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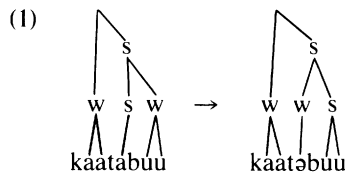
Squibs and Discussion

STRESS SHIFT AND METRICAL STRUCTURE

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The first argument for metrical structure (in the sense of Liberman (1975) and Liberman and Prince (1977)) from a language other than English and the first argument that supports metrical structure for its dynamic role in the phonological derivation appears in Prince's (1975) seminal work on the phonology of Tiberian Hebrew. Prince argues that penultimate stress in near-underlying /kaatábuu/ is shifted rightward under vowel reduction to yield /kaatəbuu/ (which ultimately surfaces as *kāθβú*). Prince's metrical interpretation of this observation is that vowel reduction to schwa forces a concomitant relabeling of a right-branching metrical tree, automatically shifting stress rightward:



If vowel reduction entails relabeling, then the metrical structure assigned by the Hebrew stress rule predicts the direction of stress shift—the stress moves to the sister node of the metrical tree. As Prince points out, a representation of stress without the elaborated structure provided by trees would make no such prediction.¹

Phenomena of this sort have emerged lately as a means of comparing arboreal metrical theories (like that above) and grid-based metrical theories, which posit prominence relations without associated hierarchical structure. Here we will present what

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¹ Prince (1975) also observes that phenomena of grammatically controlled stress shift provide further support for the metrical conception of stress shift in Tiberian Hebrew. McCarthy (1979b), discussing the full range of stress shift rules in Tiberian Hebrew, concludes that they require direct reference to metrical foot structure. Rappaport (1984) reaches a conclusion similar to that of Prince, making an explicit comparison between arboreal and grid metrical theories.

we believe to be an unimpeachable case of stress shift under vowel deletion where the direction of shift is governed by arboreal metrical structure. The data come from the language of the first author, a Bedouin Arabic dialect spoken in the Hijaz, Saudi Arabia. A comprehensive account of the major phonological processes in this dialect, which we will refer to as Bedouin Hijazi Arabic or BHA, appears in Al-Mozainy (1981), where the stress shift and its arboreal metrical interpretation were first noted. Our argument is in some ways complementary to that constructed by Kenstowicz (1983), who treats stress shift under vowel deletion with respect to the totally different stress system of a Bedouin dialect spoken in the Negev.

BHA shares with all other Bedouin Arabic dialects a rule deleting short *a* in an open syllable if the following syllable is also open and contains short *a*. This rule is formulated in Al-Mozainy (1981) essentially as follows:

- (2) *Low Vowel Deletion*
 $a \rightarrow \emptyset / C \text{ — } [Ca]_{\sigma}$

This rule is responsible for the following alternations, chosen from several different morphological patterns:

- | | | |
|--------|---------------------|------------------------------|
| (3) a. | sáħab | šhábat |
| | 'he pulled' | 'she pulled' |
| | saħábna | šhábow |
| | 'we pulled' | 'they (m.) pulled' |
| | | šhában |
| | | 'they (f.) pulled' |
| b. | náxal | nxálah |
| | 'palm trees' | 'a palm tree' |
| | g ^y álaš | g ^y lášah |
| | 'castles' | 'a castle' |
| | sálag | slígah |
| | 'hunting dogs' | 'a hunting dog' ² |
| c. | ǧánam | ǧními |
| | 'sheep' | 'my sheep' |

As is apparent from the data in (3), the effects of Low Vowel Deletion are distributed widely through the language and are not tied to any particular morphological configuration. The structural description of the rule can be met, as in (3a), by inflectional suffixation to the perfective verb. It can also be met by formation of so-called nomina unitatis from collective nouns by addition of the feminine suffix *-ah* and by suffixation of pronominal enclitics like *-i* 'my'. Although this rule is not surface true (subsequent processes create configurations of the sort that Low Vowel Deletion eliminates), it does appear to be excep-

