ACCENTUAL PROMINENCE AND CONSONANT LENGTHENING AND STRENGTHENING IN MAWNG

Janet Fletcher, Hywel Stoakes, Deborah Loakes, and Ruth Singer

School of Languages and Linguistics, The University of Melbourne
janetf; hstoakes; dloakes; rsinger@unimelb.edu.au

ABSTRACT

In this paper we investigate the contribution of consonant duration to the signaling of accentual prominence in Mawng, a language spoken in Northern Australia. We compare consonants in VC sequences where the vowel is part of an accented or tonic syllable vs. non-tonic (non-prominent) VC sequences. We further analyse the contribution of vowel-consonant timing to prominence, through an analysis of VC ratios. Similar to other Australian Indigenous languages, post-tonic sonorant consonants show stronger prominence-related lengthening effects than accented vowels.

Keywords: Accentual prominence, consonant lengthening, prosodic structure, obstruents, sonorants.

1. INTRODUCTION

1.1. Accentual prominence in Australian Languages

Australian Indigenous languages are usually described as stress languages although this has come into question in recent years [4, 13]. Most experimental studies of Australian languages show that pitch is the major acoustic cue to accentual prominence (see the summary in [4]). One typologically unusual feature of some of these languages is that accentual prominence or main word stress is not cued strongly by the usual acoustic features associated with accentual prominence in stress languages i.e. spectral tilt differences, higher intensity, or shaper vowel quality [see 6 compared with 7 for Warlpiri, and Gupapuyngu; 13 for Pitjantjatjara]. In some languages accented syllables are associated with longer acoustic vowel durations e.g. Dalabon [6], Pitjantjatjara [13], and Burarra [7], whereas others show limited lengthening [e.g. Warlpiri, Kayardild, Iwaidja Dalabon and Kundedjnjenghmi [4]; Warlpiri Gupapuyngu [7]; and Wunambal [9]. By contrast, in languages like Warlpiri, accentual prominence in words with initial main stress is associated with "strengthening" and lengthening of the post-accent consonant in ˈC_1VC_2V words (i.e. C_2) [e.g. 10 for Warlpiri]. Similar patterns have also been observed in a Northern Australian language, Bininj Gun-wok particularly in ˈC_1VNC_2V sequences [8].

One of the hypotheses that has emerged from previous research is that post-accent or *post-tonic* consonant lengthening may be related to the so-called 'place-of-articulation imperative' [3]. There is a need to protect and preserve vowel-consonant transitions, particularly in vowel-sonorant sequences where coarticulatory spread may lead to blurring of the vital cues to place of articulation contrasts [3,4]. As suggested in [4], longer sonorants also allow for fuller realization of the intonational peak accent that cues main stress and accentual prominence in all these languages.

In this context, it is also worth considering the relationship of V->C timing in the form of duration ratios to investigate their potential contribution to temporal organization in Australian languages [e.g. 12]. One might expect the relative contribution of consonants to be greater in accentually prominent (i.e. post-tonic) contexts versus non-prominent contexts given the relatively high functional load of consonants versus vowels in these languages. Therefore it could be argued that the consonant should be lengthened rather than the vowel. In [12: 196] it was suggested that this is the case in the three Australian languages examined in this study, but it was also suggested that results were inconclusive due to the fact that segmental materials were not tightly controlled.

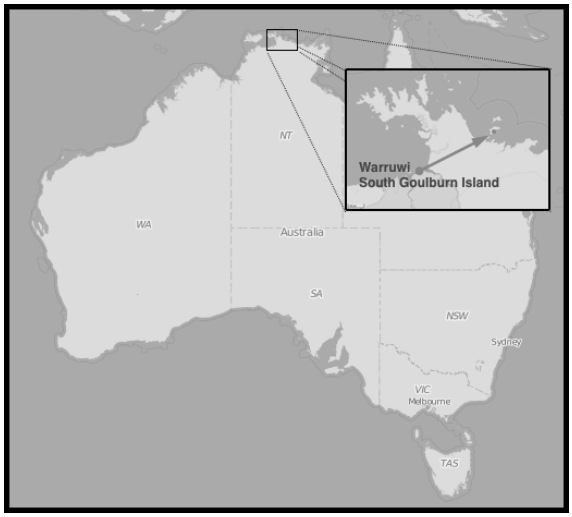
It remains to be seen whether post-tonic consonant lengthening is a widespread cue to accentual prominence in all Australian languages. In this paper, we explore acoustic durational patterns associated with accentuation in the Northern Australian language, Mawng, generally analysed as a stress language [11]. We also hope to contribute to the understanding of temporal organisation of sequences in Australian languages by including an analysis of Vowel-Consonant

ratios in tightly controlled segmental contexts. This will enable us to see whether consonant lengthening contributes more than vowel lengthening in signaling prosodic prominence as has been claimed for other Australian languages.

