Washo vowel harmony revisited

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Introduction: Washo, a severely moribund language spoken around Lake Tahoe in California and Nevada, is reported to exhibit a case of vowel harmony where a prefixal vowel alternates between [a] and [e] depending on the quality of the following stressed vowel. In particular, the target vowel is [a] when the following stressed vowels is /a/ or /o/ (1a), while it is realized as [e] if the prefixal vowel is followed by /e, i, ɨ, u/ (1b; Jacobsen 1964).

(1)	a.	da-hánga	‘his mouth’	b.	de-k’étep	‘his bottle’
		da-tóʔo	‘his throat’		de-gúʔu	‘his mother’s mother’
		da-ŋaʔmíʔming	‘her children’		de-p’ísew	‘his ear’

This pattern is unusual for several reasons. First, the conditioning vowels do not form natural classes (e.g., /a, o/ vs. /e, i, ɨ, u/) in terms of backness, height, or rounding (the canonical vocalic features that condition vowel harmony). This case also exhibits properties of metaphony where the stressed vowel trigger need not be local (e.g., *gašuʔmáwɨt* / gA-šuʔm-awd/ “throw it over”). Finally, variation occurs within and across speakers in Jacobsen’s original description (e.g., *gešuʔmáwɨt* ~ *gašuʔmáwɨt* “throw it over”, p.302). This study reports the findings of an acoustic investigation examining the nature of this harmony process. The phonetic evidence suggests that the purported vowel alternation might be better analyzed an instance of vowel-to-vowel coarticulation.

Methods: Stimuli for the acoustic study were drawn from field recordings collected in the summer of 2005 and 2006 with a male Washo-speaking elder (S) in the early 70s without any known speech impediment. The stimuli examined in this study consisted of 210 words that were minimally disyllabic with the pre-tonal vowel being either /a/ or /e/ while the following vowel is stressed and must contain one of the following vowels (e.g., /a, o, e, i, u/; the stressed vowel /ɨ/ was not included in this analysis due to its extreme infrequency in the corpus). 87 tokens contained a pretonic vowel that is tautomorphemic (henceforth “lexical” vowels) and the rest came from words where the pretonic vowel is within one of the following prefixes: *dA-* “nominalizer/3 possessive” and *gA-* “imperative” (the “A” indicates the alternating vowel).

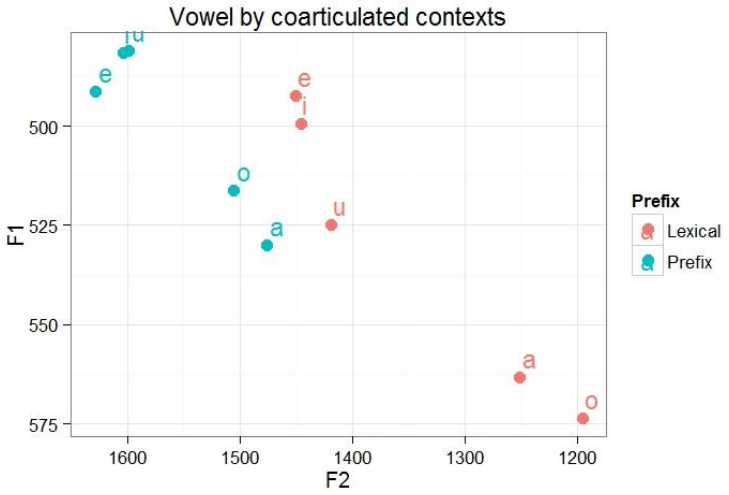

Figure 1. Prefixed and tautomorphemic (“Lexical”) vowels in different vocalic contexts in Washo. Formant values taken at the midpoint of the vowel.

Analysis: The recordings were first forced-aligned automatically using the Montreal Forced Aligner (McAuliffe et al. 2017). The resulting textgrids of forced alignment were hand-corrected and the formant values of the target vowels were measured at eleven measurement locations using a customized Praat script.