² The raising of *a* to *i* in this and the following example is the result of a separate process discussed in Al-Mozainy (1981).

tionless in its scope of application. We must therefore conclude that it is authentically phonological.³

Stress is assigned in BHA by the usual Eastern Arabic Stress Rule (McCarthy (1979a; 1980)), a slight variant of the familiar Romance Stress Rule. Stress falls on a superheavy ultima (CVVC or CVCC); lacking one, it falls on a heavy penult (CVV or CVC); lacking both, it falls on the antepenult. Examples appear in (4):

- | | | |
|--------|-----------|-------------------|
| (4) a. | maktúub | 'written' |
| | ḡaḡábt | 'I hit' |
| b. | maktúufah | 'tied (f. s.)' |
| | gaabílna | 'meet us (m. s.)' |
| c. | máalana | 'our property' |
| | yáṣṣribin | 'they (f.) drink' |

As expected, disyllabic words retract stress as far as they can consistent with their length and distribution of syllable weight.

The question at issue concerns the interaction of Stress Assignment and Low Vowel Deletion. The forms in (3) are consistent with ordering Low Vowel Deletion before Stress Assignment, so that, for example, underlying /saḡabaw/ could first lose the vowel in the antepenult and then receive stress on the penult, yielding *sháḡabaw*. There are, however, a number of counterexamples to this conjecture in longer words:

- | | | |
|-----|-------------------|--------------------------|
| (5) | ʔínkisaḡ | ʔínskárat |
| | 'he got broken' | 'she got broken' |
| | ʔíntiḡaḡ | ʔíntḡáran |
| | 'he waited' | 'they (f.) waited' |
| | ʔíftikaḡ | ʔíftkáraw |
| | 'he remembered' | 'they (m.) remembered' |
| | ʔíxtibaḡ | ʔíxtbáraw |
| | 'he took an exam' | 'they (m.) took an exam' |

The penultimate syllable of the forms on the left has underlying *a*, which is raised in an open syllable (depending on the adjacent consonantism) by an independently motivated rule of BHA (cf. footnote 2 and Al-Mozainy (1981)). Thus, the underlying representations are /ʔínkisaḡ/ and so on, with Low Vowel Deletion applying in the forms on the right.

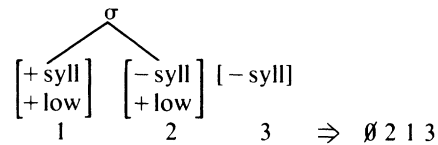
Although the forms on the left in (5) are stressed in accordance with the usual pattern, those on the right are, at least on the surface, in violation of it. If, as we first conjectured, Low Vowel Deletion precedes stress assignment, then the forms on the right cannot be derived; we would expect *ʔínk-

³ Al-Mozainy (1981) argues that there is another rule deleting *a* that is not purely phonological and that has a quite different environment. This rule deletes the vowel of the feminine singular suffix *-at* before a vowel: *ḡúrmti* 'my wife' from underlying /ḡurḡm + at + i/ (cf. *ḡúrmaḡ* 'woman').

sarat and so on.⁴ It must instead be the case that stress is assigned and subsequently Low Vowel Deletion applies, forcing a rightward shift of stress when the stressed vowel is deleted as in (5).

An additional example of stress shift under vowel deletion also occurs in this language. In BHA, as well as in some other Bedouin dialects both in Saudi Arabia and elsewhere, a sequence of a short low vowel followed by a uvular, pharyngeal, or laryngeal consonant (therefore also [+low]) undergoes metathesis in a closed nonfinal syllable, according to the rule in (6):

(6) *Metathesis*



This rule is supported by the following data from the imperfective verb. In (7a) we see the normal CVCCV(C) canonical pattern of the underived imperfective; only when the second consonant is [+low], as in (7b), do we find the CCVCV(C) pattern that results from metathesis:

- | | | | |
|--------|--|----|---|
| (7) a. | yáktib
'he writes'
yášrab
'he drinks'
táktib
'you (m. s.) write'
násbah
'we swim' | b. | yγázi
'he raids'
yḥákum
'he rules'
tšárif
'she knows'
nxátuf
'we snatch' |
|--------|--|----|---|

The CVCCVC canonical pattern is the underlying case in both types, so that, for example, /yayzi/ underlies the surface form *yγázi*.

