Weak radicals, weak suppletion and phonological indices in Semitic

1. Introduction

Consider the regular, productive relation from Palestinian Arabic in (1a-c), whereby the imperative is the bare imperfective (with an epenthetic [ʔ]). In light of this generalization, both (1d) and (1e) are surprising. The imperative in (1d) is not the expected [ʔokol], but instead involves subtracting the initial vowel of the imperfective; in (1e), the imperative employs an entirely different stem, with different vowels and different consonants. There is no imperative form [ʔiži].

(1) Suppletion in Palestinian Arabic

<table>
<thead>
<tr>
<th>imperfective</th>
<th>imperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>ęktob</td>
<td>ʔuktob</td>
</tr>
<tr>
<td>ʔmor</td>
<td>ʔmor</td>
</tr>
<tr>
<td>ımši</td>
<td>ımši</td>
</tr>
<tr>
<td>okol</td>
<td>kol</td>
</tr>
<tr>
<td>iži</td>
<td>tafaːl</td>
</tr>
</tbody>
</table>

The irregularities in (1d) and (1e) are referred to respectively as weak and strong suppletion. In weak suppletion, the unexpected form is similar to the expected form; in strong suppletion, it is completely different. A recurrent issue in the conference on the logic and limitations of allomorphy, of which this volume is a product, was the theoretical distinction between weak and strong suppletive allomorphy. Several speakers suggested that in terms of the symbolic process, there is no distinction: in both cases, the speaker has to memorize an idiosyncratic stem. In a recent handbook chapter on allomorphy, Paster (2014) adopts this view: “Since suppletive allomorphs have separate underlying forms […] the degree of phonetic similarity or difference is not referred to by the grammar (p. 221).”

Strong suppletive allomorphy is used by Harley in a target article (2014) to argue that roots - the basic component of morphological computation - cannot be phonologically identified. The root for both forms of ‘come’ in (1e) must in Harley’s theory be the same, a formless index represented with a number to distinguish it from other indices, e.g. 342. As several of the authors of the same volume remark, the reasoning ignores the rarity of such suppletive relations: in most if not all languages, strong suppletion is restricted to a handful of items. But if Paster is right, and there is no real difference between weak and strong suppletion, then Harley’s formless indices play a much more central role in morphology.

In this paper I will argue against the monolithic view of (non-phonological) allomorphy, whereby weak and strong suppletion are the same phenomenon. In order to falsify this view, one has to find a case where the weakly suppletive allomorphy clearly does not reference the entire stem, but only part of it; this will distinguish this type of allomorphy from strong suppletion, i.e. allomorphy that substitutes the entire stem. If the weakly suppletive allomorph can be shown to reference a phonological feature of the root, Harley’s claim as to the lack of phonology in roots will hold only for a minuscule group of items.

The model to be proposed incorporates the idea of roots being attributed phonological indices (Borer 2005, 2009, 2013), which are a phonological common denominator of all appearances of a given root. The phonological index, it is claimed, should be distinguished from the exponent, which is the phonological form that is matched to the phonological index in a given grammatical context. A first sketch of the model is presented in (2):
The transition from the formless index matches this formless index with form, namely the phonological index. The transition from the phonological index to the UR inserts that phonological index in the underlying representation of a given word-form. Finally, the UR is processed by phonology to give the realization, i.e. the phonetic form.

In the present paper, allomorphy will be modeled as a split in the mapping arrow. In strong suppletion, Harley’s model will be adopted: the formless index is mapped into two or more phonological indices. In weak suppletion, either the phonological index or the UR may be split by respectively a readjustment rule or a morphologically-conditioned phonological rule. As suggested by the model in (2), a central point in the paper will be that the levels of the phonological index and the UR must be distinguished: readjustment of the phonological index cannot be considered as phonologically optimizing, because the phonological environment is not yet present; in contrast, the morpho-phonological readjustment of the UR may be considered as phonologically optimizing. The attribution of form to grammatical features - i.e. to anything other than the root - occurs at the moment of the attribution of a UR to the phonological index: the realization of grammatical features may thus be sensitive to either the phonological index or its specific UR (all of these scenarios will be illustrated in the body of the paper). Finally, “realization” refers to the processing of the fully specified UR of the entire word-form by the phonology and the production of phonetic form.

The data in this paper will all be taken from Semitic weak verbs, namely verbs which do not have three stable consonants throughout their inflection, such as (1c-e) above. The behavior of such verbs, I will claim, provides the required cases in which only part of a root’s form is referenced in allomorphy. The analysis of the different cases will necessitate assuming all three levels of the model in (2), and all the operations mentioned.

The paper is organized as follows. In the next section, data from Tigre serve as an illustration of the weakness of weak verbs, without appealing to allomorphy. In section 3, data from Qaraqosh Neo-Aramaic exemplify why weak and strong suppletion cannot be the same phenomenon: in weak suppletion, the input to the process has to have phonological form, whereas in strong suppletion it must not have phonological form. In section 4, the levels of the phonological index and the UR are shown to be distinct in that there are allomorph processes which must be viewed as applying to, or triggered by one level but not the other. The examples are from Israeli Hebrew and the Qaraqosh and Jewish Sanandaj dialects of Neo-Aramaic. Section 5 concludes with a discussion about the contribution of the paper to the study of allomorphy in general, and in particular in Semitic languages.

2. Semitic weak roots: an illustrative simple case

This section discusses the case of weak roots in Tigre, where no appeal to the concept of allomorphy (as construed here) is made. It is intended to facilitate the understanding of the data and analyses in the following sections.

The prototypical Semitic root is an ordered set of three elements, also called “radicals”, which appears in a family of inflectionally or derivationally related items (Israeli Hebrew xiʃev
‘he calculated’, mexašev ‘calculating.MSG’, xašav ‘he thought’). Verbs in Semitic languages are formed by placing this ordered set in a template, i.e. a fixed syllabic space with C and V slots. The elements that make up the root are prototypically mapped to the consonantal positions in the template. Besides syllabic structure, templates are distinguished from one another by template-specific affixes (maxšev ‘computer’) and vocalizations (xišev ‘he calculated’, xašev ‘calculate!’ (msg’), the latter defined as the morphologically meaningful vocalic element(s) inserted in the template.

