Vowels in the Barunga variety of North Australian Kriol

Caroline Jones[1], *Katherine Demuth*[2], *Weicong Li*[1], *Andre Almeida*[1]

[1]MARCS Institute for Brain, Behaviour & Development, Western Sydney University, Australia
[2]Department of Linguistics, Macquarie University, Australia

caroline.jones@westernsydney.edu.au, katherine.demuth@mq.edu.au, weicongli@outlook.com, a.almeida@unsw.edu.au

Abstract

North Australian Kriol is an English based creole spoken widely by Indigenous people in northern Australia in areas where the traditional languages are endangered or no longer spoken. This paper offers the first acoustic description of the vowel phonology of Roper Kriol, within a variety spoken at Barunga Community, east of the town of Katherine in the Northern Territory.

Drawing on a new corpus for Barunga Kriol, the paper presents analyses of the short and long monophthongs, as well as the diphthongs in the spontaneous speech of young adults. The results show the durations and spectral characteristics of the vowels, including major patterns of allophony (i.e. coarticulation and context effects). This updates the phonology over the previous description from the 1970s, showing that there is an additional front low vowel phoneme in the speech of young people today, as well as a vowel length contrast. Interestingly there are points of similarity with the vowel acoustics for traditional Aboriginal languages of the region, for example in a relatively compact vowel space and in the modest trajectories of diphthongs.

Index Terms: language description, vowels, phonetics, Kriol

1. Introduction

North Australian Kriol is an English based creole spoken widely by over 20,000 Indigenous people in northern Australia [1]. It is the first language of children and young adults in many rural and remote areas where traditional languages are no longer spoken or are spoken fluently by elderly people. For the Roper Kriol variety spoken east of Katherine in Australia's Northern Territory, it is now several generations since the language was first described, in the 1970s [2, 3]. In this region, today's young adults are fluent bilinguals in Kriol and in Australian English, and Kriol, as an everyday vernacular language variety, is regionally variable and changing rapidly [4, 5]. Drawing on a new corpus of spontaneous speech, this paper offers an updated description of the vowel phonology in the Barunga variety of Roper Kriol. This complements other recent research on consonant voicing in Roper Kriol at Numbulwar [6] and vowels and consonants in Gurindji Kriol, another local variety in the region [7, 8, 9].

Methodologically the updated description benefits from acoustic analysis and modern phonological insights, both not available to the earlier description. A recurrent observation in the earlier description was of surprising linguistic variability -- within speakers, between speaker generations, and across interlocutor types, especially in the phonology [2, 3]. In light of this possibility, in the present study considerable care was taken with the social context of the field recording situation. Data are presented here on the speech of the young adult generation, in spontaneous conversation with a familiar Indigenous adult, without the presence of a non-Indigenous English speaking researcher (since the latter tends to result in code-switching towards English).

This paper constitutes the first acoustic description of vowels for any variety of Roper Kriol, and provides a detailed account of the spectral and temporal characteristics of short and monophthongs as well as the trajectories of diphthongs.

2. Vowels in Barunga Kriol

For Barunga Kriol as spoken by young adults, this paper advances our knowledge in relation to three questions: (1) What is the vowel phoneme inventory? (2) What are the acoustic characteristics of the monophthong phonemes, including allophony? (3) What are the acoustic characteristics of the diphthongs? These questions are addressed below in Sections 2.1, 2.2-2.3, and 2.4 respectively.

2.1. Vowel inventory

The existing description [2, 3] proposes a phonemic orthography for Kriol which implies for the Barunga variety a system of five short monophthongs and five diphthongs. Orthographically, these are: i, e, a, o, u, and ai, ei, oi, au, ou. In inventory Barunga Kriol was noted to be similar to the traditional languages of the area which typically have five monophthongs, as opposed to areal languages with three monophthongs.