1.2. The language, Mawng

Mawng is an endangered language spoken in the community of Warruwi on South Goulburn Island off the coast of Northern Australia (see Figure 1. for the approximate location).

Figure 1: The location in Australia where the Indigenous language Mawng is spoken (source: Open Street Map, 2015).



Mawng is an Iwaidjan language and classified as a member of the Non-Pama-Nyungan grouping of Australian languages. There are approximately one thousand speakers of the language and it is one of the handful of Indigenous languages that is still being acquired by children as a first language. Like many Australian languages, Mawng has a relatively rich range of place of articulation contrasts within the stop and nasal series (see Table 1), but has a relatively small phonemic vowel inventory (see Table 2).

Much of the interest in the phonetics and phonology of Australian languages has focused on the unusual characteristics of the consonant inventories (i.e. the lack of contrast between stops and fricatives) with relatively few acoustic phonetic studies of prosodic features of these languages. This paper examines the interaction between the segmental and the prosodic.

Table 1 Phonemic Consonant inventory- Mawng [11]

	Peripheral		Apical		Laminal
	bilab.	**velar**	**alv.**	**post alveolar**	**palatal**
Plosives	p	k	t	ʈ	c
Nasals	m	ŋ	n	ɳ	ɲ
Laterals			l	ɭ	
Approx.	w		ɹ		j

Table 2 Phonemic Vowel inventory- Mawng [11]

	front	**central**	**back**
close	ɪ		ʊ
mid	ɛ		ɔ
open		ɐ	

1.3 Aims of this study

This study explores three related research questions:

1. What are the durational characteristics of the post-tonic consonant in accented, henceforth tonic ˈVC sequences, where the vowel is part of the accented syllable, compared to weak (non-tonic, unaccented) VC sequences?
2. Are there differences in C-length across tonic ˈVC and non-tonic VC sequences where the consonant differs in manner (obstruent versus sonorant)?
3. For VC syllables, what is the durational relationship between the vowel and the consonant (the VC ratio) in tonic ˈVC and non-post-tonic conditions?

Overall, the study aims to determine whether post-tonic consonant lengthening contributes to the signaling of accentual prominence in Mawng in a way that compares with other Australian languages investigated so far.

2. METHOD AND MATERIALS

2.1 Speakers and language materials.

The Mawng corpus was recorded during two field trips conducted by the fourth author at Warruwi, Goulburn Island. Three female speakers (NN, NG and SM) participated in the speaking tasks. They produced three repetitions of a word list designed to investigate stress and prominence in Mawng. They also produced three repetitions of the same set of forms in a prosodically controlled carrier phrase "*ngarri ngat-pi-n X ta Mawng" ("In Mawng we say x.").* In the practical orthography used to represent Mawng, "rr" is a trill, "ng" is a

velar nasal. The wordlist was prepared by the first and fourth authors in consultation with a Mawng speaker who participated in this experiment.

The tokens in the carrier phrase varied from two to six syllable words, were primarily nouns, and were in semantic focus and always realised with an intonational pitch accent. While Mawng has five vowels, only /i a u/ were used in the experimental materials. Examples of the phonological structure of the words are /ŋaˈɳampala/, /iˈmaʈuk/ and /kataˈpaŋa/.

2.2 Recording and Analysis procedure

All recordings were made in the field with first language Mawng speakers, using a Sony ECM-MS957 Electret Condenser microphone and recorded onto a Zoom Portable Flash recorder as mono Wave files (16bit, 44.1 kHz). The recordings were transferred to a laptop computer for transcription and annotation in ELAN. They were then converted to Praat [2] for subsequent acoustic analysis.

Vowel and consonant segments were annotated using the system of vowel symbols shown in Table 1 The Praat TextGrid files were then converted into EMU format (*The EMU Speech Database System*) at the Phonetics Laboratory at The University of Melbourne. The files were annotated using a number of hierarchically ordered levels: utterance (citation vs. intonational phrase, word, syllable (strong or weak), phonemic and "tone" (prominence) levels. The prominence level was an intonational analysis with labelled pitch accents and boundary tones performed by the third author. All three speakers produced the focal word with a major pitch peak or movement on the focal word which was analysed as a H* or L+H* pitch accent that was often realised in the highest part of the speaker's range. The syllable associated with this pitch accent was labeled S (strong) and the following syllable was labeled W (weak). Non-focal pitch accents in longer words were also labelled S.