Weak verbs are formed from weak roots, which are called “weak” because one or more of their radicals is not always surface true. In other words, these are roots with at least one radical whose realization is either null or indirect. To illustrate, consider the two paradigms from Tigre in (3). Whereas the paradigm of ‘find’ has the stable set <r,k,b> in all the forms - i.e. the verb is “strong” - the paradigm of ‘work’ only has two such stable consonants <š,q>.

(3) Two subjunctive paradigms from Tigre (Raz 1983; data from my own fieldwork)¹

<table>
<thead>
<tr>
<th></th>
<th>a. ‘find’</th>
<th>b. ‘work’</th>
<th>c.</th>
<th>d. generalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>sg</td>
<td>a-rkab</td>
<td>a-šqe</td>
<td>/a-šqay/</td>
<td>/ay/ =&gt; [e]</td>
</tr>
<tr>
<td>2msg</td>
<td>ta-rkab</td>
<td>ta-šqe</td>
<td>/ta-šqay/</td>
<td></td>
</tr>
<tr>
<td>2f</td>
<td>ta-rkab-i</td>
<td>ta-šqa-y</td>
<td>/ta-šqay-i/</td>
<td>/ayi/ =&gt; /ayy/ =&gt; [ay]</td>
</tr>
<tr>
<td>3msg</td>
<td>le-rkab</td>
<td>la-šqe</td>
<td>/la-šqay/</td>
<td></td>
</tr>
<tr>
<td>3f</td>
<td>ta-rkab</td>
<td>ta-šqe</td>
<td>/ta-šqay/</td>
<td></td>
</tr>
<tr>
<td>pl</td>
<td>na-rkab</td>
<td>na-šqe</td>
<td>/na-šqay/</td>
<td></td>
</tr>
<tr>
<td>2m</td>
<td>to-rkab-o</td>
<td>to-šqa-w</td>
<td>/to-šqay-o/</td>
<td>/ayo/ =&gt; /awy/ =&gt; [aw]</td>
</tr>
<tr>
<td>2f</td>
<td>ta-rkab-a</td>
<td>ta-šqay-a</td>
<td>/ta-šqay-a/</td>
<td></td>
</tr>
<tr>
<td>3m</td>
<td>la-rkab-o</td>
<td>la-šqa-w</td>
<td>/la-šqay-o/</td>
<td></td>
</tr>
<tr>
<td>3fm</td>
<td>to-rkab-a</td>
<td>to-šqay-a</td>
<td>/to-šqay-a/</td>
<td></td>
</tr>
</tbody>
</table>

Morphologists dealing with Semitic strive to uncover the identity of the third radical of such verbs as Tigre ‘work’. The question to ask is: given the realizations of a strong verb, what is X such that its underlying presence in the position of the missing radical of weak verbs yields all the surface realizations of that verb?

For the Tigre data in (3), the question is not a hard one. There are two differences between the strong and weak verbs: 1) the quality of the stem vowel ([a] in the strong verb, [e] in the unsuffixed weak verb, [a] in the suffixed weak verb); and 2) the syllabic status of the suffixes ([i,o] in the strong verb, [y,w] in the weak verb). If we assume that /y/ is the missing radical, we derive the underlying representations in (3c). The three phonological rules in (3d) then derive the surface forms: the vowel [e] in the unsuffixed weak verbs is the combination of the underlying glide and the stem /a/, which reemerges in the suffixed forms, because the string is no longer final. If the suffix contains a high vowel then the consonantal nature of the radical and the quality of the suffix are combined into a single glide. When the suffix is /-a/, as in the 1/2fmpl, nothing needs to be added. Thus, by assuming an underlying phonological identity for the third element of the root, all surface forms can be derived without devising specific vocalizations or templates for weak final verbs.

¹ [y] is a high glide throughout this paper. Some additional facts about the quality of the stem vowels in (3) are omitted for simplicity.
The Tigre data can be formalized in Harley’s approach as in (4): a formless index is mapped to a unique phonological form, regardless of other grammatical information.

(4) Tigre final-weak data in Harley’s terms

\[ \sqrt{143} \rightarrow \text{\textipa{šqy}} \]

The phonological form of Tigre weak-final roots is stable in all its occurrences. It is therefore impossible to tell whether \( \sqrt{\text{šqy}} \) is some “phonological index” - not the underlying representation of any form - or simply the underlying form of the root in context. But Tigre is in fact not representative of Semitic languages in the simplicity of its weak-final paradigm, as we will see in the next sections.

3. Weak and strong suppletions apply at different levels

In several Semitic languages, while there is good motivation for assuming a phonemic identity for the weak radical, its realization is conditioned by morphological information. Such is the case of weak-final verbs in Qaraqosh Neo Aramaic, whose bases of derivation are compared to those of strong verbs in (5).\(^2\)

The infinitive form provides a first hypothesis as to the identity of the third radical: as in the Tigre case, the consonant occupying the position of the third radical is \( [y] \). Let us put the hypothesis to the test. By analogy with the strong \([\text{paθ} \text{x}] \) we expect *[\text{darəy}]. Because no word in Qaraqosh ends in such a diphthong, we can postulate that final /\text{əy}/ is realized as [i], and therefore the form is [\text{dar}i]. The analysis finds support in the forms with the object suffix (5c) and the 3FMSG. The alternation of [i] with [ɪ] when stressed in [\text{darīlə}] is unsurprising and /dary-a/ is expected to surface as [\text{darya}]. The 3PL form, expected to be [\text{daryi}], lacks both the glide and the high vowel. Once again, there are no words in Qaraqosh ending in [yi], and we can postulate a rule that interprets a sequence /\text{yi}/ as [e]. However, the 1PL form is problematic for a unifying analysis of the present stem. The suffix /-ax/ places the stem in an environment which is phonologically identical, in the relevant sense, to that of the 3FMSG /-a/. Yet the result is different, as no [\text{y}] appears on the surface. The analysis with an underlying /\text{y}/ makes the wrong prediction in this case.