What is the vowel inventory for Kriol in the speech of today's young people, at Barunga? In this paper we draw on the new speech corpus we have recorded and annotated since 2014 (approximately 50 hours of naturalistic speech, of which just over half is currently transcribed in ELAN/Praat). Based on evidence from minimal (and near-minimal) pairs, there are probably six short vowel phonemes /ɪ, ɛ, ɐ, æ, ɔ, ʊ/ and five long vowel phonemes (ɪː, ɜː, ʊː, oː, ɐː):

Table 1: *Evidence for vowel monophthong phonemes.*

Vowel contrast	Example minimal pair
/ɪ/, /ɛ/	wɪn 'win', wɛn 'when'
/ɛ/, /ɐ/	wɛn 'when', wɐn 'one, a'
/ɐ/, /ɔ/	bɐgɪː 'cart', bɔgɪː 'swim'
/ɔ/, /ʊ/	gɔd 'God', gʊd 'good'
/ɐ/, /æ/	bɐkɪt 'bucket', bæk 'back'
/ɛ/, /æ/	wɛn 'when', gwænɐ 'goanna'
/ɪː/, /ɪ/	fɪːlɪm 'feel', fɪlɪmɐp 'fill'
/ɜː/, /ɛ/	nɜːs 'nurse', nɛs 'nest'
/ɐː/, /ɐ/	ʃɐːp 'sharp', ʃɐp 'shop'
/oː/, /ɔ/	koːs 'course', kɔs 'cost (verb)'

/ʊː/, /ʊ/	pʊːl ‘pool’, pʊl ‘pull’

In terms of functional load, there are relatively few lexical items which include /æ/: words derived from English words containing /æ/ were historically often reassigned to the /ɛ/ or /ɐ/ categories in Kriol; the emergence of /æ/ seems to be a new feature of young adult speech, not previously described.

2.2. Acoustic analysis methods

The speech sample analysed acoustically in this paper comprises vowel tokens (N=1049; 650 short vowel tokens, 186 long vowel tokens, and 213 diphthong tokens) from our new corpus. All vowel tokens were from the stressed syllable of prosodically prominent content words, in spontaneous speech. For this analysis tokens were from a range of utterance positions (initial, medial, and final), and from both open and closed syllable contexts; although we might expect these factors to influence vowel durations and also formants, for this first analysis of vowels in Barunga Kriol the contextual effects were not analysed separately. Similar numbers of tokens were sampled from five young adult female speakers of Kriol from Barunga, Northern Territory. Speakers were audiorecorded using Olympus LS-14 linear PCM recorder with lapel microphone, at 44.1kHz, 16-bit, in quiet outdoor field conditions, in conversation with a familiar local Aboriginal age-peer from the same community.

Forced alignment using WebMAUS (Italian system) [10, 11] was applied to the audio and orthographic transcription, after using the MAUS Chunking service [12]. In Praat [13], vowel labels and vowel onsets and offsets were manually corrected (with reference to the onset/offset of regular voicing in the waveform and the onset/ offset of vowel-related intensity), and acoustic measurements taken.

2.3. Vowel monophthongs

This section presents the acoustic characteristics of the six short and five long monophthongs.

2.3.1. Short monophthongs

Three levels of vowel height (/ɪ, ʊ/, /ɛ, ɔ/ and /æ, ɐ/) are distinguished by midpoint F1 (Figure 1). Overall, the high vowels tend to have F1 values of just under 500 Hz, i.e. a fairly compact vowel space in terms of vowel height.

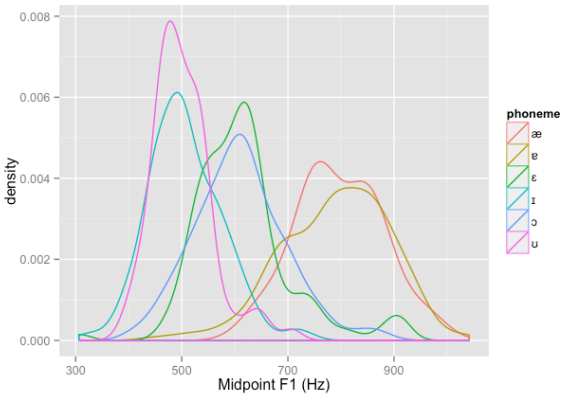

Figure 1: *Midpoint F1 (Hz) for short monophthongs.*

In midpoint F2 (Figure 2), the back vowels (ʊ, ɔ) differ from /ɐ/, which differs in turn from the front vowels /æ, ɛ, ɪ/.

