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Uh-oh: Glottal Stops and Syllable Organization in Sulawesi¹

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Glottal stops pattern differently than other consonants in a number of languages spoken on the Indonesian island of Sulawesi. In the Makassar languages of South Sulawesi, glottal stop alternates with [k]; in the Kaili-Pomona language Uma of Central Sulawesi, stem-final glottal stop is mobile, apparently metathesizing with material suffixed to the stem; and in the Central Sulawesi Saluan language Balantak, glottal stop is invisible with respect to a particular affix which is normally suffixed to vowel-final stems but infixes to consonant-final stems. I will argue that the various anomalies of the glottal stop result from the fact that glottal stops lack oral place specification; this lack of oral place allows consonants to coalesce with neighboring vowels without loss of place information, and makes glottal stops undesirable onsets in languages (like these) which prefer to locate place contrasts in syllable onsets.

1. Glottal Stop Alternation: Makassar languages

The Makassar languages of South Sulawesi include Standard Makassarese (Lakiung), Selayarese, Konjo, Bantaeng, and Turatea. These languages are mutually intelligible but differ in some vocabulary and exhibit some systematic differences in structure. Our focus here is on Makassarese, Selayarese, and Konjo. All three share a restricted syllable structure, allowing only [ʔ] and [ŋ] in syllable coda, and all three exhibit an alternation between [ʔ] and [k]. In Makassarese, these two segments are in complementary distribution, [ʔ] appearing in coda and [k] in onset position:

- (1) Makassarese
- | | |
|----------|-------------|
| bájiʔ | ‘good’ |
| bájik-aŋ | ‘better’ |
| bájik-aʔ | ‘I am good’ |

Following Basri (1999), I ascribe this alternation to a constraint favoring the encoding of place

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contrasts in onsets (which has the effect of banning glottal stops from onset position):

(2) Constraints banning glottal onsets

ONSETPLACE: Onsets must have place >> IDENT(PLACE)

While this constraint is undominated in Makassarese, Selayarese and Konjo do permit [ʔ] in onset position, though glottal onsets are restricted to a specific grammatical context. When a glottal-final stem takes a vowel-initial suffix, the stem-final glottal, now in onset position, is realized as [k], as in (3b, 4b). But stem-final glottal before a vowel-initial clitic is realized as a glottal stop, as in (3c, 4c).

(3) Selayarese:

- | | |
|--------------|------------|
| a. bákkaʔ | ‘big’ |
| b. bakkák-aŋ | ‘bigger’ |
| c. bákkaʔ-a | ‘I am big’ |

(4) Konjo

- | | |
|------------|-------------|
| a. hájiʔ | ‘good’ |
| b. hajík-a | ‘better’ |
| c. hájiʔ-a | ‘I am good’ |

This effect correlates with other differences between true suffixes and clitics. Apparent in (3) and (4) is different behavior of these affixes with respect to stress. The normal position of stress in Makassar languages is penultimate (Aronoff et.al 1987, Mithun and Basri 1986). True suffixes form part of the domain for assignment of penultimate stress, while clitics fall outside the stress domain, giving rise to antepenultimate stress. Based on these and other facts, Basri et. al (1999, 2000) argue that that true suffixes (such as the comparative -aŋ, -a) attach to the stem to form a single morphosyntactic word, while phrasal clitics (such as the absolutive -aʔ, -a) are not part of the morphosyntactic word, but simply part of the phrase (and therefore outside the stress domain).

Thus, Standard Makassarese differs from Konjo and Selayarese in that the distribution of glottal stop in Makassarese is governed solely by phonetic context: glottal stop may never occur prevocally. In Selayarese and Konjo, however, glottal stop may occur before a vowel, but only so long as glottal stop and the following vowel are not contained in the same prosodic word. The ability of grammatical factors to override the preference for onsets with oral place may be expressed either by output-output constraints enforcing identity of stems in base and derived forms (as argued in Selkirk 1999), or by constraints disfavoring syllabification across prosodic words. Under either approach, the Makassar languages share a dispreference for glottal onsets, allowing them, if at all, in a very restricted set of contexts. Below we will see that the placelessness of glottal stops is a factor in explaining their behavior in other Sulawesi languages as well.