Results: Figure 1 shows the realization of the target vowels in the context of different following stressed vowels. The lexical vowels before /a/ and /o/, transcribed by Jacobsen as /a/, have higher F1 and lower F2 than the lexical vowels before /i/, /e/, /u/ (Jacobsen transcribed them as /e/). The distribution of the prefixal vowels is quite different. The prefixal vowels generally have low F1 and high F2. They are much closer in F1 and F2 values to the lexical /e/ vowel than the lexical /a/ vowel. The affinity to lexical /e/ is true even when the prefixal vowel is in the context of /a/ and /u/. As illustrated in Figure 2, which shows the distribution of all the different vowels in speaker S's acoustic vowel space, the low vowels tend to have qualities where F1 is above 550 Hz and F2 is below 1300 Hz. The fact that all of the prefixal vowels, regardless the nature of the following stressed vowel, have F1 values below 550 Hz and F2 values above 1300 Hz suggests that the prefixal vowel is /e/ in nature. Of particular interest is the influence of the stressed vowel on the realization of the pretonic vowel. Figure1 shows that when the stressed vowel is /a/ or /o/, the realizations of the prefixal vowels cluster together around F1 at 525 Hz and F2 at 1500 Hz. When the stressed vowel is /i, e, u/, the F1s of the prefixal vowels are generally lower than 500 Hz and F2 higher than 1550 Hz. Taken together, our findings suggest that vowel alternations in the prefixes do not constitute a case of vowel harmony. That is, while /a/ and /o/ exert similar F1 and F2 effects on the prefixal vowels that seem to differ from the effects of the other stressed vowels, the changes in the prefixal vowels do not result in the low vowel /a/.

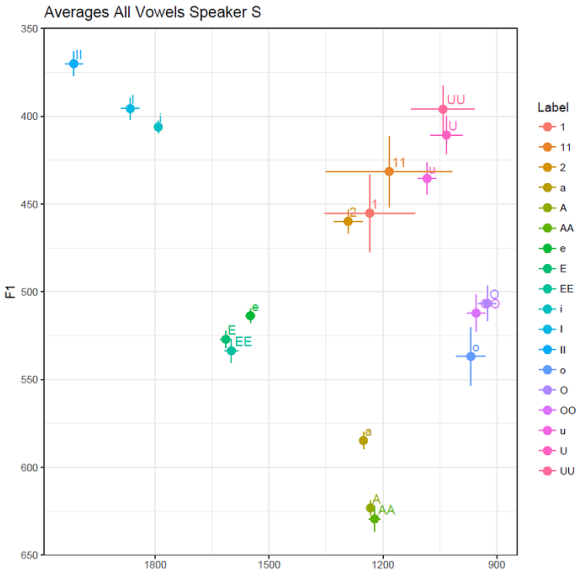

Figure 2. The acoustic realizations of vowels in Washo as spoken by speaker S. Formant values came from the midpoint of the vowel.

Conclusion: This acoustic investigation reveals that the target prefixal vowels are acoustically more closely related to the vowel /e/ and do not approach the underlying /a/ in Washo. The investigation suggests that the vowel alternation in Washo might be better analyzed as a case of gradient vowel-to-vowel coarticulation. Additional data analysis from additional speakers, including archival acoustic data from Jacobsen's original fieldwork should be able to ascertain the robustness of the coarticulated nature of prefixal vowel alternation in Washo.

References

Jacobsen, William. 1964. *A grammar of the Washo language*. PhD dissertation, University of California, Berkeley.

McAuliffe, Michael, Michaela Socolof, Sarah Mihuc, Michael Wagner, and Morgan Sonderegger (2017). *Montreal Forced Aligner* [Computer program]. Version 0.9.0, retrieved 17 January 2017 from http://montrealcorpustools.github.io/Montreal-Forced-Aligner/.