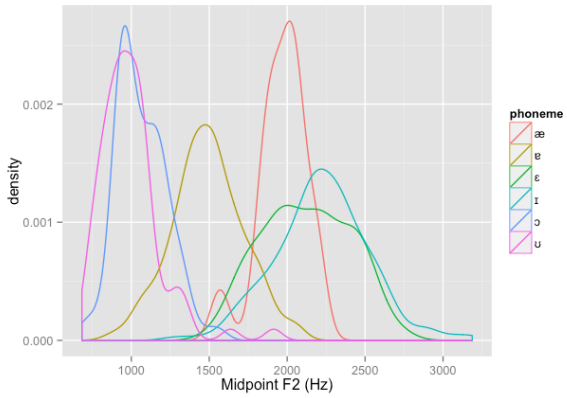

Figure 2: *Midpoint F2 (Hz) by short monophthongs.*

As shown in Figure 2, the /ɛ/ phoneme has considerable variability in midpoint F2. When analysed by consonantal context, two previously unreported patterns of allophony (coarticulatory or context effects) are clear (Figure 3):

- Tensing (approximately to [e]): /ɛ/ is higher (Figure 4a) and less retracted (Figure 4b) when followed by a voiced coda consonant, e.g. *ben* ‘band’, *med* ‘mad’, *prem* ‘pram’.
- Lowering (approximately to [æ]): /ɛ/ is sometimes lower (Figure 4a) and sometimes more retracted (Figure 4b) when followed by a lateral, e.g. *telim* ‘tell’, *helpim* ‘help’.

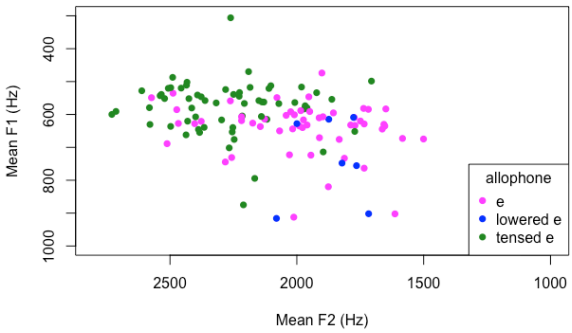

Figure 3: *Midpoint F1xF2 (Hz) for /ɛ/ allophones.*

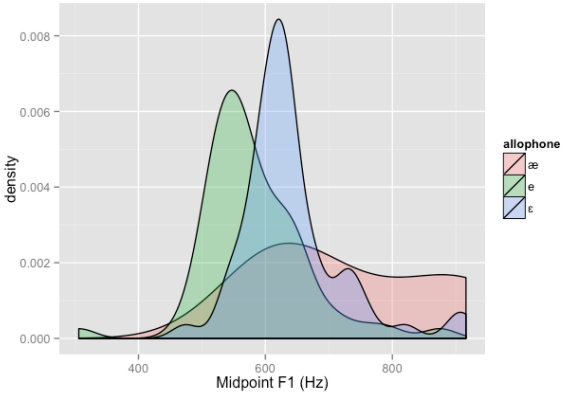

Figure 4a: *Midpoint F1 (Hz) for /ɛ/ allophones.*

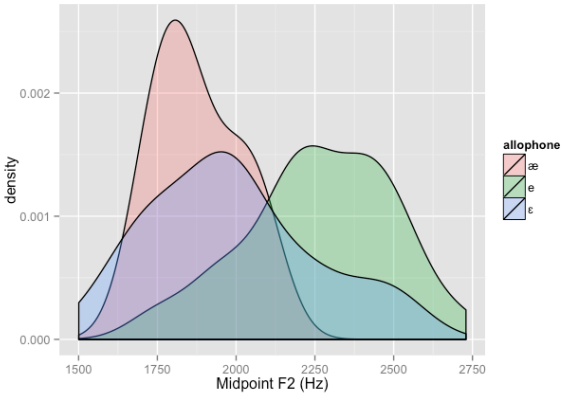

Figure 4b: *Midpoint F2 (Hz) for /ɛ/ allophones.*

2.3.2. Long monophthongs

Three levels of vowel height are distinguished in midpoint F1: /ɪː, ʊː/, /ɜː, oː/, and /ɐː/ (Figure 5). There is perhaps particular variation for /ɜː/ in midpoint F1.

