrametrical with initial stress on the first syllable:

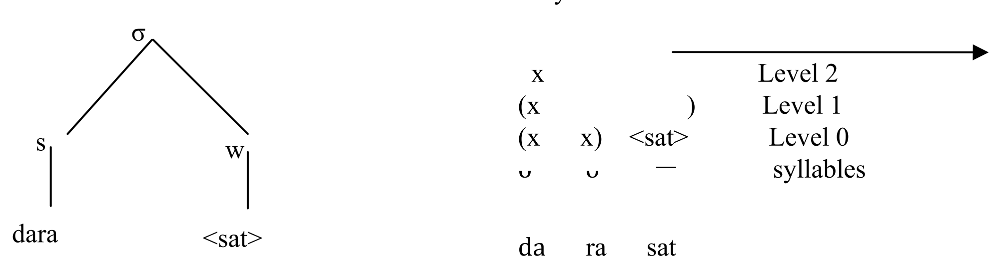

Figure 28. The Metrical Structure of Stress Assignment in the Word ['mad. ra. sa]

Pattern (5): Light-heavy-heavy ᴗ ˈ—— [wa.ˈzi:. run] (minister)

We can notice that stress occurs on the second syllable since the ultimate is not superheavy. This can be illustrated by marking the final syllable as extrametrical and then applying end rule right. with moraic foot over the second heavy syllable. As for the first light syllable, it is skipped over by the special priority clause principle since it is followed by heavy syllable to enforce strong prohibition on degenerate feet (Hayes, 1995), see the following:

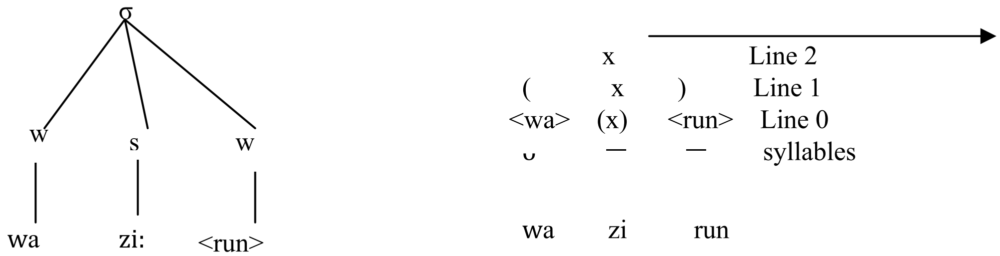

Figure 29. The Metrical Structure of Stress Assignment in the Word [wa.ˈzi:. run]

Patten (6): Light-heavy-superheavy ᴗ — ˈ═ [di . ra: .ˈsa:t] (studies)

We can see the stress occurs on the final superheavy syllable where the last consonant is marked as extrametrical to prevent foot extrametrical. Scanning the word from left to right, the initial light syllable cannot construct foot itself so it is skipped according to the rule of priority clause principle since it is followed by heavy syllable and one moraic feet formed over the second heavy syllable and the other one over the last heavy syllable. Primary stress occurs on the ultimate syllable after applying end rule right, see the following:

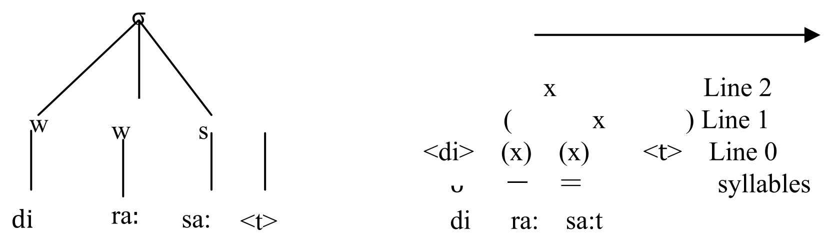

Figure 30. The Metrical Structure of Stress Assignment in the Word [di . ra: .ˈsa:t]

Pattern (7): Heavy-light- superheavy —ᴗ ˈ═ [ṭa: . ʔi . ˈra:t] (planes)

In the above pattern, the final consonant in the last syllable marked as extrametrical and then applying the stress on the ultimate syllable by end rule right. Scanning from the left-to-right, the word is parsed into moraic feet starting from the first heavy syllable and then the parsing is stopped as there is a light syllable which is must be skipped by the rule of priority clause principle since it cannot construct a moraic feet. The parsing resumes to form another moraic feet over the last superheavy syllable as follows:

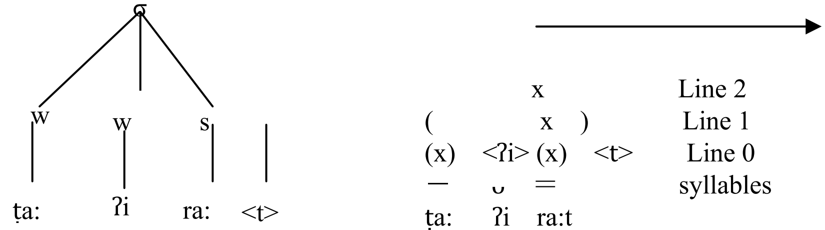

Figure 31. The Metrical Structure of Stress Assignment in the Word [ṭa: . ʔi . ˈra:t]

Pattern (8): Light-light-superheavy ᴗ ᴗ ˈ═ [ta. ma . ˈΘi:l] (status)