(5) Strong vs. weak-final verbs in Qaraqosh Neo-Aramaic: non-finite forms

<table>
<thead>
<tr>
<th></th>
<th>a. ‘open’</th>
<th>b. ‘put’</th>
<th>c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>infinitive</td>
<td>p\text{θ}axa</td>
<td>draya</td>
<td></td>
</tr>
<tr>
<td>subjunctive</td>
<td>3MSG</td>
<td>pa\text{θ}ax</td>
<td>dərə</td>
</tr>
<tr>
<td>3FMSG</td>
<td>p\text{θ}x-a</td>
<td>dər\text{ɬ}-a</td>
<td></td>
</tr>
<tr>
<td>3PL</td>
<td>p\text{θ}x-i</td>
<td>dər-e</td>
<td></td>
</tr>
<tr>
<td>1PL</td>
<td>p\text{θ}x-ax</td>
<td>dər-ax</td>
<td></td>
</tr>
</tbody>
</table>

\(^2\) All the data from Qaraqosh is taken from Khan (2002). Stress is predictably penultimate in all forms.
Let us now attempt to take the perspective of the learner. Based on strong verbs, which represent the majority of verbs in the language, learners are incited to look for the tripartite set at the base of a paradigm. For weak-final verbs, there is no ambiguity as to the first two elements of the set. As for the third element, the first four forms as well as (5c) provide a candidate /y/. The fact that no strong [y]-final verbs exist in the language supports this analysis. However, one form, the 1PL, is problematic in this respect. I conclude that there is enough reason to assume that the root is /y/-final, except that in one grammatically well-defined case, instead of /y/ we find the absence of a radical. This generalization - but not anything about the specific predictable forms - has to be memorized.

Faust (2012) analyzes a similar state-of-affairs in Israeli Hebrew by assuming /y/ is the default phonological nature of the radical, but it can be replaced by more specific information when the facts require such a replacement. This view will be adopted and explored here as well. To formalize the deviation from the expected realizations I will use a readjustment rules (Embick & Halle 2005), the ad-hoc nature of which reflects the morpho-phonological - rather than phonological - nature of the alternation. Given the phonological generalizations discussed above, in order to describe the data hitherto examined a single readjustment rule is called for:

(6) Readjustment of 1PL in weak final forms

\[ y \rightarrow \emptyset /\sqrt{QT}_3 / [\text{subjunctive}], 1PL \]

The rule in (6) suppresses the insertion of the UR /y/ in the third position of a root in the subjunctive 1PL form. In itself, it is nothing but a formalization of the facts. Yet if this formalization is correct, it has a crucial consequence as to the storage of roots.

The 1PL subjunctive stem in (5), we have seen, is weakly suppletive: the modified form is similar to the general form. As discussed in the introduction and around (4) above, Paster (2014) proposed that weak and strong suppletions are the same phenomenon. Combining this view with Harley’s (2014) formless index, the same formless index is mapped to two different forms.

(7) Weak suppletion in 1PL

\[ \sqrt{143} /\text{dry/} \]

The models in (6) and (7) differ in their description of the linguistic knowledge and, as a consequence, in their predictions. In (6), one phonological form is replaced by another in a given context. As long as the readjustment is not marked as specific to a given root, it is expected to apply to all those roots whose third element is /y/. In (7), in contrast, the same formless index is mapped to two phonological forms. Under this view, the mapping of the third radical of the root \[ \sqrt{143} \] to /ø/ in the 1PL subjunctive is independent of its mapping to /y/ elsewhere. The prediction is made that there might be roots whose third element is /y/ and which do not have a third element ø in the 1PL subjunctive stem. This prediction is false: all weak-final verbs behave in exactly the same manner, as expected under the readjustment formulation, where the input to the statement

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3 Henceforth the set QTL will be used to designate the three elements of the root. \[\sqrt{QT}_3\] designates “the third position in the root”.

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5
of exceptionality crucially has phonological form. Such weak suppletion cannot take as its input a formless index.

If the input must be a phonological form, the situation in (5) is best described not as in (7), but as in (8), with the readjustment rule applying to a phonological input.

(8) Weak suppletion in 1PL: revisited

\[
y \Rightarrow \emptyset \sqrt{QT\_ - \text{past}}, \text{1PL}
\]

The question is raised as to the identity of the tripartite set on both sides of the dotted line. Specifically for the input to the process, is it a root? And if so, do we still need Harley’s formless roots?

Harley’s model is still very adequate for strong suppletion. Recall the case of Palestinian Arabic imperatives, repeated here for convenience. However the correspondence between the imperfective and imperative forms is to be formalized for the regular cases (9i.a-c) and for the weakly suppletive case of (9i.d), a completely different formulation will have to be devised for the strong suppletion in (9i.e). Such a formulation is proposed in (9ii): the same formless index splitting in two different phonological forms.\(^4\) Note that the phonological form of the suppletive imperative is fully specified, since it is not only completely different in form, but also exceptional in that it cannot be associated to any independently attested imperative template of Palestinian Arabic.

