【Forum】

More on Pitch, Stress, and Vowel Reduction

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Abstract: Based on Welsh, a language which has separated stress (intensity/amplitude) and pitch onto different syllables in polysyllabic words, Griffen (1998) argues that vowel reduction correlates with pitch, not stress. He also notes that aspiration correlates with stress. This note takes issue with both of these points. The Ryukyuan language of Taketomi, a pitch language with no phonemic stress, has historical vowel reduction which does not correlate with pitch. An explanation is proposed for this vowel reduction, and it is suggested that this explanation may also apply in the case of Welsh. In the Ryukyuan language of Nakijin, a pitch accent language with no phonemic stress, aspiration correlates with foot structure, not stress. Indications are that Welsh aspiration may be similarly distributed.*

Key words: vowel reduction, aspiration, pitch, stress, foot structure

1. Introduction

Griffen (1998) questions the assumption that vowel reduction is a reflex of lack of stress, and instead gives evidence that, in Welsh, vowel reduction is to be instead associated with the loss of high pitch accent. He also claims, again on the basis of Welsh, that aspiration insertion correlates with stress. In this paper I shall argue against both of these conclusions, giving evidence from non-stress languages and giving analyses which are consistent with the processes observed in Welsh and English.

Griffen (1998) defines phonological vowel reduction or centralization as "a phenomenon in which the vowel in an accented syllable is shifted toward the mid-central position when the accent is removed from the syllable" (p. 17). Accent is not explicitly defined, but Griffen's usage is consistent with an abstract entity which is given phonetic realization in terms of stress (intensity) and/or pitch.[1] I

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[1] Griffen (1998: 24) writes that "accent is traditionally interpreted as a function of stress" and that "in the Welsh data […] accent is a function of pitch".

Griffen (1998: 17) defines "stress" as "the strength with which a sound is articulated [which] corresponds to modulations of amplitude", and this is equivalent to stress being interpreted

shall use accent in this sense in this paper.

In his paper, Griffen explains that, in Welsh, certain tense vowels are reduced to mid-central position in non-ultimate syllables (including in the stress-accented penult) (p. 19). The ultimate syllable, which is immune to reduction, is the syllable to which "primary pitch" (p. 18) is assigned. This fact suggests to Griffen that the High pitch[2] on the ultimate syllable is what is responsible for blocking vowel reduction in that syllable. Griffen draws on previous research in physiological phonetics which shows that "movement of the hyoid to a rest position from the forward (and upward) tilt associated with pitch accent correlates with the mid-central (schwa) position of the tongue-body musculature" (p. 28–29), and from this he draws the conclusion that vowel reduction is a physiological reflex of loss/lack of High pitch.

Vowel reduction in English is usually ascribed to lack of stress (or, according to Griffen (p. 17), lowering or loss of stress). This interpretation of English vowel reduction is, however, at variance with Griffen's account of vowel reduction in Welsh and with the physiological evidence for a causal relationship between a drop in pitch and mid-central vowel articulation. Because stressed syllables are usually pronounced with increased pitch in English (in intonationally neutral pronunciation), Griffen proposes that it is in effect the lowering (or loss) of pitch which leads to reduction in English too.

Problematic for Griffen's analysis would be a language where, as in Welsh, stress and pitch are separated, but where vowel reduction correlates with stress; or alternatively a language with vowel reduction which does NOT correlate with pitch distinctions. In Section 2 I shall introduce a language of the latter type.

Also on the basis of Welsh, Griffen proposes that aspiration insertion is "stress-motivated". As such, one would not expect to see such a process in a non-stress language, but in Section 3 I shall give an example of one such language, and show that it can be analysed in the same way as Welsh and English if the environment for aspiration-insertion/deletion is sought at a more abstract level.