We extracted VC sequences where the vowel was accented / tonic (S, bearing a H* pitch accent) and non-tonic sequences (usually W, with no associated pitch accent). The terms tonic and non-tonic sequences refer to these two conditions in the presentation of the results that follows. The term post-tonic refers to the C that follows the accented/tonic vowel. In both tonic and non-tonic cases, the measured consonant followed the vowel in (C)VC(C) sequences. Final VC sequences were excluded from the analysis due to the potential effects of phrase-final lengthening. We observed 539 VC sequences in tonic position and 836 non-tonic VC sequences. Citation forms (n=689) were analysed separately from those that occurred in the carrier phrase (n=686). Token numbers per speaker were not identical; 634 tokens produced by SM were labelled, with 364 tokens from NN and 377 from NG. Sonorants were more prevalent than obstruents in VC sequences in this corpus, which is typical of Australian languages which tend to have 70% sonorants compared to 30% obstruents in their consonant inventories [3].

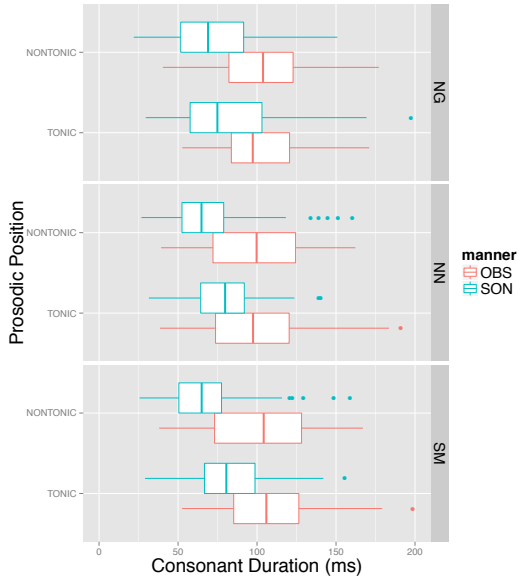
VC sequences were extracted and analysed using the programme *R* (version 2.15.3) and the *lme4* package [1]. Linear mixed-effects modeling (LMEM) was used to model the effects of accent or "tonicity" on consonant lengthening. In each of the mixed models "speaker" was included as a random factor and "accent" (whether the phoneme was included in a tonic, or non-tonic sequence) was included as a fixed factor.

3. RESULTS

3.1 V<u>C</u> duration

Figure 2 shows consonant duration in a V<u>C</u> sequence plotted by speaker in tonic (accented) versus non tonic (unaccented) positions. The figure also separates obstruents from sonorants. Across the corpus, obstruents have comparable mean duration and standard deviation values regardless of whether they are produced in tonic or non-tonic contexts ($\chi^2(4, N = 328) = 2.42$, $p < .12$). There is also no appreciable difference in mean durational range between obstruents when tonic (accented) and non-tonic (unaccented) conditions are compared. By contrast, there is a clear durational difference for sonorants ($\chi^2(4, N = 1047) = 65.3$, $p < .001$). Sonorants that follow an accented (tonic) vowel have longer mean durations (82 ms) when compared with those in non-tonic sequences (68 ms). This is consistent across the corpus with all three speakers showing significant post-tonic lengthening when a Tukey HSD is applied. Obstruents are also longer than sonorants overall which is not unusual relative to other languages There is also higher level of durational variation across both conditions and fewer obstruent tokens overall.

Figure 2: The duration of tonic vs. non-tonic consonants in VC contexts for obstruents (OBS) and sonorants (SON) by speaker (NG, NN, SM).



3.3 VC ratios

Figure 3: Scatterplots comparing V duration (ms) (y axis) against C duration (ms) (x axis).

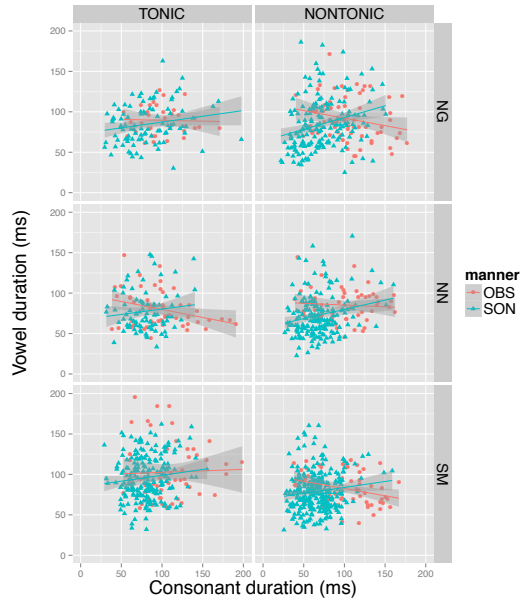


Figure 3 plots the duration of vowels compared to following consonants in VC sequences with superimposed regression lines. Separate plots are shown for each speaker and for tonic versus non-tonic contexts. Regression lines are relatively flat (slope < 0.2 for all environments), indicating a weak correlation between the durations of V to the durations of C. Although the plots show a weak positive relationship between preceding V and following sonorant duration and a weak negative correlation between V and following obstruent duration, the correlations are not significant in either tonic or non-tonic position for either sonorants or obstruents ($\chi^2(4, N = 1375) = 2.5$, $p < 0.11$). This pattern is consistent across the three speakers.