2. Glottal Stop Mobility: Uma

Uma, a member of the Pipikoro group of the Kaili-Pamona/Toraja languages of Central Sulawesi, shows what appears to be movement of glottal stop (data from Martens 1988 and Martens & Martens 1988):

- (5) a. ánaʔ ‘child’
 b. mo-ʔaná-iʔ ‘to have children’
 c. mo-ʔánaʔ-i ‘she gave birth’
- (6) a. mo-níuʔ ‘to bathe’
 b. po-níu-aʔ ‘bathing place’
 c. mo-níuʔ-a ‘I take a bath’

Uma, like the Makassar languages, has a contrast between true suffixes-- which appear inside the stress domain, giving rise to normal penultimate stress-- and clitics, which appear outside the stress domain. When a suffix is added to a stem ending in a glottal stop, as in (5b, 6b), the glottal stop appears to metathesize with the suffix, appearing after it.

Martens 1988 and Martens & Martens 1988 argue that the glottal stop should be analyzed not as a consonant at all, but rather as a word-level autosegment which is realized at the right edge of a prosodic word--which, as in Makassar languages, does not include clitics:

(7) Morphological Positioning of Glottal Stop

- mo-ʔaná-iʔ]_{PWd}]_{PPH} ‘to have children’
 mo-ʔánaʔ]_{PWd} -i]_{PPH} ‘she gave birth’

This analysis is, as they point out, consistent with the syllable structure of Uma, which allows no syllable codas whatsoever--with the sole exception of word-final glottal stop.

A possible scenario for the history of Uma syllable structure makes clear how glottal stops could have come to be the only word-final survivors, and to have eventually lost their status as independent consonants. Sneddon notes (Sneddon 1993) that a number of Sulawesi languages show a change from Proto-Austronesian syllable structure, with a fairly rich array of final consonants, to the current state of highly impoverished codas or no codas at all. Sneddon argues for a stage in Uma in which stops lost their place (that is, became glottal stops), while final sonorants deleted. This suggests a scenario that led to the maintenance of final glottal stops but loss of final sonorant consonants: children hearing only final glottal stops assumed that the language banned all syllable codas, and final glottal stops were reanalyzed as glottalization on a preceding vowel. The reanalysis of final glottal stop as non-codas was possible because, as Sumner (1999) argues, a glottal stop can merge with a neighboring vowel without violating constraints on place identity, since the segment resulting from merger will preserve the place features of both the vowel and (vacuously) the glottal stop. We can assume the following constraints to describe the grammar of a speaker at the stage at which all final consonants except glottal stop are lost:

(8) a. NoCoda: Syllables must not have codas.

b. Ident(CPlace): input and output correspondents must have identical specifications for consonantal place. (Here I assume, following Clements and Hume (1995), that consonant place features are specified under a Cplace node, vocalic features under a Vplace node; secondary articulations on consonants consist of addition of a Vplace node to a consonant.)

c. Max(C): any consonant in the input must have a correspondent in the output.

d. Linearity: output segments must retain the same precedence relations as their input correspondents.

The tableau below shows a ranking which would preserve final glottals but not other final consonants. Candidate (9a) preserves glottal stop as an independent consonant, violating high-ranking NoCoda, while (9b) deletes glottal stop, violating Max(C). But coalescence of the glottal stop with the preceding vowel in (9c) preserves the glottal articulation without violation of NoCoda, Ident(Place), or Max(C), since the glottalized vowel is the output correspondent of both the vowel and the glottal stop:

| (9) /anaʔ/ 'child' | NoCODA | IDENT(CPLACE) | MAX(C) | LIN |
|-----------------------|--------|---------------|--------|-----|
| a. a. naʔ | *! | | | |
| b. a. na | | | *! | |
| ☞ c. a.naʔ | | | | * |

Final consonants specified for C place cannot, in contrast, be preserved via coalescence, since the consonant's place features would conflict with those of the vowel. Thus, the development of Proto-Austronesian *katel > kata 'itch' can be envisioned as in (10). Here merger of [l] with the preceding vowel is not an option, since it would create a segment (a lateral vowel) serving as output correspondent of both [e] and [l]. This merged segment would contain the consonantal place features of [l], violating Ident(Cplace). The remaining option in this case is deletion of the sonorant:

| (10) /katel/ 'itch' | NoCODA | IDENT(CPLACE) | MAX(C) | LIN |
|------------------------|--------|---------------|--------|-----|
| a. ka.tel | *! | | | |
| ☞ b. ka.te | | | * | |
| c. ka.te (e=e,l) | | *! | | * |

The reanalysis of final glottal stops as part of the preceding vowel, rather than as independent codas, leads naturally to the analysis suggested by Martens in which these are

floating features. In fact, as Martens points out, final glottals are continuing to undergo even more drastic reanalysis: “in the speech of some Umas, especially young children, words with final glottals also have medial glottals before stops...The entire word seems ‘tense’ to them...” (Martens and Martens 1988, 280.):