(9) Strong suppletion in Palestinian Arabic: formulation

i. a. ‘write’ b. ‘command’ c. ‘walk’ d. ‘eat’ e. ‘come’
   imperfective -uktob -uʔmor -imši -okol -iži
   imperative ʔuktob ʔuʔmor ʔimši kol taʔaːl

ii. \[ \sqrt{23} \Rightarrow \emptyset \sqrt{\partial\_} \]
   taʔaːl / [imperative]

If so, Harley’s model is still necessary in order to describe strong suppletion. We have thus identified two levels of representation which must serve as inputs to morphological realizational processes: one void of form and the other crucially having form. To illustrate, the Qaraqosh case can now be modeled as in (10):

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\(^4\) Nothing need be stated about the default form of this root, \[ \sqrt{\partial\_} \], whose behavior in the imperfective is like that of \[ \sqrt{mšy} \] in (9ii.c).
Neither $\sqrt{143}$ nor $\sqrt{\text{dry}}$ are the underlying representation of any word-form: in this sense, they are both roots. Borer (2005, 2009, 2013) refers to roots as “phonological indices”, roughly defined as a common denominator of all occurrences of the root. In order to incorporate Harley’s proposal, we can use Borer’s notion of phonological index for $\sqrt{\text{dry}}$, without claiming perfect identity between the root and its phonological index. I will henceforth call this level “the phonological index” and distinguish it from the UR, which is the form attributed to the root in a specific grammatical environment. The UR of a root is the form that will be inserted in the template, and thus does constitute part of the underlying representation of a specific lexical item, unlike the phonological index.

To return to the theoretical question of weak vs. strong suppletion, it emerges from our discussion that strong and weak suppletion are not the same process: the formless index is the input to strong suppletion, while the phonological index feeds into weak suppletion.

Another issue that bears discussion in view of (10) is the formalization of allomorphy. As mentioned in the introduction, allomorphy is formalized as a split in the mapping process from one input to two or more outputs, each conditioned by some morphological property (or lack thereof) in the context of insertion. In the present case, this split is achieved via readjustment rules. In cases such as (10), where both input and output have phonological form and the input is identical to one of the outputs, that form can be considered as more basic, with the other form derived from it (at least conceptually; note that neither of the forms on the right is derived from the other). But this is of course not the only view of allomorphy. A contending view stresses the dimension of selection: it does not posit one form as more basic, and assumes instead two options provided by the lexicon (e.g. Rubach & Booij 2001 for phonologically-conditioned allomorphy). In a case like the one described above, the phonological index would be $\sqrt{\text{dry}/\emptyset}$, and the selection of /y/ or /ø/ would be grammatically determined, rather than the replacement of one by the other. While a comparison between the two approaches is beyond the scope of this paper, it seems to me that at least in the cases presented in this paper, the two allomorphs cannot be formalized as having equal status, since one is definitely the default realization and the other the special case. Representing the phonological index as $\sqrt{\text{dry}/\emptyset}$ would miss that point entirely.

To summarize this section, the phonological index has been established as a level of representation that is distinct from the formless root, and which can undergo processes resulting in allomorphy. In order to support the existence of the level of the phonological index and to further disambiguate this level of representation from that of the underlying representation, the next section will discuss realization processes that reference either of these two levels.
4. More on the distinction between phonological index and underlying representation

In the previous section, we identified the level of representation of the phonological index. This level, it was argued, should be distinguished not only from the formless index, but also from the UR associated with the phonological index in a certain environment. In order to further bolster this distinction, in the present section we will see four types of allomorphy that result from this construal of the realizational process:

1) Allomorphy triggered by the phonological index, rather than by its UR
2) Allomorphy triggered by a specific UR of the phonological index, rather than by the phonological index itself.
3) Allomorphy applying to the phonological index, rather than to its UR
4) Allomorphy applying to a specific UR of the phonological Index, rather than to the phonological index itself.

Although we have already encountered a case of allomorphy applying to the phonological index (3 in the list, and (10) above), the case we will examine in this section will allow us to further characterize this scenario.

4.1. The phonological index as a trigger of Allomorphy: Israeli Hebrew

Assuming that the phonological index is a level of representation that is both cognitively real and distinct from a specific instantiation of the root - that is, a specific UR - we expect to find allomorphic sensitivity to this level. In such a scenario, the trigger of allomorphy will not be a specific UR of the root, but rather (one aspect of) the phonological index. For weak roots, even if in a given grammatical context a weak radical R is suppletively replaced by /X/ in the UR, its original phonological quality /R/ in the phonological index is a possible trigger for an allomorphic realization of the grammatical context. Such cases are admittedly hard to find, because it is usually possible to analyze the allomorphy as an effect of the UR, rather than the phonological index. Nevertheless, I would like to suggest that such a case is found in Israeli Hebrew.

The verbs in (11) are all from the same verbal type, as can be seen by the prefixal root augment [h-] and by the typical haQTaLa pattern of the action noun. In (11a-c), another common feature is the appearance of a vowel [i] in the second syllable of the form. The verb in (11a) is a regular strong verb, while those in (11b-d) represent three types of weak verbs: they all have an unstable final radical. In (11b), no consonant appears as a third radical, but other than that the verb is well-behaved. (11c) is almost identical to (11b), except that in its 3msg form one finds, instead of a final consonant, an unstressed [a]. Finally, (11d) is different from all the others: it has [a], rather than [i], in its second syllable; it has a different 3fmsg suffix [-ta]; and its vowel [a] disappears upon suffixation (the [e] of [hifrta] is inserted to prevent a triconsonantal sequence *[hifrta]). All verbs lacking the [i] in the 3msg form have the 3fmsg allomorph [-ta].
(11) Modern Hebrew HiQTI-type verbs

<table>
<thead>
<tr>
<th></th>
<th>a. ‘shine’</th>
<th>b. ‘convalesce’</th>
<th>c. ‘disturb’</th>
<th>d. ‘fertilize’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past 3MSG</td>
<td>hivrik</td>
<td>hivri</td>
<td>hifria</td>
<td>hifra</td>
</tr>
<tr>
<td>3FMSG</td>
<td>hivrik-a</td>
<td>hivri-a</td>
<td>hifri-a</td>
<td>hifrε-ta</td>
</tr>
<tr>
<td>3PL</td>
<td>hivrik-u</td>
<td>hivri-u</td>
<td>hifri-u</td>
<td>hifr-u</td>
</tr>
<tr>
<td>Action noun</td>
<td>havrak-a</td>
<td>havra-a</td>
<td>hafra-a</td>
<td>hafray-a</td>
</tr>
</tbody>
</table>

The roots of (11a-d) are respectively √brk, √brʔ, √prʕ and √pry (/p,b/ undergoing spirantization post-vocally), with the gutturals /ʔ/ and /ʕ/. Although the phonemic status of gutturals in Israeli Hebrew is controversial (see Faust 2005, Pariente 2012), any synchronic account must distinguish between the three types of verbs in (11b-d). At the very least, the form of the action noun supports the characterization above for (11d): its root is √pry. This is a central claim in the only existing synchronic account of verbs such as (11d), namely Faust (2012), where further corroborating evidence is produced. Crucially for our purpose, it is shown in that account that the [t] in the 3fmsg must be part of the suffix, rather than the stem.