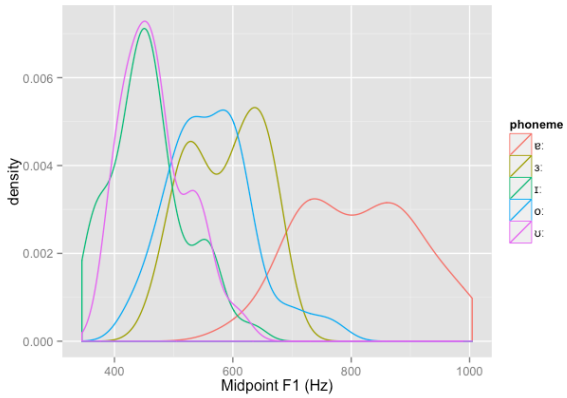

Figure 5: *Midpoint F1 (Hz) for long monophthongs.*

In terms of midpoint F2, there are four groupings distinguishing /ɪː/, /ɜː/, /ɐː/, and /ʊː, oː/ (Figure 6). There is some midpoint F2 variation in the high vowels /ɪː/ and /ʊː/.

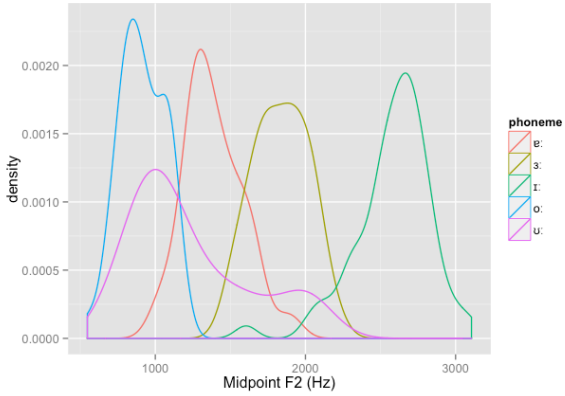

Figure 6: *Midpoint F2 (Hz) for long monophthongs.*

Spectrally, the phonological long vowels tend to be slightly more extreme (in midpoint F1 and F2) than the short vowels, as can be seen in the comparison of Figures 1 and 2 with Figures 5 and 6.

The vowel tokens analysed in this paper are from spontaneous, running speech, so it is a worthwhile question as to the extent of durational differences between phonologically long and short vowels. In Figures 7a-c are plotted the durations of the high, mid and low monophthongs, respectively; the long vowels tend to have longer durations than the short vowels. There are, however, some tokens with quite large durations regardless of phonological vowel length (these are often in phrase-final position, where vowels are sometimes very elongated especially in storytelling).