- | | | | |
|------|-------------------------|--|-----------------------------|
| (11) | a. Normal Pronunciation | | b. Children’s Pronunciation |
| | ládiʔ ‘knife’ | | láʔdiʔ ‘knife’ |
| | karábiʔ ‘comb’ | | karáʔbiʔ ‘comb’ |

Therefore, as in Makassar languages, the placelessness of glottal stops leads them to pattern differently from other consonants. In the Makassar languages, where place contrasts are limited to onset position, glottal stops occur only in codas. In Uma, glottal stops are the only final consonants to survive, because they are placeless, and can therefore be reanalyzed as elements of the preceding vowel. This reanalysis, however, leads to further reconception of glottal stops not as independent segments but as a feature of glottalization. We now turn to a third language, Balantak, in which glottal stop fails to pattern with other consonants.

3. Glottal Stop Invisibility: Balantak

Balantak, a Saluan language of Central Sulawesi, has an interesting allomorphy which casts light on the nature of glottal stop in this language. The second person singular possessive (2PS) has four forms. With stems ending in a single vowel, or two non-identical vowels, the 2PS appears as a suffix consisting of a copy of the preceding stem vowel followed by [m]:

- | | | | |
|-----------------------|-------------------|--|--------------------|
| (12) Suffix <i>Vm</i> | | | |
| a. tama | tama- <i>am</i> | | ‘your father’ |
| b. tambue | tambue- <i>em</i> | | ‘your green beans’ |
| c. kopi | kopi- <i>im</i> | | ‘your coffee’ |
| d. tigo | tigo- <i>om</i> | | ‘your tobacco’ |
| e. apu | apu- <i>um</i> | | ‘your fire’ |

Following stems ending in V_xV_x , a [w] precedes the copy vowel:

- | | | | |
|------------------------|---------------------|--|----------------|
| (13) Suffix <i>wVm</i> | | | |
| a. palaa | palaa- <i>wam</i> | | ‘your palm’ |
| b. see | see- <i>wem</i> | | ‘your odor’ |
| c. kasabii | kasabii- <i>wim</i> | | ‘your cassava’ |
| d. opuu | opuu- <i>wum</i> | | ‘your egg’ |
| e. suloo | suloo- <i>wom</i> | | ‘your heart’ |

With stems ending in VC, 2PS appears between the final VC, and is simply a copy of the adjacent stem vowel (I assume that the suffix on in (14b) is attached inside the stem):

(14) Infix V

| | | |
|------------|------------|----------------------|
| a. sarat | sara-a-t | ‘your foot’ |
| b. wewer | wewe-e-r | ‘your water’ |
| c. witis | witi-i-s | ‘your calf (of leg)’ |
| d. popurun | popuru-u-n | ‘your sago’ |
| e. suap+on | suapo-o-n | ‘burned by you’ |

And with stems ending in V_xV_xC , 2PS is again infixated before the final stem consonant and again takes the shape of a copy of the final stem vowel, in this case preceded by [w]:

(15) Infix wV

| | | |
|------------|------------|--------------------|
| a. balaan | balaa-wa-ŋ | ‘your palm stem’ |
| b. roon | roo-wo-n | ‘your banana leaf’ |
| c. tuur | tuu-wu-r | ‘your knee’ |
| d. bako+on | bakoo-wo-n | ‘cut by you’ |

Alternations such as the one above, in which an affix is realized either in peripheral or internal to a constituent, are not uncommon, and one very interesting result of Optimality Theory has been to analyze such phenomena as a result of the interaction of morphological and phonological constraints (see for example McCarthy and Prince 1993a). What is particularly interesting about Balantak is the position of 2PS with stems ending in glottal stop. While other consonant-final stems take the infixated version of 2PS, with glottal-final stems this morpheme is realized as a suffix:

(16) Suffix Vm: with stems ending in [ʔ]

| | | |
|------------|------------|----------------------|
| a. aleʔ | aleʔ-em | ‘your garden’ |
| b. waaʔ | waaʔ-am | ‘your ear infection’ |
| c. oriiʔ | oriiʔ-im | ‘your poles’ |
| d. bakokoʔ | bakokoʔ-om | ‘your knife’ |
| e. bauʔ | bauʔ-um | ‘your pig’ |

Thus, glottal-final stems pattern with vowel-final stems in contrast to stems ending in other consonants. In the following sections I will provide an account of the suffix-infix alternation; the asymmetry of stems ending in oral consonants and stems ending in glottal stops; the appearance of [m] in suffixes, and the appearance of [w] following two identical vowels.