If so, the 3fmsg has two allomorphs: /-ta/ in verbs such as (11d), and /-a/ elsewhere. What is the condition under which the allomorph in (11d) is selected (besides the [+past] feature)? Is it the phonological index or its specific UR in this case? Suppose it is the latter. In this case, what distinguishes between (11d) and the rest of the verbs in (11)? It cannot be the fact that the stem ends in a vowel, because (11b) [hivri] and (11c) [hifrá] are also vowel-final. The latter even has the same final vowel as (11d). Another possibility is to evoke identity avoidance, whereby adding /-a/ to [hifra] would lead to identical 3msg and 3fmsg forms. But such an identity exists in (11c) and is not avoided with the same strategy. I conclude that what triggers the insertion of /-ta/ rather than /-a/ is the phonological index, and more specifically the presence of /y/ in the third position of the phonological index:

(12) UR association rule for the 3fmsg.past

\[
[3fmsg],[past] \Leftrightarrow /-a/ \\
\Leftrightarrow /-ta/ / √QTY
\]

Abstracting away from irrelevant detail, a derivation of [hifrεta] is presented in (13). The root is √pry. As argued for in Faust (2012), the second glide is converted to φ in this case. The rule in (12) applies and /ta/ is associated to the information in the Agr head. Epenthesis breaks the illicit triconsonantal cluster to yield [hifrεta].

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5 Stress final unless marked. The feminine ending [-ta] and the lack of [i] in the Past 3msg in this specific type of verbs do not always correlate with a [y] in the action noun (e.g. [hirsε-ta] ‘she lectured’ [hartsa-a] ‘a lecture’, *[hartsaya]). Nevertheless, this is the default correlation, systematically apparent in other verb types.

6 The condition cannot reference the formless root, since [ta] appears in all and only the forms that behave like (11d) in the unsuffixed from.

7 In the 3msg [hifra], the vowel [a] of the stem would be inserted by default, since the conditions for the strong /i/ - the presence of a final consonant - do not hold. But this /a/ is not inserted in the 3fmsg form in (13).
The derivation of [hifrəta] ‘she fertilized’

\[
\text{AgrP} \Rightarrow /hfr\text{a}/ \Rightarrow [hifrəta]
\]

\[
\begin{array}{c}
\text{Agr} \\
\quad [3\text{msg}] \\
\quad \text{TamP} \\
\quad \text{vP} \\
\quad /\text{ta}/ \\
\quad /h_{\text{QT}}\_\text{L}/ \\
\quad /\text{prø}/ \\
\end{array}
\]

Note that according to this analysis, information about the phonological index must be accessible at the moment of realization of Agr.

To conclude this subsection, we have seen a case where the phonological index, rather than a specific UR associated to it, triggers allomorphy. By distinguishing the phonological index from its UR, we make the prediction that there can be cases of allomorphy that are crucially triggered by the UR, rather than by the phonological index. We examine such a case in the next subsection.

### 4.2. A specific UR as the trigger of Allomorphy

As already mentioned, it is not easy to tell whether a specific allomorphic reaction is triggered by the phonological index or by a UR of the root in context. In the previous section we saw a case that was arguably of the first type. In the present section we return to Neo-Aramaic, and review a case which I will claim must instantiate the second option, namely an allomorphy that is triggered by a specific UR rather than by the phonological index.

All Neo-Aramaic dialects have at least two verb types, generally referred to as Stems I and II and distinguished by the templatic forms of their bases of inflection. In Qaraqosh, for instance, the past base of verbs in stem I has the templatic form QTəL (e.g. [pəx-] ‘open’), whereas that of verbs in stem II has the form mQuTiL ([qudim-] ‘propose’). Consider now the comparison in (14) of Qaraqosh data with those of another dialect, the Jewish Sanandaj (JS) dialect (Khan 2009). In (5) above, the template QTaLa was shown to mark infinitives in Qaraqosh. The verbs discussed belonged to Stem I. In stem II, both Qaraqosh and JS have another type of infinitive, consisting of a melody <a,o,e> or <a,o,ə>, depending on the dialect (14a). Quadriradical roots in both dialects behave like Stem II roots (14b). The two dialects differ however in the stem I infinitive (14c): In JS, the infinitive template of Stem II has been generalized to strong stem I infinitives, too, whereas in Qaraqosh the template QTaLa exists for these verbs. The crucial information is in (14d): in JS, /w/-medial roots still appear in the old template QTaLa.
If so, in both dialects, the grammatical information [infinitive] has two allomorphs: an ordered stem vocalization <a,o,e> and a template QTaLa. In Qaraqosh, the conditioning factor is the type of stem (possibly conveyed by the number of elements in the root); but in JS, an additional requirement is stated: the second radical must be the glide /w/. The JS case is thus a possible candidate for the scenario of a specific UR of the phonological index triggering allomorphy. The allomorphy is stated in (15):

(15) Allomorphy in Jewish Sanandaj infinitives

Infinitive \[\Rightarrow <a,o,e> \Rightarrow QTaLa /QwL/, Stem I\]

The rule in (15) is again only slightly more than a statement of the facts. The only interesting aspect about it is its designation of the trigger of allomorphy as the UR, rather than the phonological index. However, at the present moment, the choice of allomorph could be triggered by the phonological index, as in the case from Israeli Hebrew above. Now consider the additional JS verbs in (16):