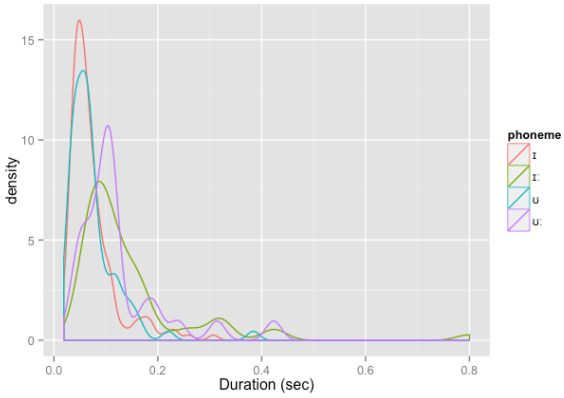

Figure 7a: *Duration (in seconds) for high vowels.*

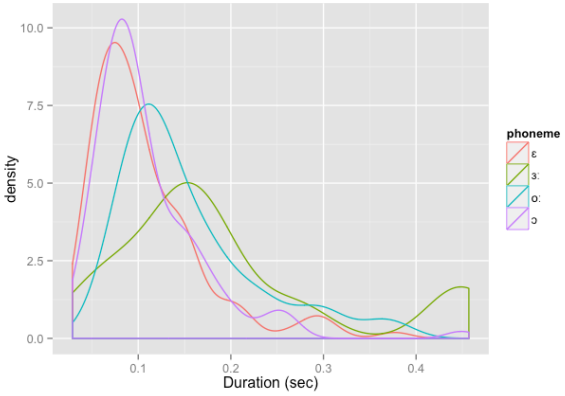

Figure 7b: *Duration (in seconds) for mid vowels.*

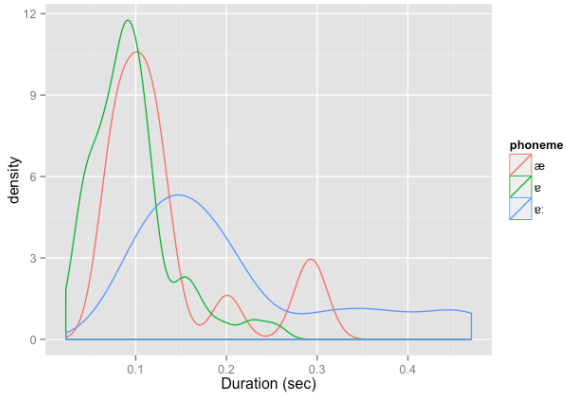

Figure 7c: *Duration (in seconds) for low vowels.*

2.4. Diphthongs

Figure 8 shows the trajectories of the five diphthongs (tokens in faint lines, means in bold) in F1xF2 space (in Hz). Each diphthong is plotted at five time points: at 20, 35, 50, 65 and 80% of vowel duration. Individual token trajectories are fairly variable; the tokens are from spontaneous speech. The trajectories from 20 to 80% of vowel duration are also relatively modest in their F1xF2 spectral movement, with the possible exception of the diphthong /oɪ/.

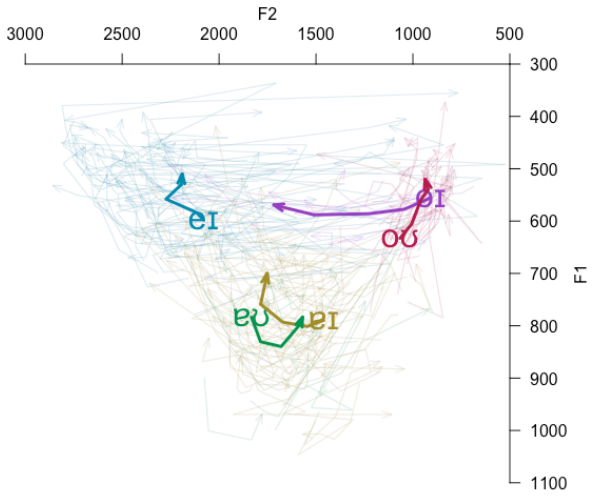

Figure 8: *Diphthong trajectories from 20% through 80% of vowel duration (bold=means, faint=tokens).*

3. Discussion

The analyses in this paper offer the first quantitative glimpse at the vowel system of Barunga Kriol. On the basis of the phonological and acoustic patterning there would appear to be six short vowel phonemes and five long vowel phonemes. The sixth short vowel /æ/ represents a new and emerging vowel in the speech of young adults. The vowel space is relatively compact, with minimum F1 values just under 500Hz in approximate terms and variability in the maximum F1 values in low vowels. Both these observations have previously been made for traditional Aboriginal languages of northern Australia [10, 11] but not previously for Roper Kriol. This pattern suggests a possible role for the substrate (traditional) language in having influenced the implementation of vowels within what are historically English-derived words in the Roper Kriol lexicon. This situation seems to have a parallel in the mixed language Gurindji Kriol, spoken several hours further south-west, which has a compact vowel space in its English-derived as well as its Gurindji-derived lexicon [12].