2. Vowel Reduction without Lowering of Pitch

The only example of phonological vowel reduction given by Griffen in support of the view that vowel reduction correlates with lack (or loss) of pitch comes from Welsh, and he comments that "Welsh appears to be the only clear-cut instance of separation of pitch from stress" (p. 20 fn2). There is, however, a large class of languages which appear to have escaped Griffen's attention; namely tone/pitch(-

as combined intensity and duration (total amplitude) (Beckman 1986: 174-7, 198-9; Lawrence 1998). I shall conform to this usage of stress in this paper. It should be noted that some linguists use "stress" in the more abstract sense of "a hierachically organised rhythmic structure" (Hayes 1995: 26), but in this paper this corresponds to the notion "foot head".

[2] Hereafter pitch/tone is referred to using capitalised High/Mid/Low, in order to avoid confusion with vowel height. In this paper High vowels are marked with an acute accent (V́), and Low vowels are unmarked.

accent) languages.

One tone/pitch language which has a reduced vowel is the Taketomi dialect of Southern Ryukyuan Japanese.[3] This dialect has 6 phonetically contrasting oral vowels [i, e, ə, a, o, u] (Kuno Makoto 1990; Tsuji 1991), although both historically and synchronically this system derives from 5 vowels (viz. /i, e, a, o, u/).[4] Comparison with other Southern Ryukyuan dialects shows that historically the schwa derives from a short *a*, and that the phonetic [a] comes from long *a* (Lawrence 1999). In other words, historically, the following two context-free sound changes have taken place in the order given.

(1) a > ə
    aː > a

The second process is part of a more general process of vowel shortening. Although diachronically the result of shortening, the difference between *ə* and *a* is one of place of articulation and not length (see Lawrence 1999: 171-2 for formant and duration measurements). Taketomi *ə* is typically a neutral vowel pronounced mid-centrally and a little higher than the low central vowel /a/, but its place of articulation is heavily influenced by that of vowels in adjacent syllables, suggesting that it lacks an articulation target.[5] The phonetic evidence is thus that *ə* in this language lacks place-of-articulation features. Synchronically, modern Taketomi is best analyzed as having underlying *ə* (i.e. a vowel with no place-of-articulation features), and that when immediately following another vowel position it is supplied with the feature [+low] giving *a*.[6] Synchronically, therefore, there is no reduction involved; instead the opposite, strengthening, is taking place. Historically, however, reduction HAS taken place, and it is this historical reduction which bears on

[3] Ryukyuan (made up of Northern and Southern branches) is a sister language family to Japanese. Southern Ryukyuan is made up of over 50 languages/dialects, divided into the Miyako group and the Yaeyama group. The Taketomi dialect, spoken on Taketomi island, belongs to the Yaeyama group.

[4] There are also nasalised vowels which are due to the loss of certain medial consonants, usually /m/ (Kajiku 1996).

[5] Lawrence (1999: 172) gives the example *nəːndərikəːndəriʃi* 'half-heartedly', where the first and third schwas have a first formant at 650 Hz, and the second formant at 1450 Hz and 1650 Hz respectively. These values fall within the normal range of formants for *ə* pronounced in monosyllables. However, the schwa in the second syllable had F1 and F2 values of 600 Hz and 1700 Hz, and the schwa in the fifth syllable was pronounced with F1 and F2 values of 550 Hz and 1750 Hz, placing them higher and further forward than the normal range of Taketomi schwa, but further back than /e/. This is interpreted as being due to the influence of the high front vowels in the adjacent third and sixth syllables.

[6] A referee reminds me of the existence of Nishioka (2010), where it is suggested that Taketomi *a* and *ə* are synchronically different phonemes. I am not convinced by his arguments, but a full discussion of the issues is beyond the scope of this paper. The issue which is relevant to this paper is the historical source of the Taketomi schwa, and Nishioka (2010) does not dispute that it is the result of reduction from an historical short /a/.

Griffen's account.

Taketomi is a pitch language where the vocabulary is divided between two pitch "classes": a level class, pronounced on a Mid pitch, and a contour class, which has a High pitch on the word-final mora in forms cited in isolation, and the syllable containing the second mora has a High pitch in the phrasal pronunciation (Hirayama 1967: 45; Kuno Mariko 1990).[7] The following are some words from the contour class (high tone marked with an acute accent). Note that the reduced vowel *ə* is found in both High and Low syllables.

