Optimality Theoretic Representation of Stress in Cairene Arabic

Rajaa Aquil
School of Modern Languages, Georgia Institute of Technology, Atlanta, USA
Email: rajaa.aquil@modlangs.gatech.edu

Received July 13th, 2012; revised August 13th, 2012; accepted August 20th, 2012

Stress pattern of Cairene Arabic (CA) has played a major role in the development of stress placement theory. Syllable weight plays a role, however, the weight to stress principle does not always apply. Bimoracity of a foot is very important and is largely addressed in the literature. Stress in CA is described in the literature as Moraic Trochee, but primary stress is on one of the three leftmost syllables. Many studies investigated primary stress in CA. These studies employed different theoretic formulations based on the segmental rules, the metrical phonological tree, and the metrical phonological grid. Notwithstanding, no recent study has translated the findings of the aforementioned literature into an Optimality Theoretic Constraints framework. The present paper attempts to accomplish this feat. The paper also presents a new set of data based on CA spoken language.

Keywords: Cairene Arabic Primary Stress; Optimality Theoretic Framework; Constraints Hierarchy; Cairene Arabic Spoken Data

Introduction

The stress pattern of Cairene Arabic (CA) has played a major role in the development of metrical and stress placement theory (Halle & Vergnaud, 1987; Hayes, 1995; Prince, 1983; Selkirk, 1984). There is no dispute over the place of primary stress in CA, namely, it is on one of the rightmost three syllables (Gairdner, 1926; Halle & Vergnaud, 1987; Harms, 1981; Harrell, 1957; Hayes, 1995; McCarthy, 1979; Mitchell, 1956, 1960a; Welden, 1980).

1) a) Stress the penult, whether light or heavy.
   i) bána he built
   ii) fihim he understood(3rd sg, m)
   iii) mibbahb easygoing

b) Stress the final if superheavy.
   i) barabánd one who talks very fast and fluently
   ii) mutaʕallaqáat belongings
   iii) baraniit hats

c) Stress the antepenult or the penult, whichever is separated by an even number of syllables from the immediately preceding heavy syllable or the beginning of the word (where zero separation is counted as even).
   i) šágara a tree
   ii) ṭibádaš invented
   iii) sabahlála haphazard

Formulations of primary stress have had different representations, e.g., rule-based stress assignment (Chomsky & Halle, 1986, 1991), metrical phonological tree (Liberman & Prince, 1977) and metrical phonological grid (Halle & Vergnaud, 1987).

2) Segmental Rule-Based (Welden, 1980).

S is either a heavy syllable (H) or a light syllable (L)

S → [+stress]/ (# X H) ___ L L ##

The rules abbreviate the following environments.

i) Stress the antepenult if it is a light syllable, right after a heavy syllable or starting the word, as in a) and b).

ii) Or stress the penult, as in c) or the final elsewhere, as in d).

a) L → [+stress] / # X H ___ L L ##
   ?mbásat'ú they became happy
b) L → [+stress] / # ___ L L ## kātabu ‘they wrote’
   c) S → [+stress] / ___ L ## ráma ‘he threw’
      maktába ‘a library’
   d) S → [0 + stress] / ___ ## šáaf ‘he saw’
      kataba‘l’il> ‘they wrote it’
      kitáab ‘book’

It is well known that segmental rule-based theory was not adequate to represent all stress-related phenomena, especially the internal structure of a syllable and its role in determining where stress is placed. For example, rules could not capture the hierarchical structure of a syllable structure, as the syllable cannot be explained in a single line or linear approach. This led researchers to adopt nonlinear phonological theories, e.g., metrical tree phonology and metrical grid phonology, to capture prosodic phenomena that were not straightforwardly represented in the segmental rule-based theory. The following metrical phonological tree and metrical phonological grid structures 3) demonstrate the representation of the primary stress in the word [ʕasaliyyáaya] ‘kind of candy’.

3) a) Metrical Phonology Tree

b) Metrical Phonology Grid

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However, to my knowledge, no study has ever translated the findings of the literature in relation to primary stress in CA into an Optimality Theoretic Framework. In this paper I attempt to accomplish this feat.

The data set analyzed in this paper is drawn from Cairenese spoken Arabic. Studies conducted on Arabic so far have either focused on Classical or Modern Standard Arabic, and on Classical Arabic as pronounced by Egyptian or Cairenese Arabic speakers, what has come to be known as Egyptian Radio Arabic (Halle & Vergnaud, 1987; Hayes, 1995; Kenstowicz, 1980, 1994; McCarthy, 1979; Mitchell, 1960b). As a result, the findings and motivating models available in the literature are, for the most part, based on the Cairenese pronunciation of Classical Arabic, a variety that may exhibit two different stress systems: Cairenese Arabic and Classical Arabic pronounced in a Cairenese way. The literature motivates the inclusion of Classical Arabic since it supplies the data with a wider array of possible syllabic shapes, and thus provides a stiffer test for any proposed model (Hayes, 1995: p. 67).