(16) More Jewish Sanandaj verbs

<table>
<thead>
<tr>
<th>Root</th>
<th>substantive</th>
<th>infinitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. √dwq</td>
<td>doq</td>
<td>dwaqa</td>
</tr>
<tr>
<td>b. √dyq</td>
<td>deq</td>
<td>dyaqa–daqoe</td>
</tr>
<tr>
<td>√pyf</td>
<td>pef</td>
<td>pyaʃa–paʃoe</td>
</tr>
<tr>
<td>c. √xɔr</td>
<td>xar</td>
<td>xaroe</td>
</tr>
<tr>
<td>√ʃɔr</td>
<td>ʃar</td>
<td>ʃaroe</td>
</tr>
</tbody>
</table>

The data in (16) support a division into three groups of verbs that have biconsonantal stems in the subjunctive. Two of them (16b,c) have the infinitive form QaToLe, but only those in (16b) have a QTaLa form, too (whereas in 16a, this is the only form attested). What unifies the verbs in

---

8 The different formulations of the two templates are due to their flexibility and phonological predictability. The positioning of the vowels of <o,a,e> is phonologically predictable, whereas in QTaLa the initial cluster has to be recorded lexically.
(16a,b) is the glide status of their second radical. The rule in (15) above must therefore be slightly generalized to account for both /QwL/ and /QyL/ roots:

\[
(17) \quad \text{Allomorphy in Jewish Sanandaj infinitives: revised}
\]

\[
\begin{align*}
\text{[Infinitive]} & \quad \Leftrightarrow \quad <a,o,e> \\
& \quad \Leftrightarrow \quad \text{QTaLa} / /QT_{[-\text{conson}]}L/ , \text{Stem I}
\end{align*}
\]

The difference between (16a) and (16b) is the crucial point for our discussion. (16b), but not (16a), can function like the truly “hollow” verbs of (16c) (hollow because their middle radical is null). It is now important to distinguish between \(\sqrt{QwL}\) and \(\sqrt{QyL}\) roots, because only the latter are subject to regularization. I interpret this as the result of an optional allomorphic rule that replaces a middle radical /\(y/\) with /\(\emptyset/\) in the infinitive, thereby rendering \(\sqrt{QyL}\) similar to \(\sqrt{Q\emptyset L}\) roots.

The question to ask is whether the target of this allomorphic rule is the phonological index or its UR. Note that the output of this rule must be the input to the selection of the infinitive allomorph QTaLa or \(<a,o,e>\). Therefore, deletion of /\(y/\) must somehow precede consideration of the form of the infinitive. The model developed here has one stage preceding the consideration of grammatical URs, namely the stage of the attribution of a UR to the index root. It follows that the target of the rule must be the phonological index.

The representation of the process is given in (18). A phonological index \(\sqrt{QyL}\) in the infinitive has two possible underlying representations, /\(QyL/\) and /\(Q\emptyset L/\), depending on the application of an optional readjustment rule to the phonological index. A rule associating an exponent to the information [infinitive] is applied after this choice has been made, in the construction of the word-form. Thus, the realization of the infinitive depends on the specific UR that is inserted, rather than on the phonological index, which itself always contains \(y\) as the second radical. This is therefore a case of sensitivity to the UR, rather than the phonological index.\(^{10}\)

---

\(^9\) The glide is also the reason for the special vocalization of the subjunctive form. A strong subjunctive base has the form [\(\text{gar}\partial\)]. The glide-medial roots originate in a representation like /\(\text{dayq}/\Rightarrow [d\partial k], /\(\text{dawq}/\Rightarrow [d\partial k].\)

\(^{10}\) A reviewer suggests an alternative, which is interesting to go over in this context to avoid a specific type of confusion. What if the phonological index \(\sqrt{dyq}\) were optionally mapped to a UR /\(dyqa/\) in the environment of [infinitive]? That is, if the template QTaLa were not the direct realization of the infinitive? This mapping would block the regular application of \(<a,o,e>\). In this scenario, this would be a case of sensitivity of the phonological index to grammatical information, rather than sensitivity of grammatical information (choice of template) to the UR of the phonological index. The major fault that I find in this view is that it construes QTaLa in JS as an arbitrary, fully-vocalized UR of certain roots, rather than an independent templatic morph. Indeed, the mere idea that roots can have fully-vocalized URs undermines the entire root-and-templative analysis of QTaLa infinitives. Note, moreover, that in Qaraqosh QTaLa would probably have to be viewed as a template, and not an arbitrary UR, because of its regularity; this raises the question of when a template ceases to be one and becomes an arbitrary realization of the phonological index.
(18) Allomorphic sensitivity to a specific UR, rather than the phonological index

In the last two subsections, we have seen cases which must be viewed as triggered by either the phonological index or its UR. In the example just discussed we have also seen a third case of allomorphy, one in which the undergoer is the phonological index. In the next subsections, I further elaborate on the issue of the undergoers of allomorphy, and show that from this perspective, too, one needs to recognize two distinct levels of representation: the UR and the phonological index.

4.3. The phonological index vs. the UR as undergoers of allomorphy

This subsection adds a final piece of evidence to the distinction between the phonological index of a root and its UR. Alongside an additional case of the phonological index undergoing allomorphy, we will encounter a case wherein the undergoer of allomorphy must be the UR, and not the phonological index. It will further be shown that in both cases, allomorphy may be regarded as optimizing, albeit on different levels.

Consider the set of data from Qaraqosh in (19) below. The paradigm of the /y/-initial verb (19b) is on the whole phonologically regular. The initial clusters /yC/ of the infinitive and imperative singular - expected by analogy to the strong verb - become [ʔiC], with the glide becoming syllabic and an epenthetic [ʔ] inserted. The stress of the imperative singular is also regular: its underlying form is /yqoð/, and stress being penultimate in Qaraqosh, it falls on the first vowel, making [ʔiðoð] unsurprising. Note that the first vowel cannot be regarded as epenthetic: Khan remarks (2002; 64-65, 101) that initial clusters are often repaired by epenthetic [ə] or prosthetic [ʔə], which he does not transcribe, but such vowels never attract stress.

