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The phonology of the glottal stop in Garo*

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1. Introduction

Burling (1992) provides many detailed and in my view accurate observations on the phonology of the Tibeto-Burman language Garo. He also points out that the glottal stop [ʔ] acts in some ways like a tone and unlike a regular consonant. The properties of the Garo [ʔ] are summarized in (1).

(1) a. [ʔ] occurs only in the coda but not in the onset.
b. [CVʔ] syllables are similar to [CV] instead of [CVC].
c. [ʔ] is the only coda that is transparent to vowel assimilation.
d. [ʔ] is subject to deletion, but other C codas are not.
e. [ʔ] is not restricted to the coda position, but may occur on other segments.

Since [ʔ] is usually considered a consonant (for example, by the International Phonetic Association), (1) comes as some surprise. However, Burling's observation that [ʔ] differs from other Cs is well founded.[1] In this article I discuss how the properties in (1) can be accounted for in current phonological theory. I also argue that the Garo [ʔ] is not a tonal feature.

The interaction between [ʔ] and tone is fairly well-known in Asian languages. Although Burling finds [ʔ] to act like a tone, he does not consider [ʔ] a tone per se. On the other hand, Li (1992) takes a stronger position and states that "the syllable-final -ʔ in Southern Min dialects is a tone feature rather than a true consonant. The same interpretation seems to hold true for other Chinese dialects..." My discussion on whether [ʔ] is a tone feature is addressed more to the latter view.

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* This article was initiated by a talk Robbins Burling gave on Garo in June 1994 at the University of Michigan, and by the ensuing e-mail exchanges Rob and I had daily over the following week. Many thanks to Rob for sharing his thoughts with me and for his comments on an earlier draft. Thanks also to the audience at Rob's talk, in particular Prathima Christdas. Neither Rob nor the audience may agree with all I say.

1 According to the distinctive features system of Chomsky and Halle (1968:67), [ʔ] is not [+consonantal] but [-consonantal], just like the glides [y w]. This view is maintained by Halle (1992) in the current version of feature theory, namely, feature geometry. Burling's observation is in line with the analysis of Chomsky and Halle.

2. The Garo [ʔ]

First of all, (1a) and (1d) need not imply that [ʔ] is something other than a segment, or that it is a tonal property. With regard to (1a), one notes that [ŋ] in English occurs in the coda but not in the onset. Similarly, in Mandarin Chinese [ŋ] as a contrastive phoneme occurs only in the coda and not in the onset (although for some speakers [ŋ] can occur in the onset as an allophone of the "zero onset"). But in neither Chinese nor English is [ŋ] considered a suprasegmental or tonal property. With regard to (1d), one notes that it is not uncommon that some coda consonants are more prone to deletion than others. For example, of the six historical codas [p t k m n ŋ], Mandarin Chinese has lost [p t k m], and of the three nasal codas [m] has been the first to disappear. Exactly why some Cs are more vulnerable than others has yet to be fully understood, but there is no evidence that those that disappear early are in any way less of a segment or more of a prosodic property.

The other three properties of [ʔ], namely, (1b), (1c), and (1e), do require more discussion. I examine each in turn.

2.1. The similarity between [CVʔ] and [CV] syllables

Burling gives three cases, summarized in (2), in which [CVʔ] is like [CV] and unlike [CVC].

(2) a. The phoneme /i/ is phonetically [i] in [CV] and [CVʔ] and [ĩ] in [CVC].
b. In the Bangladeshi dialects the phoneme /e/ becomes [i] in [CVC] but remains [e] in [CV] and [CVʔ].
c. In some Bangladeshi dialects the phoneme /o/ becomes [u] in [CVC] but remains [o] in [CV] and [CVʔ].

As Burling points out, if [ʔ] is a consonant, [CVʔ] and [CVC] should be similar environments for the V; in fact, however, [CV] and [CVʔ] go together.

To understand what is going on, let us digress to three other issues: the syllable structure of [CV], the structure of geminates, and the notion of complex segments.