Because studies investigating the stress pattern of CA have generally looked at the CA pronunciation of Classical or Modern Standard Arabic norms, I set on analyzing a CA data set independent of Classical, in order to present a stress account that is based solely on uniquely CA phonetic outputs.

The CA data in (1) show that stress in CA words is placed on the penult, whether it is heavy or light, but may also be placed on the ultimate final syllable if it is super-heavy or on the antepenult whether it is light or heavy. Therefore, neither position nor weight is the sole decisive factor in determining where stress should fall.

From the data-set in 1) we can reach the following generalizations:

4) Generalizations on stress
   a) Monosyllabic words must be bimoraic.
   b) Main stress in bisyllabic (LL) words is on the left syllable.
   c) In a polysyllabic word, the main stress must fall on the rightmost light or heavy syllable.
   d) Stress does not fall on a final CVC syllable.
   e) Stress falls on a final syllable only when it is CVV or super-heavy, i.e., CVCC or CVVC.

Well-established phonological analyses of minimal word requirements in the literature demonstrate that some languages require content words to be of some minimal size, often two syllables or two moras (Kenstowicz, 1994). In CA, a monosyllabic content word must be superheavy, CVVC or CVCC. A final consonant does not add to the weight of a syllable, so only superheavy syllables reach the minimum size of two moras. As a result, a degenerate foot must be forbidden—a conclusion also reached by Watson (2002) within autosegmental phonological theory.

Since super heavy syllables attract stress, we can infer that a constraint, which prefers weight to be stressed, must be at play. Likewise, since stress falls on one of the last three right-most syllables, an alignment constraint favoring the right edge of the word must also be at play in stress assignment. Directionality of how feet are constructed also plays a role in where stress falls, as exemplified in [šágara] in (c)1 where stress is on a leftmost, rather than the rightmost syllable. Finally, we realize from the data that final CVC and CVV act differently. The former does not attract stress, but the latter does.

I propose an Optimality Theoretic (OT) analysis in tableau (Tableaux 1-11) using violable as well as un-dominated constraints. This analysis demonstrates and represents straightforwardly and economically the optimal place where primary stress docks in a word. The following constraints are at play.

### Optimality Constraints Ranking Approach

OT adopts a representational framework in which the optimal candidate that satisfies the high-ranked constraint wins over all other candidates produced by GEN (the generator that creates linguistic candidates). The grammar decides on the winner through EVAL, which selects the best candidate that satisfies the high-ranked constraints. In addition, the grammar decides on surface forms; therefore, there is no resort to ordering rules. In OT, forms are marked with respect to some constraint if they violate it. These forms are literally marked in that they incur violation marks for the constraint as part of their grammatical derivation. In this way, these forms or candidates are considered losers and an [L] is marked in the column of the given constraint. The constraints in 5) are considered to have a role in stress placement in CA.

5) Prosodic and stress constraints in CA

**FOOT BINARITY (FTBIN)**

Feet must be binary under syllabic or moriac analysis (McCarthy & Prince, 1986, 1990, 1993b; Prince, 1980).

**Weight-to Stress Principle (WSP)**

Heavy syllables must be stressed (Prince & Smolensky, 1993, 2004).

**PARSE-Syllable (PARSE-σ)**

A syllable must be footed (Prince & Smolensky, 1993, 2004).

**Foot-form (trochaic) (TR)**

Leftmost position of the foot is the head of the foot. This constraint requires feet to be left headed and accounts for the trochaic form of the disyllabic feet (Prince & Smolensky, 1993, 2004).

**PARSE Segment (PARSE SG)**

All segments of a syllable must be linked to the level immediately above (McCarthy, 2008).

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1Optimality Theory (McCarthy & Prince, 1993a; Prince & Smolensky, 1993, 2004) is a constraint-based approach to phonological well-formedness. It posits that Universal Grammar has a set of violable universal constraints (CON). These constraints encompass universal properties of languages. All universal constraints are available in every language in the world. However, each language has its particular ranking of these constraints, i.e., a certain hierarchy. Some languages may rank a certain constraint high in its hierarchy while others may rank the same constraint very low. This difference in constraint ranking explains the variation that arises between languages. In addition Optimality Theory (OT) adopts a representational framework in which the candidate that optimally satisfies a given constraint ranking wins over all other candidates produced by GEN (the generator that creates linguistic candidates). The grammar decides on the winner through EVAL, which selects the best candidate that satisfies the high-ranked constraints.

2CA data was extracted from (Badawi & Hinds, 1986), A dictionary of Egyptian Arabic.