3.1. Suffix/Infix Alternation and Glottal-Oral Consonant Asymmetry

We can make sense of these facts as follows. First, I assume, following Busenitz & Busenitz (1991), that vowel sequences in Balantak, as in other Sulawesi languages, are heterosyllabic. Busenitz and Busenitz point out that the minimal word is disyllabic (again, a common feature across Sulawesi, resulting from the requirement that a bisyllabic trochaic foot be aligned with the right edge of each prosodic word; see Alderete 1999, Broselow to appear). The

existence of words whose only two vowels are adjacent argues for the heterosyllabic status of vowel sequences:

- (17) a. óe ‘rattan’
b. káan ‘to eat’

The analysis of all vowel sequences as heterosyllabic is also consistent with the fact that there seem to be no restrictions on two-vowel sequences—any two vowels may be adjacent. They point out that VV sequences pattern as two vowels with respect to stress, which falls on the penultimate vowel, even when this is the second of a sequence of adjacent identical vowels (though they note that they do not hear a phonetic distinction between stress on the first vs. the second of two identical vowels):

- (18) a. kaánon ‘eaten’
b. kaanónku ‘eaten by me’:

We therefore accept the argument that all vowel sequences are heterosyllabic, a situation enforced by ranking the constraints MAX(C) and DEP(V), which respectively forbid insertion of a consonant and deletion of a vowel, above ONSET, which requires syllables to have onsets. This ranking makes *V.V* rather than **V.CV* or **V∅* the optimal realization of input /VV/.

We next assume that 2PS is basically a suffix, its preferred position specified by the following constraint:

- (19) RIGHTMOST: 2PS should occur at the right edge of the prosodic word

The preferred placement of 2PS can be overridden by higher-ranking constraint:

- (20) ALIGN: The right edge of the stem must be aligned with the right edge of a syllable.

Only when suffixation would force misalignment does 2PS appear as an infix, as we see impressionistically below:

- (21) Suffix vs. Infix

| | | | |
|-----------------------|--|---------------|-------------|
| a. vowel-final stem: | ta.ma.]am. | ‘your father’ | (tama+2PS) |
| b. oral C-final stem: | sa.ra.at.] | ‘your foot’ | (sarat+2PS) |
| | *sa.ra.t]am, which fails Align | | |
| | *sa.rat.]am, which is syllabically illformed | | |

(See Broselow 2000 for discussion of the role of this constraint in preserving illegal stem-edge codas in Balantak, as well as comparison of infixation compelled by alignment and by syllable structure constraints.)

The assumption that alignment compels infixation allows us now to account for the

asymmetry between oral consonants and glottal stop, with one additional assumption—namely, that in Balantak, as in Makassarese, the constraint against glottal stop onsets is highly ranked; as in Uma, glottal stop is syllabified with the preceding vowel. This is the position explicitly argued for by Busenitz and Busenitz (1991), who point out that [ʔ] is the only consonant that never occurs initially. Furthermore, “When a single consonant occurs intervocalically, native speaker intuition views this consonant as an onset for the following vowel...The only exception is the glottal consonant. It alone seems to function as closure for the preceding vowel” (Busenitz & Busenitz 1991, 31).

I assume that the correct interpretation of Busenitz & Busenitz’s description of intervocalic glottal stop as closure on preceding vowel is, as in Uma, the coalescence of vowel+glottal stop. (Quick (2000) makes similar arguments for nearby Pendau.) Such coalescence is possible because it does not violate Ident[Place], since glottal stop has no oral place.

The assumption that stem-final glottal stops are realized through coalescence with a preceding vowel means that glottal-final stems should pattern with vowel-final rather than consonant-final stems. We can now compare the three stem types. I assume, in addition to the constraints OnsetPlace, Align, and Rightmost, one additional constraint:

(22) SyllableContact: in a sequence X.Y, X should be of higher sonority than Y

These constraints compel infixation in consonant-final stems, as shown in (23):

| (23) /sarat+2PS/ ‘your foot’ | ONSETPLACE | SYLLCONTACT | ALIGN | RIGHTMOST |
|---------------------------------|------------|-------------|-------|-----------|
| a. sarat.] <i>am</i> | | *! | | |
| b. sara. t] <i>am</i> | | | *! | |
| ☞ c. sara. at] | | | | * |

Both (23a) and (23b) maintain the preferred suffixal position of 2PS, but both with a cost. (23a) satisfies Align, but creates the structure VC.V, which violates not only Onset (which is fairly low ranked in Balantak) but also SyllableContact. This leaves the properly aligned infixing form as the optimal output. In contrast, because vowel sequences are heterosyllabic, a vowel-final stem can satisfy both Align and Rightmost:

| (24) /tama+2PS/ ‘your father’ | ONSETPLACE | SYLLCONTACT | ALIGN | RIGHTMOST |
|----------------------------------|------------|-------------|-------|-----------|
| ☞ a. tama.] <i>am</i> | | | | |
| b. tama-a] | | | | *! |