Starting from the left-to-right, the first moraic feet is formed over the first two light syllables and then the second one begins with the single heavy syllable as the final consonant is marked as extrametrical to protect foot extrametrical with prominence on the ultimate syllable by applying the end rule right:

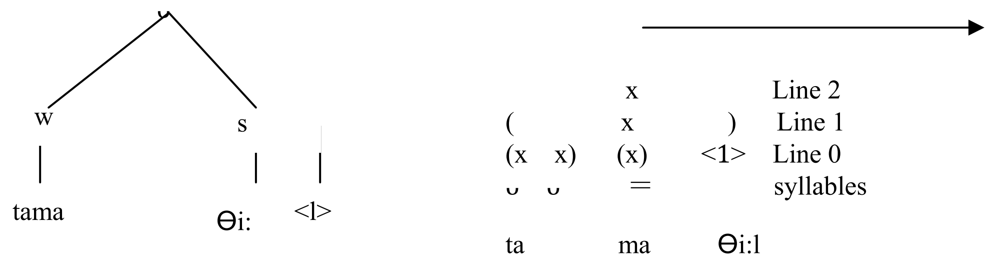

Figure 32. The Metrical Structure of Stress Assignment in the Word [ta. ma .ˈƟi:l]

The following Table (3) summarizes the stress patterns rules of Trisyllablic words in MSA in the light of MPT:

Table 3. Primary Stress Patterns in MSA Trisyllablic Lexical words

Word Pattern	Location of Primary Stress	Metrical Rules	Examples
ˈᴗ ᴗ ᴗ	Initially	-Final ᴗ extrametrical. -Moraic foot over the first two syllables	[ˈka. ta. ba] (he wrote)
ˈ— ᴗ —	Initially	-Final consonant extrametrical. - Moriac feet from left-to-right.	[ˈʕa:.li.mun] (a scientist)
ˈ— ᴗ ᴗ	Initially	-Foot construction from left-to-right. -foot extrametricality.	[ˈmad. ra. sa] (school)
ˈᴗ ᴗ —	Initially	-Final syllable extrametrical. --Moriac feet from left-to-right.	[ˈda. ra. sat] (she studied)
ᴗ ˈ— —	Medially	-Final syllable extrametrical. -First ᴗ skipped over -moraic foot over the second heavy syllables. -End rule right.	[wa.ˈzi:. run] (minister)
ᴗ — ˈ=	Finally	-Final consonant extrametrical. -First ᴗ skipped over. -foot construction over the second heavy Syllable and the last heavy syllable. -End rule right	[di . ra:.ˈsa:t] (studies)
— ᴗ ˈ=	Finally	-Final consonant extrametrical. -Moriac feet from left-to-right -Second syllable is skipped over by priority Clause principle. -End rule right	[ṭa: .ʔi . ˈra:t] (planes)
ᴗ ᴗ ˈ=	Finally	Final consonant extrametrical. -Moraic feet from left-to-right. -End rule right.	[ta. Ma .ˈƟi:l] (status)

After applying the metrical rules on the stress patterns rules of trisyllabic words, the metrical rules can predict and generate the stress rules in MSA in which the final superheavy attracts stress after applying consonant extrametricality and end rule right. If the final syllable is not superheavy, the penultimate attracts stress if it is heavy through considering the final syllable as extrametrical, otherwise the antepenultimate is stressed after applying one of the three kinds of extrametrical, i.e., either consonant extrametrical or syllable extrametrical or foot extrametrical.

7. Conclusions

In this analysis, the researcher has investigated the stress patterns rules of MSA in terms of metrical phonology theory. It is noticed that this theory can predict and account for primary stress assignment of lexical words specifically monosyllabic, disyllabic and trisyllabic words in MSA by adopting numerous rules like extrametricality, end rule right , and priority clause principle. Besides, tree and grid models are used to represent the stress in two ways in which the first one is used to show the hierarchal structure of the prosodic word whereas the second one is used to show the prosodic structure in relation to stress assignment in MSA, i.e., the prominence of the stressed syllable. However, the major conclusions of this study are summarized as follows:

1)MSA is a quantity-sensitive language which is based on syllable weight to assign stress location. Heavy syllables assign two moras to (cvc) and (cvv) in non-final position whereas superheavy syllables assign two moras in word-finally and non-finally position.

2)All feet in MSA are maximally binary which are called moraic trochees and degenerate feet are not allowed in MSA. Feet parsing of the word in MSA begins from the left-to-right and we start represent syllable weight from the final syllable until we reach the first.

3)Extrametricality can be applied on segmental and prosodic level in MSA. On the segmental level, the consonant is marked extrametrical to obtain the correct stress placement or on the prosodic level the whole syllable or foot may be marked as extrametrical in order to account for the location primary stress.

4) The metrical rules of disyllabic words indicate that ultimate syllable attracts stress if it is superheavy after performing consonant extrametricality and end rule right otherwise stress the penultimate after performing the consonant extrametricality in the pattern (light-heavy) and syllable extrametricality in the pattern (heavy-heavy) . In trisyllabic words, the final superheavy attracts stress after applying consonant extrametricality and end rule right. If the final syllable is not superheavy, the penultimate attracts stress if it is heavy through considering the final syllable as extrametrical, otherwise the antepenultimate is stressed after applying one of the three kinds of extrametrical, i.e., either consonant extrametrical or syllable extrametrical or foot extrametrical.

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