Based on the patterns of (near) minimal pairs and the acoustic data from the spontaneous speech sample it appears likely that Barunga Kriol has a vowel length contrast. At each of three levels of vowel height the duration values for the tokens which were perceptually analysed by the researchers as short vowels tend to have values of under 100ms; long vowels are typically 100-200ms (Figures 7a-c). In many lexical items the vowel length contrast corresponds closely to the tense/lax distinction in Australian English. Not every lexical item, however, has been regularly assimilated, probably due to different timedepths of borrowing from English.

Several clear patterns of allophony emerge in these data which have not previously been described. These include the extensive allophony in the mid vowel /ɛ/ which shows tensing (like some world English dialects, but more extensive than Australian English e.g. [13]) and lowering (like some quite distant Australian English varieties e.g. [14]).

The five diphthongs have modest movement in F1xF2. This is again similar to the patterns found for Gurindji Kriol [12] and rather unlike Australian English [13].

4. Conclusions

Authors must proof read their PDF file prior to submission to ensure it is correct. Authors should not rely on proofreading the Word file. Please proofread the PDF file before it is submitted.

5. Acknowledgements

The authors would like to acknowledge the speakers and research assistants involved in data collection and transcription or in checking the forced alignment.

6. References

[1] NILS, "National Indigenous Languages Survey Report," Report submitted to the Department of Communications, Information Technology and the Arts by the Australian Institute of Aboriginal and Torre Strait Islander Studies in association with the Federation of Aboriginal and Torres Strait Islander Languages. Canberra: Commonwealth of Australia, 2005.

[2] J. R. Sandefur, *An Australian Creole in the Northern Territory: A Description of the Ngukurr-Bamyili Dialects (Part 1). Work Papers of SIL-AAB, Series B, Volume 3.* Darwin: SIL, 1979.

[3] J. R. Sandefur, *Papers on Kriol: The Writing System and a Resource Guide. Work Papers of SIL-AAB, Series B, Volume 10.* Darwin: SIL, 1984.

[4] E. Schultze-Berndt, F. Meakins, and D. Angelo, "Kriol", in English-Based and Dutch-Based Languages (pp. 241-251), edited by S. Michaelis, P. Maurer, M. Haspelmath, and M. Huber. Oxford: Oxford University Press, 2013.

[5] A. Butcher, "Linguistic aspects of Australian Aboriginal English," *Clinical Linguistics & Phonetics*, vol. 22 no. 8, pp. 625-642, 2008.

[6] B. Baker, R. Bundgaard-Nielsen, and S. Graetzer, "The obstruent inventory of Roper Kriol," Australian Journal of Linguistics, vol. 34 no. 3, pp. 307-344, 2014.

[7] C. Jones, F. Meakins, and H. Buchan, "Comparing vowels in Gurindji Kriol and Katherine English: Citation speech data", *Australian Journal of Linguistics*, vol. 31 no. 3, pp. 305-326, 2011.

[8] C. Jones, F. Meakins, and M. Shujau, "Learning vowel categories from maternal speech in Gurindji Kriol," *Language Learning*, vol. 62 no. 4, pp. 1052-1078, 2012.

[9] C. Jones, and F. Meakins, "Variation in voice onset time in stops in Gurindji Kriol: picture naming and conversational speech," *Australian Journal of Linguistics*, vol. 33 no. 2, pp. 196-220, 2013.

[10] F. Schiel, "Automatic phonetic transcription of non-prompted speech," *Proceedings of the ICPhS 1999*, 1999, pp. 607-610.

[11] T. Kisler, U. D. Reichel, F. Schiel, Ch. Draxler, B. Jackl, and N. Poerner, "BAS Speech Science Web Services – an update of current developments," *Proceedings of the 10th International Conference on Language Resources and Evaluation (LREC 2016)*, 2016, paper id 668.

[12] N. Poerner, and F. Schiel, "An automatic chunk segmentation tool for long transcribed speech recordings," *12. Tagung Phonetik und Phonologie im deutschsprachigen Raum, 2016*, pp. 145-147.

[13] P. Boersma, and D. Weenink, "Praat: doing phonetics by computer [computer program]. Version 6.0.26, retrieved 2 March 2017 from http://www.praat.org/

[14] W. Labov, "Transmission and diffusion," *Language*, vol. 83, pp. 344-387, 2007.