Of course, these data are compatible with either order of Stress Assignment and Metathesis, but longer words show that stress is applied first and then shifted after the application of Metathesis. In the so-called tenth form of the verb, the usual

⁴ Abboud (1979) has suggested that stress retraction is blocked by a sequence of three consonants. Apart from the inherent implausibility of this suggestion, which is unprecedented in the by now quite comprehensive literature on the relationship between syllable weight and stress, it is false empirically. Al-Mozaini (1981) shows that stress retracts over three consonants in other circumstances, where a different syncope rule has applied: *yáktbin* 'they (f.) write'; *yáktbih* 'he writes it (m.s.)'.

surface canonical pattern is CVCC^ʕCCVC:

- (8) ʔistáslam 'he surrendered'
 ʔistáfham 'he inquired'
 ʔistágdam 'it became old'

But when the first consonant in the root is a laryngeal, pharyngeal, or uvular, we find that Metathesis yields a surface form that is opaque with respect to Stress Assignment:

- (9) /ʔistaʕzam/ → ʔistáʕzam
 'he accepted an invitation'
 /ʔistaɣfar/ → ʔistáɣfar
 'he asked Allah for forgiveness'

If these forms were stressed after the application of Metathesis, we would expect stress to fall on the initial syllable rather than the penult. We conclude, then, that the deletion component of the Metathesis rule induces exactly the same sort of rightward stress shift as Low Vowel Deletion.⁵

Metrical theory with hierarchical tree structure provides a general account of these two cases of rightward stress shift, relating the direction of shift to the form of the stress rule itself. The tree-structure or arboreal interpretation of a stress rule of the BHA type is uncontroversial in metrical theory: a left-branching metrical foot includes the stressed syllable and any syllables that follow it (Prince (1976), McCarthy (1979a; 1980), Hayes (1980)). Since differences among the proposals for deriving a foot of this sort are irrelevant to our point here, we will adopt a formulation in the style of Hayes (1980) without argument or discussion. The algorithm for stress assignment proceeds as follows:

(10) *Stress Assignment*

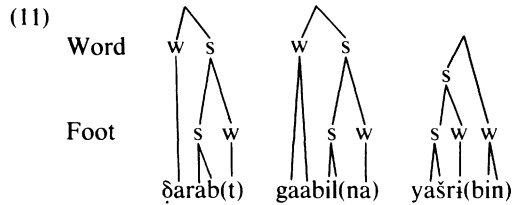
On the rhyme projection

- a. A word-final rhyme is extrametrical.
- b. Construct a binary, left-dominant foot from right to left.
- c. Construct a right-dominant word-level tree.

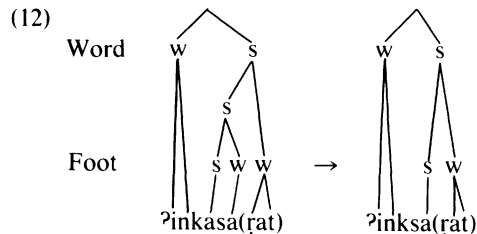
⁵ A possible reanalysis of the phenomena underlying Metathesis is suggested by some observations from Tiberian Hebrew phonology. In Hebrew, syllable-final pharyngeal and laryngeal consonants trigger insertion of a following very short *a* (Prince (1975), McCarthy (1979b)): /yaʕmod/ → yaʕámôð 'he stands'. If we suppose, as does Abboud (1979) for a Najdi dialect, that such a rule applies in BHA, we can then appeal to Low Vowel Deletion to complete the derivation: /yaɣzi/ → yaɣazi → yázi. This would then reduce the two distinct cases of stress shift under deletion to one, while demonstrating the very general applicability of Low Vowel Deletion. It does, however, lead to a number of rule ordering difficulties discussed in Al-Mozainy (1981, 171ff.) that have not yet been resolved.