(2) pə́í-nu 'needle-GEN' nə́í-jə 'wave-TOP'
çi̥tusərə́ 'one plate' kəbirə́ 'butterfly'

The Taketomi pitch pattern has been reconstructed as the pitch pattern for the proto-language from which all Yaeyama dialects except Yonaguni and Kuroshima descend (Hirayama 1967: 9). Whether or not this reconstruction is correct, there is no doubt that at the stage when the Taketomi dialect underwent vowel reduction there was a lexical pitch distinction, and because ALL short /a/ vowels were reduced, vowel reduction has taken place whether the syllable was High or not.

Vowel reduction has taken place historically in the Taketomi dialect regardless of the pitch. It is therefore premature to claim as Griffen does that because in one language (Welsh) vowel reduction correlates with pitch, this must be the case in another language. It may be the case that vowel reduction is a reflex of what could be termed "prosodic bleaching" (the loss of stress, pitch, or length), but this leaves unexplained the fact that vowel reduction is much more common in stress(-accent) languages than in pitch languages where it is almost unknown (see Dressler 1985: 33).

Interestingly, it has been observed that vowel reduction may correlate with the sonority of the vowel – if a vowel α exhibits reduction in some language, then any vowel β that is more sonorous than α also exhibits reduction (Hammond 1997: 7). The more sonorous the vowel, the lower and longer (inherent duration) it is. Recalling that Taketomi reduction applies to the most sonorous vowel (plausibly the longest of the short vowels), and that phonologically long vowels are shortened, it may be worth considering the possibility that reduction is an attempt to shorten a phonologically short vowel. In Taketomi, long vowels shorten, and the longest of the short vowels appears to have become caught up in this process. In English, a stress-timed language, stressed syllables tend to lengthen and unstressed syllables tend to shorten. This shortening may be the cause of the reduction.

As for Welsh, Williams (1989: 32ff) and Ball & Williams (2001: 180) point out that, in penultimately stressed non-prepausal words, the final syllable almost always has longer duration than the stressed syllable, and shortness of vowel dura-

[7] An anonymous referee claims, based on his direct observation of the dialect, that the contour class is characterized by the pitch contour not being fixed (but the syllable containing the second mora has High pitch in phrasal pronunciation). The contours in (2) are from the author's fieldwork.

tion characterises the stressed penult. It is plausible that this longer duration associated with the final syllable may aid in signalling a word boundary, and it would therefore serve to enhance the boundary-marking function of the long ultima if pre-final syllables were shortened.[8]

3. Aspiration Alternations without Stress

Griffen (1998: 22) argues on the basis of Welsh that, in the same way that vowel reduction is pitch-motivated, "aspirate insertion is stress-motivated." In this section I will demonstrate that the motivation for aspirate insertion should be sought at a more abstract level.

The Nakijin dialect of Northern Ryukyuan Japanese (Nakasone 1983) is a pitch accent language with an iambic foot structure. Stress plays no role in the phonology. Accents are assigned cyclically to either the penultimate mora (the unmarked case) or the ultimate mora (the marked case).[9] High tones are assigned to the rightmost accent in a word, and also to the leftmost mora (the marked case) or first mora after the leftmost foot (the unmarked case) of a word. This High tone is then moved to the head of the foot it is in. All moras dominated by or located between High tones within a word are pronounced on a High pitch.

Quantity-sensitive iambic feet are erected from left to right across words, prior to most compounding, and iambic lengthening generally applies, but is blocked on high vowels if adjacent to an accented mora. The foot structure is involved in a number of segmental processes (vowel lengthening, *r*-deletion, progressive palatalization), but is independent of accent position.

This dialect has phonetically contrasting unaspirated (glottalized) and aspirated stops and affricates. With the exception of a very small number of recent loans, aspiration is restricted to foot-initial consonants.