(19) Weak-initial paradigms in Qaraqosh

<table>
<thead>
<tr>
<th></th>
<th>a.</th>
<th>b.</th>
<th>c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>subjunctive</td>
<td>páθɔx</td>
<td>yáqəð</td>
<td>ʔáxəl</td>
</tr>
<tr>
<td>infinitive</td>
<td>pθáxa</td>
<td>ʔiʔáðə</td>
<td>ʔəxála</td>
</tr>
<tr>
<td>imperative SG</td>
<td>pθox</td>
<td>ʔiʔoð</td>
<td>ʔixol</td>
</tr>
<tr>
<td>PL</td>
<td>pθúxu</td>
<td>ʔáqûu</td>
<td>ʔáxlu</td>
</tr>
<tr>
<td></td>
<td>‘open’</td>
<td>‘burn’</td>
<td>‘eat’</td>
</tr>
</tbody>
</table>

d. [imperative, PL] <=> θ / yC_Cu
The imperative plural of (19b), however, is not straightforwardly explicable without reference to extra-phonological factors. One would expect /yquðu/ to be realized as [ʔiqúðu] (cf. infinitive /yqaða/ => [ʔiqáða]); but what one finds is [ʔə́qðu], with the unexpected syncope of the medial vowel (the reduction of /i/ to [ə] in closed syllables is regular). Khan (p. 101) mentions that the stress “would have moved back by analogy to the singular”. The elision of the /u/ can be diachronically related to this paradigmatic uniformity: if stress remained on the same stem vowel and the /u/ were realized, the form would be *[ʔiqúðu], ill-formed for its antepenultimate vowel. Nevertheless, note that unless we admit Paradigm Uniformity (see e.g. Steriade 2000) with respect to stress as a synchronic phonological process, it must be assumed that /u/ is arbitrarily absent from the underlying representation of /y/-initial verbs, as formalized in (19d) above. The environment of the application of this rule is that of the underlying representation, rather than the phonological index, for reasons that will become clear in what follows.

Now consider the paradigm in (19c). Its phonological index has an initial /ʔ/, as shown by the subjunctive base. In the infinitive, the impossible cluster /ʔsara/ is broken up by an epenthetic vowel [ə] (which Khan does transcribe). This is again an unsurprising, predictable phonological process. In the imperative, however, instead of the expected [ʔxóð], [ʔxúlu] (from /ʔxol/ and /ʔxulu/ respectively), with the same repair as in the infinitive, we find forms that are identical to those of the /y/-initial paradigm. It can be concluded that there has been paradigm merger: /ʔ/-initial verbs have assimilated to /y/-initial verbs in the imperfective. In our terms, phonological indexes of the type √ʔTL are inserted as /yTL/ in the imperative.11

This allomorphic scenario is presented in (20a). Again, the undergoer of allomorphy is the phonological index: a phonological index with a first radical /ʔ/ is converted into a /y/-initial UR, through a readjustment rule conditioned by the syntactic environment of the imperative. The specific exponent association rule in (19d) will be sensitive to this UR (more on the choice of this trigger below). In the subjunctive, there is no readjustment rule and the expected form is found. In the case of y-initial roots (20b), no readjustment of the phonological index occurs and the same UR appears in both environments.

(20) Readjustment of a phonological index

<table>
<thead>
<tr>
<th>Root</th>
<th>Phon.index</th>
<th>URs</th>
<th>Realizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. √235</td>
<td>√ʔx₁</td>
<td>/ʔx₁/</td>
<td>[ʔaxel]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/yxl/</td>
<td>[ʔáxlu]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/yqð/</td>
<td>[ʔaqð]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/yqð/</td>
<td>[ʔaqðu]</td>
</tr>
<tr>
<td>b. √230</td>
<td>√ʔyqð</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Readjustment Rule</td>
<td>[imperative, pl] ↔ ø /yQ_Lu/</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11 These cases can be described as resulting from interparadigmatic pressures (for an implementation in Semitic, see Zadok & Bat El (2015)) or metasyntcretism (Bobaljik 2001).
The analysis in (20) involves yet another case of allomorphy of the phonological index. Its main import is in stressing the function of this allomorphy. The data in (19) constitute paradigm merger, i.e. a case where the realizations of two otherwise distinct bases are indistinguishable. As a consequence, the scenario in (20) illustrates one way of formalizing paradigm merger in the present framework: in a specific environment, a phonological index (in this case √ʔTL) is readjusted so that its UR becomes identical in the relevant sense to the UR of a distinct phonological index (in this case √YTL).

But of course, not all cases of base allomorphy target the phonological index. Indeed, in a paper that distinguishes between UR’s and phonological indexes, it is crucial to show that UR’s, too, can undergo allomorphic alternations. Consider now the additional two paradigms in (21b,c). The subjunctive form of the verb in (21b) designates it as having a /y/-initial root. However, in the rest of the forms, this /y/ and the second consonant of the root metathesize, because the template requires an initial cluster. This metathesis does not make it a y-medial root since, as (21c) illustrates, if a phonological index has /y/ in the second position, this /y/ is converted into ø in the past and imperative bases, but not in the infinitive base. This is true of all verbs with [y] as a second consonant in the present and infinitive bases.

