# "Bottom-Up" Stress Assignment: Evidence from Arabic

The metrical theory outlined in Hayes (1995) analyzes word stress by postulating a universal and highly constrained inventory of foot shapes: the moraic trochee, the syllabic trochee, and the iamb. These are used to scan and parse a string of syllables into feet. This approach to footing, which uses metrical feet as analytical primitives, can be thought of as a "top-down" approach. In contrast to this, Idsardi (1992) and Halle & Idsardi (1995) treat stress assignment as an algorithm for constructing a bracketed prominence grid. In this latter account, feet only exist as a result of the application of a parameterized set of rules. I will term this the "bottom-up" approach to building metrical structure. A survey of three Arabic dialects reveals certain problems that are inherent to a top-down account (represented by analyses given in Hayes (1995)). These problems do not arise in a bottom-up account.

1. Classical Arabic (CA) (McCarthy 1979) has an unbounded stress system; i.e., it has no binary feet. Since the top-down account of metrical theory only allows binary feet, Hayes relies on a totally separate system, the prominence grid, to assign main stress in such cases. However, a set of grid construction rules for CA stress based on the Idsardi (1992) formalism, e.g. (1), does not encounter this problem. (2a) shows the stress grid for a word containing heavy syllables, and (2b) shows a stress grid created over a word with all light syllables.[1]

2. Palestinian Arabic (PA) (Kenstowicz 1983) retracts stress to the preantepenult in four-syllable words containing only light syllables. In Hayes (1995), this is achieved by marking the word-final foot as extrametrical (4b). Yet in the same account, foot extrametricality cannot apply in certain contexts, e.g., (5b) and (6b). A bottom-up system, because it need not (in fact, *cannot*) refer to feet as units, avoids the problem of foot extrametricality altogether. Proposed rules for PA are shown in (3), with the stress grids derived from these rules shown in (4a), (5a), and (6a).

3. Bani-Hassan Arabic (BHA) (Irshied & Kenstowicz 1984, Kenstowicz 1983, 1994): Because of the restricted set of foot shapes, a top-down account forces an analysis of BHA which relies on "weak local parsing" (Hayes 1995), i.e., leaving an unfooted syllable between each foot (8b). However, a bottom-up account is not so restricted: the unremarkable set of rules given in (7) can achieve the right stress pattern (8a). Another issue is raised by the syncope rule illustrated in (9). In the bottom-up analysis (9a), the surface stress grid is a straightforward result of deletion of a vowel and its associated grid mark. However, in the top-down foot-based analysis (9b), deletion results in a degenerate foot in weak position, which is not allowed by the theory. In a bottom-up account, of course, there is no such thing as "degenerate feet."

Overall, Hayes's top-down analysis results in quite different modes of stress assignment for these three dialects—CA stress is not metrical at all, and BHA essentially has ternary footing. But a bottom-up account of stress grid construction results in the very similar sets of rules given in (1), (3), and (7). Even CA does not seem so different from the modern dialects, since all that it lacks is iterative binary foot construction (the ICC). It seems reasonable to expect that analyses of closely related languages should be similar to one another. This similarity is achieved in the bottom-up account.

The stress patterns of the three Arabic dialects described above, as well as other dialects not mentioned here, can all be accounted for by a restricted set of grid construction rules, rather than a restricted set of foot shapes. If the bottom-up analysis of grid construction rules is the correct way to think about stress, metrical feet should not be considered phonological primitives, but rather units which arise as the result of the application of ordered rules.

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[1] In CA, as in all the dialects surveyed here, a word-final consonant is extrametrical, and does not count toward syllable weight. This is indicated by the angle brackets. CV syllables are light, while CVV and CVC are heavy.

(1) Classical Arabic Stress Assignment Rules

Line 0 Project All syll. project a grid mark onto Line 0.
Heavy:L Heavy syll. project a left bracket: (x.
Edge:RRR Place a right bracket to the right of the rightmost grid mark.
Head:L Project the left member of each group onto Line 1.
Line 1 Edge:RRR
Head:R

(3) Palestinian Arabic Stress Assignment Rules

Line 0 Project
Heavy:L&R Heavy syll. project a left and a right bracket: (x).
Light#:0 Word-final light syll. do not project a grid mark.
Edge:LLL Place a left bracket to the left of the leftmost grid mark.
ICC:R,L→R Insert right brackets iteratively in a binary pattern, moving from the left edge rightwards.
Head:L
Line 1 Edge:RRR
Head:R

(7) Bani-Hassan Arabic Stress Assignment Rules

Line 0 Project
Heavy:L
Light#:0
Edge:RRR
ICC:R,L→R
Head:L
Line 1 Edge:RRR
Head:R

Classical Arabic

```
        x          x
      x  x)        x)
    x(x (x  x)     x x x x)
```

(2)a. mana:di:lu 'kerchiefs' (nom.) b. balaḥatu<n> 'date' (nom.sg.)

Palestinian Arabic

```
      x                 (x  )
      x)                (x .)<(x .)>
    )(x x)x .
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(4) a. šaǰaratu<n> 'a tree' b. šaǰa ratu<n>

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      x                 (  x)
    x x)                  (x)
  )(x(x)
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(5) a. daras<t> 'I studied' b. daras<t>

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      x
      x                 (x    )
    )(x .               (x .  )
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(6) a. kata<b> 'he wrote' b. kata<b>

Bani-Hassan Arabic

```
        x
    x    x)           (     x  )
  (x  x)x).           (x)   (x .)
```

(8) a. ʕallamatu<h> 'she taught him' b. ʕallamatu<h>

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       x                  x
   x   x)               x x)
  )x x)x).            ) x)x).
```

(9) a. saḥabata<k> → sḥabata<k> 'she pulled you(m.sg.)'

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  (     x  )        (    x  )
  (x .)(x .)        ( x)(x .)
```

b. saḥa bata<k> → sḥa bata<k>

References:

Halle, M. and W. Idsardi. 1995. Stress and metrical structure. In *The handbook of phonological theory*, ed. J. Goldsmith, 403-43. Oxford: Blackwell.

Hayes, B. 1995. *Metrical stress theory*. Chicago: Univ. of Chicago Press.

Idsardi, W. 1992. The computation of prosody. Doctoral dissertation, MIT, Cambridge, Mass.

Irshied, O. and M. Kenstowicz. 1984. Some phonological rules of Bani-Hassan Arabic: a Bedouin dialect. *Studies in the Linguistic Sciences* 14.1:109-47.

Kenstowicz, M. 1983. Parametric variation and accent in the Arabic dialects. *Chicago Linguistic Society* 19:205-13.

Kenstowicz, M. 1994. *Phonology in generative grammar.* Oxford: Blackwell.

McCarthy, J. 1979. On stress and syllabification. *Linguistic Inquiry* 10.3:443-65.