As described above, foot structure is usually erected prior to compounding, but there is a class of compounds (specifically, all number/classifier compounds, and around 50 other noun compounds) which are formed prior to foot structure being erected, with the result that, in these compounds, the foot structure is not interrupted at compound boundaries. In these "early compounds" a regular alternation between aspirated and unaspirated consonants may be observed. (A period in the following forms marks the foot boundaries.)

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[8] Two of the four processes that Griffen (1998: 19) lists as synchronically vowel reduction/centralisation were historically just such processes ([u]/[ï] > [ɵ]/[ə] > [ə]), but the other two historically involved both reduction/centralisation and lowering. Old Welsh [ei]/[e͡ɯ] lowered to [ai]/[aï] in final syllables some time after the movement of stress onto the penult (Jackson 1953: 686-7), and became centralised as [əi]/[əï] in other syllables. It may be that low [ai]/[aï] were intrinsically longer than mid [ei]/[e͡ɯ], with the lowering thus historically contributing to marking word boundaries.

[9] This account is simplified. There are words with no accent, due to other factors. Unaccented words are pronounced with a High tone on the ultimate mora. For a full account of the accentuation of the Nakijin dialect, the reader is referred to Lawrence (1990).

(3) a. tʰukuu.má /tukuma/[10] 'place' cutu.kúma. /cʔu-tukuma/ '1 place'
mutúú.kuma. /mu-tukuma/ '6 places'
nana.tʰukúú.ma /nana-tukuma/ '7 places'
jatúú.kuma. /ja-tukuma/ '8 places'
kʰunu.tʰukúú.ma /kunu-tukuma/ '9 places'

b. tʰágu. /tagu/ 'bucket' cutáá.gu /cʔu-tagu/ '1 bucketload'
mutáá.gu /mu-tagu/ '6 bucketloads'
nanaa.tʰágu. /nana-tagu/ '7 bucketloads'
jatáá.gu /ja-tagu/ '8 bucketloads'
kʰunu.tʰágu. /kunu-tagu/ '9 bucketloads'

Note that the distribution of aspiration is a function of the foot structure, and is independent of pitch and location of accent. It is, of course, unrelated to stress. It does, however, share a remarkable similarity with the distribution of aspiration in English.

English aspiration is dependent on the position of the voiceless stop within the foot (Kiparsky 1979: 437). English is argued to have trochaic feet with surface footing of a dactylic sequence (Davis 2003), and aspiration is restricted to foot-initial position (as is *h* (Borowsky 1986: 271)). Although for English one might be tempted to follow Griffen (1998: 18-9) by saying that "[s]uch aspiration is clearly the result of the more forceful articulation of the stress-accented syllable", such a characterisation does not extend to the Nakijin situation, where there are no "stress-accented syllables", and where aspiration occurs on the WEAKER of the syllables in the foot. The Nakijin and the English data taken together suggest that aspiration tends to be lost (or not assigned) in non-foot-initial position – and, conversely, is retained (or assigned) in foot-initial position.

The same characterisation also applies to Welsh. To illustrate the distribution of the aspirate in Welsh, Griffen (1998: 18) gives the derivationally related pair *brenin* 'king' and *brenhines* 'queen'. Historically *brenin* derives from *brenhin*, with *h* lost in non-stressed syllables, but in the modern language this is now interpreted as the acquisition of "aspiration" in certain words (Griffen 1998: 18, 19fn1).[11]

[10] /tukuma/ underlyingly has a non-glottalised initial consonant, the underlying distinction being between glottalised and non-glottalised consonants. Aspiration (*h*) is associated with non-glottalised voiceless consonants in foot-initial position.

[11] Griffen gives the impression that Morris Jones (1913: 64) interprets the appearance of [h] as intrusion, but Morris Jones (1913) makes it clear that intrusion refers to the historical insertion of *h* by analogy where it is etymologically not present, and he makes no judgment regarding the synchronic status of aspiration.