As Burling (p.38) points out, the Garo V is longer in [CV] than in [CVC] and [CVʔ]. This is no accident for a monosyllabic language, which Garo is. The same is true in many Chinese languages (Duanmu 1993). In particular, [CV] syllables have been found to be phonetically as long as [CVC] syllables.[2] In

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[2] For example, Howie (1976) has shown that in Mandarin Chinese CV and CVN syllables have similar durations. Kao (1971) found similar results for CV and CVN in Cantonese. On the other hand, Kao reports that Cantonese [CVC] with [p t k] codas is shorter than [CV]. However, Kao did not include the unreleased closure duration of the [p t k] codas. According to my own work, when the closure period of the [p t k] codas are included, the durations of [CV] and [CVC] become much closer.

addition, the longer V in [CV] is not due to phonetic effects, since in non-monosyllabic languages, such as English, CV is not known to be as long as [CVC]. On the other hand, it would be redundant to posit a phonemic length distinction in vowels, since vowel length is fully predictable: long in CV and short in [CVC] and [CVʔ]. The solution is to propose a fixed syllabic structure, CVX, where X is either a coda or the length of a vowel (an extra timing slot).[3] This analysis has three merits (apart from implications for tone and stress, see Duanmu 1993). First, it does not increase the underlying segment inventory. Second, it simplifies the syllabic inventory. Third, it correctly predicts vowel lengths. This means that, as is in Mandarin, what is transcribed as [CV] in Garo is in fact [CV:].

Let us now consider long segments, or geminates. Since geminate consonants do not concern us, I consider geminate vowels only. In multitiered phonology, vowel length is not represented as a feature in the vowel itself, but as the number of slots it is linked to on the "skeleton tier". (3) shows the structural contrast between [a] and [a:].[4]

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(3)  X        XX        Skeleton tier
     |        \/
     a        a         Segment tier
     [a]      [a:]      Letter representation
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Each X on the skeleton tier represents a unit of timing. The short vowel in (3) has one timing unit, and the long vowel has two. In this representation information on length does not reside in the segment itself, but in the skeleton tier. Therefore, recognizing vowel length does not imply increasing the underlying segment inventory. (4) shows how a fixed syllable structure predicts vowel length in [pan] and [pa] = [pa:].

```
(4)  a.  CVX  --> CVX          b.  CVX  --> CVX
                  | | |                    |\/
         pan      pan              pa      p a
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The CV-tier is similar to the X-tier supplemented with syllabic information (Levin 1985). When there is a coda, the vowel takes one skeletal slot, as in (4a), and when there is no coda, the vowel takes two skeletal slots, as in (4b).

Next consider complex segments. A complex segment, or what is traditionally called double (or multiple) articulation, is one that involves two (or more) articulators at the same time. For example, [t] is a simple segment

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3 Burling (p.c.) points out, however, that he was not sure whether the Garo V in CV is twice the length of V in CVC.

4 In the moraic theory (e.g., Hayes 1989), the skeleton tier is replaced by the mora tier, so that [a] is linked to one mora and [a:] to two moras. In addition, each symbol on the segment tier is in fact a shorthand for the feature structure of that segment.

involving the articulator coronal (traditionally called alveolar), and [t^w] is a complex segment involving the articulators coronal and labial. When there are two articulations, the one with greater oral constriction is called the primary articulation. Thus, in [t^w] the primary articulation is [t], and the secondary articulation is [^{w}].

Let us now return to the similarity between [CVʔ] and [CV]. For concreteness, consider the structures for the rimes [a], [aʔ], and [ap], shown in (5).

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(5)  a.  XX        b.  XX        c.  XX
         \/            \/\           ||
          a             a ʔ          ap
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As discussed earlier, [a] has a long vowel, and [ap] has a short vowel. In [aʔ] the vowel can be long, too. This is because the articulator for [a] is dorsal (tongue body), and that for [ʔ] is the vocal cords (glottis). Since these are independent articulators, there is nothing to prevent them from occurring together, giving what is called a glottal vowel. This is what is shown by (5b), where the sound under the first X slot is [a] and that under the second slot is [aʔ], i.e., a glottalized [a]. Indeed, it is possible that the glottal articulation is spread over both slots, as shown in (6), which is a long vowel that is glottalized throughout.

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(6)  ʔ
     /\
     XX
     \/
      a
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Two questions arise. First: do (5) and (6) predict that the vowel in the rimes [a] and [aʔ] have the same phonetic durations? Second: why can [a] spread over both slots in (5b) but not in (5c)? For the first question, the answer is no. This is because segments do vary in duration owing to their intrinsic properties. For example, high vowels are inherently shorter than low vowels. One expects, therefore, that the vowel is probably longer in the rime [a] than in [aʔ], since glottalization ([+constricted glottis]) makes vocal cord vibration harder and hence shorter. For the second question, one notes that the articulator for [p] is labial, which is independent of the articulator dorsal for [a]. But what sound would it be if both articulators are used at the same time? Consider the structure in (7).

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(7)  a.  XX        b.  X
         |/\           /\
         a p           a p
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