Heavy syllables are assumed to project as branching rhymes, light syllables as nonbranching rhymes, and superheavy syllables as the sequence branching-nonbranching (McCarthy (1979a)). By convention, the extrametrical final rhyme is adjoined as a weak sister to the immediately preceding foot.

The ultimate result of these operations appears in (11):



These metrical feet force the direction of stress shift after a stressed vowel is deleted. Stress Assignment is stipulated to precede Low Vowel Deletion, and Low Vowel Deletion may, as in the examples in (5), delete the stressed vowel with consequent restructuring of the metrical tree. The partial derivation proceeds as in (12):



Deletion of the antepenultimate *a* induces pruning of the metrical tree, with the result that stress shifts to the right. The somewhat unexpected surface stress pattern of BHA thus follows as an automatic consequence of the system rather than as an arbitrary property of the grammar. Forms with Low Vowel Deletion like those in (3) show this stress shift as well, but we cannot prove that because their transparent surface stress means that they are consistent with the opposite ordering of the rules as well. This account, of course, generalizes in a natural way to the deletion component of Metathesis as well.⁶

⁶ Al-Mozainy (1981) argues that the rule of Low Vowel Deletion is sensitive to morphological structure in a way typical of cyclic rules, a result that may have interesting consequences for the analysis. When a form like *ʔintδāʔat* receives the third masculine singular object enclitic *-ih*, it surfaces as *ʔintδāʔtih*, with deletion of *a* from the third feminine singular agreement suffix *-at* by the rule discussed in footnote 3. The underlying form, considered noncyclically, actually displays two possible sites for Low Vowel Deletion, though only the first actually undergoes the rule: */ʔintaδaʔatih/ → ʔintδāʔtih*. The problem is to select which *a* will delete. Because Low Vowel Deletion applies to *a* in an open syllable followed by *a* in an open syllable, we cannot order the rule in

A more general result of this analysis is its implications for the proper representation of stress. A lively and productive debate is occurring at present over the relative merits of metrical theories positing trees (or properly trees and grids) (Prince (1976), Liberman and Prince (1977), Selkirk (1980), Hayes (1980; 1982; 1984)) and those positing the more impoverished grid structures only (Prince (1983), Selkirk (1984)). It appears that grid theory does not make the desired prediction for the BHA facts. To see this, we should consider how Stress Assignment (10) is translated into grid theory.

In a grid-based analysis of BHA stress, the assignment of syllable weight and extrametricality remains the same but there are differences in the procedure for distributing relative prominence. Specifically, the rule is stated as follows (cf. similar rules in Prince (1983)):

(13) *Stress Assignment (Grid)*

On the rhyme projection, where each element of a rhyme counts as a mora

- a. The word-final rhyme is extrametrical.
- b. Apply the perfect grid from right to left, trough first, mapping one grid position onto each mora.
- c. The last peak receives an extra x.

This procedure gives the following grid for the underlying form /ʔinkasaɾat/, where extrametricality is indicated by parentheses:

(14) x
 x x
 xx x x
 ʔinkasa (ɾat)

Under the assumption that deletion of a vowel induces deletion of its accompanying grid elements, the predicted direction of stress shift is incorrectly leftward, to the next most prominent syllable ʔn. Under different assumptions about deletion or about stress assignment itself (for example, that the grid elements persist after deletion of the vowel), the grid theory makes no prediction about the direction of stress shift. An analysis cast in terms of this theory would therefore need to stipulate the effect of Low Vowel Deletion on the position of stress.