3Egyptian and Cairenese Arabic refer to the same main dialect spoken particularly in the Egyptian capital of Cairo, and the delta.
ALIGN (Foot, L, PrWd, L) (AFL)
All feet aligned left
ALIGN the left edge of each foot with the left edge of some prosodic word (McCarthy & Prince, 1993).
ALIGN (Foot, R, PrWd, R) (AFR)
All feet aligned right
ALIGN the right edge of each foot with the right edge of some prosodic word (McCarthy & Prince, 1993).
ALIGN HEAD (PrWd), R PrWd, R (ALIGN HEAD/R)
Main stress of the word is rightmost
ALIGN the head foot of a prosodic word with the right edge of a prosodic word (McCarthy & Prince, 1993).

FootBinarity >> Trochaic, PARSE-σ, PARSE-SEG, ALIGN-FOOT-L

Because minimal word requirement is adhered to in CA, as noted above, FtBin must have a very high ranked role in the prosody of CA and should accordingly be high ranked. Tableau 1 illustrates the interaction between FTBIN, which stipulates that a foot consist of two moras, and PARSE SG, which specifies that all the segments of a syllable should be parsed.

Tableau 1 shows that there is a direct ranking between FTBIN and PARSE-σ. No ranking is evident between PARSE-σ and PARSE SG, as the two are in a stringency relationship, i.e., every violation of PARSE-σ is also a violation of PARSE SG, but the reverse is not the case. In Tableau 1 candidate (a) is the optimal candidate because it does not violate FTBIN. Candidates (b) and (c) lose because they violate FTBIN. Candidate (b) satisfies PARSE-σ by parsing all the syllables, and it also satisfies PARSE SG by parsing the last consonant in the word. However, by satisfying these two constraints, candidate (b) violates FTBIN when it parses a degenerate foot that is not of two moras (i.e., [li]) and when it parses the last consonant. By parsing the last consonant, the final syllable becomes trimoraic.

Tableau 2 illustrates the ranking between FOOTBINARITY and TROCHAIC.

Tableau 2 demonstrates that FTBIN dominates both PARSE-σ and TROCHAIC. The most optimal candidate (a) since it obeys FTBIN constraint at the expense of TROCHAIC and PARSE-σ. Candidate (b) loses because it parses a degenerate foot (i.e., [mi]), whereas candidates (c) and (d) lose because a foot exceeds two moras. Candidate (d) loses in spite of the fact that all the segments of a syllable should be parsed.

Tableau 3 demonstrates TROCHAIC dominating AFL and ALIGN-FOOT-L is also a violation of PARSE SG, but the reverse is not the case. In Tableau 3 candidate (a) is the optimal one because it minimally violates PARSE-σ. Candidate (b) loses to candidate (a) because, by satisfying AFL and aligning all feet to the left edge of the word, three violations of PARSE-σ occur.

Tableau 4 demonstrates PARSE-σ dominating AFL. Candidate (a) is the optimal one because it minimally violates PARSE-σ. Candidate (b) loses to candidate (a) because, by satisfying AFL and aligning all feet to the left edge of the word, three violations of PARSE-σ occur.

**Note:** The interested reader may refer to McCarthy (2008: p. 65).
WSP >> PARSE-σ

Returning to the role weight plays in stress assignment in CA, we note from Tableau 6 that weight dominates PARSE-σ. The optimal candidate in Tableau 6 is (a) because it does not violate WSP, whereas candidate (b) does. Candidate (a) obeys WSP while minimally violating PARSE-σ, a low-ranked constraint. Although candidate (b) fulfills PARSE-σ by parsing all syllables of the word, it loses because it does not obey WSP; stress is assigned to a light syllable (i.e., [tita]).

The interaction between FtBin and Wsp is illustrated in Tableau 7, which demonstrates that FtBin dominates WSP. FTBin favors candidate (a) over candidate (b). In candidate (b) the stress moves to a heavy syllable, thus satisfying WSP, but by parsing a degenerate foot [mu] FTBin is violated. In fact FTBin is shown to dominate both WSP and PARSE-σ, a finding in line with rankings already established in Tableau 1 above (FTBin >> PARSE-σ).

ALIGN-HEAD/R >> WSP

Heavy syllables, as mentioned earlier, play a role in attracting stress. However, a heavy syllable does not always attract stress in CA words such as (cf. 1 a ii [(fi)him]). This suggests that there is a more important constraint at play, which pressures stress to fall on a light syllable rather than a heavy one as long as the light syllable is among the last three rightmost syllables of the word (see 000 [sa(bah)(lalal)]. Tableau 8 demonstrates the interaction between WSP and that of ALIGN-HEAD/R, which is responsible for the main stress of a prosodic word.