In order to interpret the *h*~∅ alternation in terms of synchronic *h*-insertion/intrusion, it is necessary to mark lexical items – in fact, syllables – where insertion/intrusion takes place. Instead of using an ad hoc diacritic, however, this marking can be achieved using /h/, resulting in a deletion analysis. (The following examples are taken from Thorne 1993.)

(i) /diharheb/ 'proverb' → dihareb (sg.)
→ diarhebion (pl.)

Whether *h*-insertion or *h*-deletion, the distribution of aspiration in Welsh can be seen to be similar to that observed in Nakijin and English if Welsh is considered to have a trochaic foot structure erected from right to left across words.

(4) brenin 'king' brenhines 'queen' (hist.) brenhin > brenin 'king'

Precisely this foot structure is proposed for Welsh by Williams (1989: 182-3). Under such an analysis, "aspiration" (orthographic *h*) is retained/inserted in foot-initial position and lost/not-assigned in foot-medial position.

In Welsh, English, and Nakijin, aspiration correlates with absolute position (initial, medial) in the foot, and is not related to the headedness (i.e. relative strength of the internal constituents) of the foot, and nor is it related to whether the head of the foot is realised in terms of stress, pitch, or length.

(5) Nakijin English, Welsh

This is not to say that all languages with aspiration display a distribution which correlates with foot structure. There are of course many languages where aspiration is underlyingly contrastive and relatively untouched by rules, and it is reported that there are languages where aspiration is assigned to syllable-coda consonants (e.g. Sierra Popoluca (Elson 1947)). However Welsh, English, and Nakijin seem to illustrate a type where aspiration is dependent on the position within the foot, regardless of the headedness of the foot.

4. Conclusion

This paper has argued against Griffen's (1998) claims that vowel reduction, cross-linguistically, is a reflex of loss of High pitch, and that aspiration insertion correlates with stress. Both of these processes are attested in English and Welsh, but Welsh, unlike English, has stress (intensity) and pitch on separate syllables, potentially allowing unambiguous specification of which feature triggers these processes.

Griffen's (1998) use of Welsh in an attempt to gain a deeper understanding of phenomena found in English is methodologically sound, but expanding this to tone/pitch (accent) languages shows that, both for vowel reduction and aspiration insertion, alternative explanations have more general applicability.

Vowel reduction is attested as a historical sound change in the Taketomi dialect of Southern Ryukyuan, where short /a/ reduced to *ə* irrespective of the pitch of the syllable. This demonstrates that vowel reduction need not be correlated with pitch. An alternative suggested by Taketomi and Welsh is that vowel reduction is related

(ii) /kĭnghaneð/ 'harmony' → cynghanedd (sg.)
→ cynganeddion (pl.), *cynganheddion

to shortening (cf. Lindblom 1963) and that the resultant "vowel undershoot" has been phonologised.

That aspiration alternations are not necessarily associated with stress (intensity) is demonstrated by the Northern Ryukyuan dialect of Nakijin, a language without stress. It was noted that in Nakijin aspirated stops appear in foot-initial position, the same as in English and Welsh, suggesting that it is this position, and not the presence of stress or the location of the foot-head, which conditions aspiration in these languages.

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【要　旨】

高さ，強勢および母音弱化再考

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ウェールズ語の多音節語では強勢と高音調は別の音節にあらわれる。Griffen（1998）はウェールズ語を根拠に，母音弱化は強勢ではなく，高さと相関し，子音の帯気性は強勢と相関すると論じている。本稿では，この二つの相関性を否定する。

琉球語の一つである竹富方言は弁別的強勢をもたない音調言語であるが，歴史的に生じた母音弱化は高さと相関しない。本稿ではこの母音弱化過程の原因を短母音化に求め，短母音化がウェールズ語にも適用する可能性があることを提案する。弁別的強勢をもたない高さアクセント言語であるもう一つの琉球語である今帰仁方言では，帯気性は強勢とではなく，韻脚構造と相関する。ウェールズ語の帯気性にも同様な分布がみられると考えられる。