Halle (1982) has adduced a case of essentially the same

footnote 3 before Low Vowel Deletion and achieve the desired result; the hypothetical intermediate form /ʔintaɟaɾtiħ/ would permit deletion of neither of the italicized *a*'s. We could, of course, rather unenlighteningly stipulate that Low Vowel Deletion is left-to-right iterative, which would have the right effect, but a far more interesting solution is to consider Low Vowel Deletion to be cyclic. It would then first apply to delete the indicated *a* in /ʔintaɟaɾat/, but on the next cycle, with suffixation of *-ih*, it would be blocked from applying by the general prohibition in this language against clusters of four consonants.

character as further evidence for the arboreal nature of metrical structure. This analysis, based on work by Archangeli (Bennett (1981)), involves apparent accent shifts in Tokyo Japanese under vowel devoicing. Prince (1983, 95) observes that there are several clear tonological accounts of the same facts, all involving the independently necessary persistence of autosegmental tones under deletion. A similar point can be made about another example of the same type, the shift of accent in Russian under the deletion of jers (Halle (1973)). In view of the lack of other substantial confirmation for the use of arboreal metrical structure in pitch-accent systems and the explanatory success of the tonological alternatives, it appears that autosegmental and not arboreal interpretations should be favored for the Japanese and Slavic cases.

The tonological solution cannot be generalized to the BHA case, however. A system distributing relative prominence in the way BHA does is uncontroversially incompatible with a tonological reinterpretation along the lines described for Tokyo Japanese and Russian. Apart from the wide agreement among specialists that Arabic dialects have a system of prominence based on dynamic stress rather than pitch accent, it would be surprising and unprecedented to find pitch accent distributed by what amounts to the Romance Stress Rule.

Given that BHA has arboreal stress shift under vowel deletion, we might wonder why such phenomena are not encountered more often in the Arabic dialects, where syncope rules and similar rules of stress assignment abound. For example, no such phenomenon is reported in the detailed studies of Egyptian Arabic phonology by Broselow (1976) and Welden (1977) or of Palestinian Arabic by Younes (1982). The difference is that most syncope rules explicitly eschew deletion of stressed vowels or precede the assignment of stress and thus could not show stress shift. Characteristically, these syncope rules display a hierarchy of the vowels they delete, in some cases deleting only the less sonorous high vowels, in others deleting all vowels, in all cases only when unstressed. In other words, these syncope rules delete vowels that are less prominent by virtue of their lack of stress and, in some cases, their relatively lesser sonority. The BHA rule of Low Vowel Deletion is clearly of a much different type; it deletes only the most sonorous low vowel and then only when a low vowel follows in an open syllable. It is not governed solely by phonotactic considerations (conspiracies), but rather it appears to function as a fairly abstract kind of dissimilation, eliminating an underlying configuration of two successive identical nuclei by deleting the first of them. This typological distinction seems to underlie the differences cited, an observation that is confirmed by the fact that the reflex of Low Vowel Deletion in the Negev Bedouin dialect analyzed by Kenstowicz

(1983) also induces stress shift, though on the output of a completely different stress rule.

In sum, we have shown that two rules of BHA phonology that delete vowels induce rightward stress shift within the arboreal metrical foot. It is worth considering the status of this argument, which apparently favors the arboreal over the grid theory. The arboreal theory makes the correct prediction because it incorporates a mild sort of globality into the representational system—stress shifts rightward because that is, in effect, the direction from which the stress was assigned, within the same foot. Grid theory, by disallowing this sort of structure, is also prohibited from transmitting to subsequent rules this information about how stress was assigned. In a sense, then, our demonstration of an apparent inadequacy of grid theory is unsatisfying. In effect, we have shown that the conceptually more impoverished and universally more restrictive grid theory is incapable of performing something within the scope of the considerably richer arboreal theory. If such phenomena are common, though this does not appear to be true given the propensity of the cases for tonological or other reanalysis, then of course arboreal theory is clearly superior. As it stands, then, our result emerges as a possible direction for research rather than a completely convincing demonstration of superiority.

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EXTRAMETRICALITY AND STRESS
IN POLISH

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Metrical theory attempts to account for the range of possible stress systems within a highly constrained framework. Current research in metrical theory is directed toward demonstrating how its restrictive structure, necessitated by the demands of

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