Candidate (a) wins, although it does not fulfill WSP, since stress falls on a light syllable (i.e., [Yaddi] instead of the preceding antepenultimate heavy syllable [dal]). Candidate (b) obeys WSP, but violates a higher-ranked constraint, ALIGN-HEAD/R, and hence loses to the winner (a). The Tableau illustrates the domination of ALIGN-HEAD/R over WSP.

Tableau 6.

<table>
<thead>
<tr>
<th>?(/titihiyya/</th>
<th>WSP</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>’inauguration’</td>
<td>a. (/?i)(tita)hiyya</td>
<td>*</td>
</tr>
<tr>
<td>b. (/?i)(tita)hiyya</td>
<td>*W</td>
<td>L</td>
</tr>
</tbody>
</table>

Tableau 7.

<table>
<thead>
<tr>
<th>/musalsala/</th>
<th>FTBIN</th>
<th>WSP</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>’TV series’</td>
<td>a. mu(sal)(sala)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. (mu)(sal)(sala)</td>
<td>*W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

Tableau 8.

<table>
<thead>
<tr>
<th>/?idda/kadi/</th>
<th>ALIGN-HEAD/R</th>
<th>WSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>’term used by women’</td>
<td>a. (?i)(dal)(i) ‘?adi’</td>
<td>*</td>
</tr>
<tr>
<td>b. (?i)(dal)(i) ‘?adi’</td>
<td>W</td>
<td>L</td>
</tr>
</tbody>
</table>

Tableau 9.

<table>
<thead>
<tr>
<th>/?istiratijiyya/</th>
<th>ALIGN-HEAD/R</th>
<th>PARSE-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>’strategy’</td>
<td>a. (?i)(tira)(ti)(jiy)ya</td>
<td>*W</td>
</tr>
<tr>
<td>b. (?i)(tira)(ti)(jiy)(y)(a)</td>
<td>*W</td>
<td>L</td>
</tr>
</tbody>
</table>

Tableau 10.

<table>
<thead>
<tr>
<th>/?istiratijiyya/</th>
<th>FTBIN</th>
<th>ALIGN-HEAD/R</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>’strategy’</td>
<td>a. (?i)(tira)(ti)(jiy)(y)(a)</td>
<td>*W</td>
<td>*W</td>
</tr>
<tr>
<td>b. (?i)(tira)(ti)(jiy)(y)(a)</td>
<td>*W</td>
<td>*W</td>
<td>L</td>
</tr>
</tbody>
</table>
To sum up thus far, a direct ranking is found between the ALIGN-HEAD/R and Trochaic constraints as illustrated in Tableau 11, and between WSP and PARSE-\( \sigma \), as demonstrated in Tableau 8. But the ranking relationship between ALIGN-HEAD/R and AFL still needs to be established. I propose that ALIGN-HEAD/R dominates AFL transitively. We have seen in Tableau 9 that ALIGN-HEAD/R dominates PARSE-\( \sigma \), and in Tableau 5 that PARSE-\( \sigma \) dominates AFL. Since ALIGN-HEAD/R dominates PARSE-\( \sigma \), and PARSE-\( \sigma \) dominates AFL, then it is safe to assume that ALIGN-HEAD/R dominates AFL by means of transitivity. I also propose for the interaction between WSP and AFL that AFL dominates WSP by means of transitivity. In Tableau 6 WSP dominates PARSE-\( \sigma \), and in Tableau 5 PARSE-\( \sigma \) dominates AFL; therefore, the ranking WSP >> AFL can be assumed by transitivity as well.

Conclusion

7) Primary Stress constraint hierarchy

<table>
<thead>
<tr>
<th>FTBIN</th>
<th>ALIGN-Hd/R</th>
<th>TR</th>
<th>WSP</th>
<th>PARSE-( \sigma )</th>
<th>PARSE-( \sigma )</th>
<th>AFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(bára) (nii)&lt;t&gt;</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mu(sal)(sála)</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(fihi)&lt;m&gt;</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ʔis)(tirā)(ti jejyi)ya</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ʔd)(dala)(tádi)</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ʔt)(tí)(tí)h(í)ya</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(šága)ra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sa(bah)(lála)</td>
<td>*</td>
<td>****</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mi (šii)</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(múta)(táli)lí(qáa)&lt;t&gt;</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis also discussed WEIGHT TO STRESS constraint. The summary Tableau shows that this constraint, in conjunction with ALIGN HEAD/RIGHT, explains stress on heavy penult syllables. WEIGHT TO STRESS constraint also dominates PARSE-\( \sigma \). In fact, PARSE-\( \sigma \) is low ranked, and hence syllables that are of one mora are not parsed. With the analysis in this paper, findings in the literature concerning primary stress in CA are translated into an Optimality Theoretic framework illustrating the interaction between stress constraints.

REFERENCES