4. DISCUSSION AND CONCLUSIONS

The acoustic duration analysis of Mawng tonic and non-tonic sequences presented here suggests that post-tonic consonant lengthening (specifically sonorants) contributes to the cuing of accentual prominence in Mawng. In ˈVC sequences, the C is longer in accented (tonic) syllables. In turn, in VC sequences, there is no significant correlation between the duration of the V and C suggesting that post-tonic consonant lengthening is not dependent on preceding vowel duration.

Finally, supporting the earlier experimental literature that has found lengthening of post-tonic consonants in Australian languages (discussed in 1.1), we posit that lengthening of sonorant consonants in ˈVC sequences in Mawng may be related to the following factors: 1. *Enhancement of paradigmatic contrasts*: there are rich place of articulation contrasts in the C-heavy sonorant inventory which require strong acoustic cues to place. Long sonorants may be a reflex of the 'place-of-articulation imperative' [e.g. 3]; 2. *Segment sonority*. Post-tonic lengthening is a more general effect associated with the relatively sonorant consonant-rich, vowel-poor phonology of these languages [3]. Obstruents are already quite strong and long (around 100 ms on average for these speakers) and less frequent, and the lengthening of liquids, nasals and approximants enhances the overall sonority of the syllable. Moreover the major cue to accentual prominence in Mawng is a strongly rising pitch movement or high pitch target and the extra lengthening in sonorants enhances these major pitch cues to prominence.

5. ACKNOWLEDGEMENTS

This research was supported by an Australian Research council Discovery Project DP110100938 and the ARC Centre of Excellence for the Dynamics of Language.

6. REFERENCES

[1] Bates, D., Maechler, M., and Bolker, B., 2011. *lme4*: Linear mixed-effects models using S4 classes. R package version 0.999375-42. [Computer Program]. retrieved: 21/01/2015

[2] Boersma, P. and Weenink, D., 2015. Praat: Doing phonetics by computer [Computer Program]. The University of Amsterdam. retrieved: 21/01/2015 from http://www.praat.org, Version: 5.4.02.

[3] Butcher, A., 2006. Australian Aboriginal languages: Consonant salient phonologies and the place of articulation imperative. In Harrington J. and Tabain, M. (eds.) *Speech Production: Models, Phonetic Processes and Techniques.* New York: Psychology Press.

[4] Fletcher, J. and Butcher, A., 2014. Sound Patterns of Australian Languages. In Koch, H. and Nordlinger, R. (eds), *The Languages and Linguistics of Australia*. Berlin: Mouton de Gruyter, pp. 91-138.

[5] Fletcher, J., Butcher, A., Loakes, D. and Stoakes, H., 2010. Aspects of nasal realization and the place of articulation imperative in Bininj Gun-wok. In M. Tabain, J. Fletcher, D.Grayden, J. Hajek & A. Butcher (eds.), *Proceedings of the 13th Australasian International Conference on Speech Science and Technology,* pp. 78–81. Canberra: Australasian Speech Science and Technology Association.

[6] Fletcher, J. and Evans, N., 2002. An acoustic phonetic analysis of intonational prominence in two Australian languages. *Journal of the International Phonetic Association* 32: 123–140

[7] Graetzer, S., Hajek, J. and Fletcher, J., 2012. The effects of prosodic context and word position on Gupapuyngu vowels. In Ma, Q., Ding H., and Hirst, D (eds.), *Proceedings of the 6th International Conference on Speech Prosody*, vol. 1, 91–94. China: Tongji University Press.

[8] Hayes, B. 1995. *Metrical stress theory: principles and case studies* Chicago: University of Chicago Press.

[9] Loakes, D., Carr, T., Gawne, L. and Wigglesworth, G., 2015. Vowels in Wunambal, A Language of the North West Kimberley Region. *Australian Journal of Linguistics*, DOI: 10.1080/07268602.2015.1023169

[10] Pentland, C., 2004. *Stress in Warlpiri: Stress domains and word-level prosody*. Brisbane: University of Queensland, PhD thesis.

[11] Singer, R., 2006. Agreement in Mawng: productive and lexicalised uses of agreement in an Australian language Melbourne: University of Melbourne, PhD thesis

[12] Tabain, M., Breen, G., and Butcher, A., 2004. VC vs. CV syllables: a comparison of Aboriginal languages with English. *Journal of the International Phonetic Association* 34, 175- 200.

[13] Tabain, M., Fletcher, J. & Butcher, A., 2014. Lexical stress in Pitjantjatjara. *Journal of Phonetics* 42, 52-66.