(21) More weak verbs in Qaraqosh

\begin{verbatim}
<table>
<thead>
<tr>
<th>Subjunctive</th>
<th>Infinitive</th>
<th>Past</th>
<th>Imperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. paθəx</td>
<td>pθaxa</td>
<td>pθəx</td>
<td>pθuxu</td>
</tr>
<tr>
<td>b. yarəθ</td>
<td>ryaθa</td>
<td>ryoθ</td>
<td>ryoθu</td>
</tr>
<tr>
<td>c. rayəq</td>
<td>ryaqa</td>
<td>raq</td>
<td>ruqu</td>
</tr>
</tbody>
</table>
\end{verbatim}

What distinguishes the paradigm in (21b) from those we have seen previously is the conditioning. Unlike in (21c), metathesis applies whenever the template requires an initial cluster. In other words, it is the form of the template which triggers the allomorphy. In the strictest interpretation of allomorphic scenarios such as those in (20) above, the matching of a phonological index to the formless root cannot be influenced by the forms of its environment of insertion, which are not yet present in the computation (Bobaljik 2000). This is especially true in cases such as (21b), where the process can be viewed as phonologically optimizing: an impossible cluster /yr/ becomes [ry] (preferable with respect to sonority). One could devise a readjustment rule transforming √yrL into /ryL/ in QTVL (assuming that the form of the template is available at this point); but the phonological optimization that is the result of this rule would emerge as an accident. It seems that the metathesis is best viewed as part of the phonological computation, rather than an arbitrary rule.

The process is presented in (22). The split in (22a) represents the phonologically-optimizing allomorphy: it is the result of applying a phonological rule (which may be conditioned morphologically). Accordingly, the split is represented after UR formation, rather than as contributing to it. In this conceptualization, only processes which apply to the phonological index - such as those affecting y-medial root in (22b) - are part of UR formation.
Stem allomorphy: the root √yrθ

<table>
<thead>
<tr>
<th>Root</th>
<th>Phon.index</th>
<th>Urs</th>
<th>Realizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. √277 → √yrθ</td>
<td>/yrθ/</td>
<td>[yarəθ]</td>
<td>[ryaθa], [ryoθ], [ryuθu]</td>
</tr>
<tr>
<td>b. √225 → √ryq</td>
<td>/ryq/</td>
<td>[rayaq], [ryaqa]</td>
<td>[ryeq], [roq], [ruqu]</td>
</tr>
</tbody>
</table>

Now recall the exponent association rule of the imperative in (19d above), which stated that in the imperative plural, there is no vowel /u/ in the stem in the environment /yC_Cu/. One can now see why the conditioning environment cannot be the phonological index or its UR. If it were either of the latter two, we would expect (19d) to hold for /yqð/ and /yrθ/ equally, yielding the imperative plural *[ʔəráθu] (cf. *[ʔəráqðu] above). Instead, we find metathesized cases with the normal plural template. I assume that this metathesis blocks the application of (19d) for roots like /yrθ/.

To summarize, we have seen in this section two additional allomorphic scenarios, targeting either the level of UR or the level of the phonological index, to the crucial exclusion of the other level. These two cases join the examples of the preceding subsections, where the two levels were triggers of allomorphy, rather than its targets. A general conclusion is that what has been traditionally termed “root” is in fact three different levels of representation: the formless index, the phonological index and the UR. The next section concludes the paper, highlighting its consequences for a general theory of allomorphy, in Semitic and beyond.

5. Conclusion: what undergoes allomorphy when and where?

Theories like Distributed Morphology (e.g. Halle & Marantz 1993) have espoused the notion of the root as the most basic morpheme in the complex structure. From its beginnings, this theory equated the Semitic root with the roots of more concatenative languages (Noyer 1997, Arad 2005). Semitic roots illustrated one of the theory’s central claims about this level of representation: it is a-categorical and does not necessarily have the form of any specific item in the language. Thus, claims were made for roots in general, with Semitic roots as one, especially illustrative example.

This paper explored the opposite direction of argumentation: it examined the behavior of Semitic roots with respect to the phenomenon of allomorphy within a general theory of morphological derivation. Allomorphy, it was shown, is especially present in the Semitic systems in paradigms based on “weak” roots, i.e. roots whose radicals are not always realized in a straightforward manner, if at all. The examination of these roots yielded two claims of general application:
(23) General claims of the paper

a. Weak and strong suppletion are not the same process.
b. Roots have three levels of representation: the formless index (Harley 2014), the phonological index (e.g. Borer 2009, 2013) and the UR.

Allomorphy was defined as the correspondence of an item on one of these three levels to more than one item on the following level (including the fourth level or representation, the phonetic realization). Non-phonological allomorphy is traditionally divided into strong and weak suppletion: cases of strong suppletion instantiate in the present proposal a split in the mapping from the formless index to the phonological index, while weak suppletion should be viewed as having one phonological index correspond to two underlying representations.

The last section presented several cases of allomorphy applying to or being triggered by either the phonological index or the UR. While it is often hard to tell these processes apart, based on the cases examined one can tentatively propose the following general principles:

(24) What level undergoes what allomorphy: principles

a. Allomorphy at the level of the phonological index is non-phonologically-optimizing, but may be lexically-optimizing (paradigm merger).
b. Allomorphy at the level of the underlying representation is phonologically-optimizing.

In addition to these proposals of general application, an important difference between Semitic and non-Semitic roots emerges. In all the cases of allomorphy that we have examined, the target of allomorphy was not the root as a whole, but rather the radical, i.e. one of the phonologically identifiable parts of the root. Readjustment rules singled out one of the elements of the root and attributed to it a specific allomorphic representation. These rules are also sensitive to the position of the radical in the root. Outside Semitic, in allomorphic relations such as destroy-destruct, there is arguably little immediate profit in replacing only the final rhyme /ɔɪ/ with /ʌkt/, rather than storing another complete stem. But in Semitic, and especially in the verbal system, radicals are singled out along with their position in the root, and allomorphic processes will apply to all verbs that answer this structural criterion. To conclude and summarize this paper, I would like to advance the following claims about Semitic root-based morphology:

(25) Morphological and allomorphic principles of Semitic

1. In Semitic, roots are templatic in that they have morphologically-identifiable positions (Faust 2015, Goldenberg 1994).
2. Semitic radicals may function as declension class markers through allomorphic statements (Faust 2012).
3. There is no root allomorphy in Semitic (outside strong suppletion). The readjustment rules underlying allomorphy never target whole roots but rather only the well-defined parts of the Semitic root called radicals.

Future studies will explore the consequences of these generalizations for a general theory of allomorphy in natural language.
References