Glottal-final stems contrast with stems ending in oral consonants because, as in Uma, coalescence of vowel and glottal stop is possible, making available an option that satisfies both Align and Rightmost:

| (25) /aleʔ +2PS/ 'your garden' | ONSETPLACE | SYLLCONTACT | ALIGN | RIGHTMOST |
|-----------------------------------|------------|-------------|-------|-----------|
| a. ale]ʔ. em | | *! | | |
| b. ale. ʔ]em | *! | | * | |
| c. ale. eʔ] | | | | *! |
| ☞ d. aleʔ]. em | | | | |

3.2. Appearance of [m]

Next to account for is the appearance of [m] in the suffixed but not the infix form of the 2PS. I assume, again following Busenitz and Busenitz (1991), that [m] is part of the input, but that constraints against complex codas prevent its realization when the affix precedes a consonant. The constraint requiring that an affixal consonant be realized must rank below the constraint forbidding complex codas:

| (26) /tama+2PS/ 'your father' | ALIGN | DEP(C) | *COMPLEX CODA | RIGHT MOST | PARSE AFFIX-C |
|----------------------------------|-------|--------|---------------|------------|---------------|
| ☞ a. ta.ma.]am | | | | | |
| b. ta.ma.]a | | | | | *! |
| c. ta.ma.ma.] | | | | *! | |

| (27) /sarat+2PS/ 'your foot' | ALIGN | DEP(C) | *COMPLEX CODA | RIGHT MOST | PARSE AFFIX-C |
|---------------------------------|-------|--------|---------------|------------|---------------|
| ☞ a. sa.ra.at.] | | | | * | * |
| b. sa.ra.amt.] | | | *! | * | |
| c. sa.ra.mat.] | | | | **! | |
| d. sa.ra.t]am. | *! | | | | |
| e. sa.rat.]wam | | *! | | | |

3.3. Appearance of [w]

Still remaining to be accounted for is the appearance of [w] separating the copy vowel from two identical vowels. This motivates the following constraint:

(28) *V_xV_xV_x : No sequences of three identical vowels.

Sequences of three identical vowels never occur in Balantak, presumably because of the perceptual difficulty of distinguishing a sequence of two vs. three identical vowels.

| (29) /tama+2PS/ ‘your father’ | * V _x V _x V _x | DEP(C) | ONSET |
|-------------------------------|--|--------|-------|
| ☞ a. ta.ma.]am | | | * |
| b. ta.ma.]wam | | *! | |

| (30) /palaa+2PS/ ‘your palm’ | * V _x V _x V _x | DEP(C) | ONSET |
|------------------------------|--|--------|-------|
| a. pa.la.a.]am | *! | | ** |
| ☞ b. pa.la.a.]wam | | * | * |

3.4. Alternative Accounts

At this point it is necessary to consider a possible alternative account of the glottal/oral asymmetry. Gafos & Lombardi (1999) have argued for a hierarchy of consonant transparency--that is, consonants vary in the degree to which it is possible to copy across them, with glottal stop the most transparent to copying. We could use this factor to account for the glottal/oral asymmetry: in *ale ʔ-em*: copying across the glottal stop is not problematic, but **sarat-am* is ungrammatical because copying across consonant with oral place is prohibited. One potential problem with this account is that Balantak does freely permit copying across oral consonants in other contexts, namely, in prefixes with unspecified vowels:

- (1) Non-transparency of oral consonants
- | | | |
|----------|---------------------|-------------|
| mambaloʔ | ‘to throw’ | /mVŋ+baloʔ/ |
| moŋgoraʔ | ‘to make noise’ | /mVŋ+goraʔ/ |
| puntunu | ‘burn (imperative)’ | /pVŋ+tunu/ |
| niŋkiraʔ | ‘liked’ | /nVŋ+kiraʔ/ |

Judicious constraint ranking might provide a solution to this problem, but even so, such an account would miss the connection between the perception that glottal stop serves as closure to the preceding vowel and the asymmetry between oral-final and glottal-final stems with respect to compelling infixation.

4. Summary

We have seen three case studies of glottal stop in Sulawesi. The Makassar languages ban glottal onsets, requiring onsets to have place. Uma bans all codas, preserving final glottal stops through coalescence with a preceding vowel. Balantak, like the Makassar languages, bans glottal onsets, and like Uma, it preserves intervocalic glottal stops through coalescence with a preceding vowel.

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