

# Bolstering phonological fieldwork with ultrasound: lenition and approximants in Iwaidja

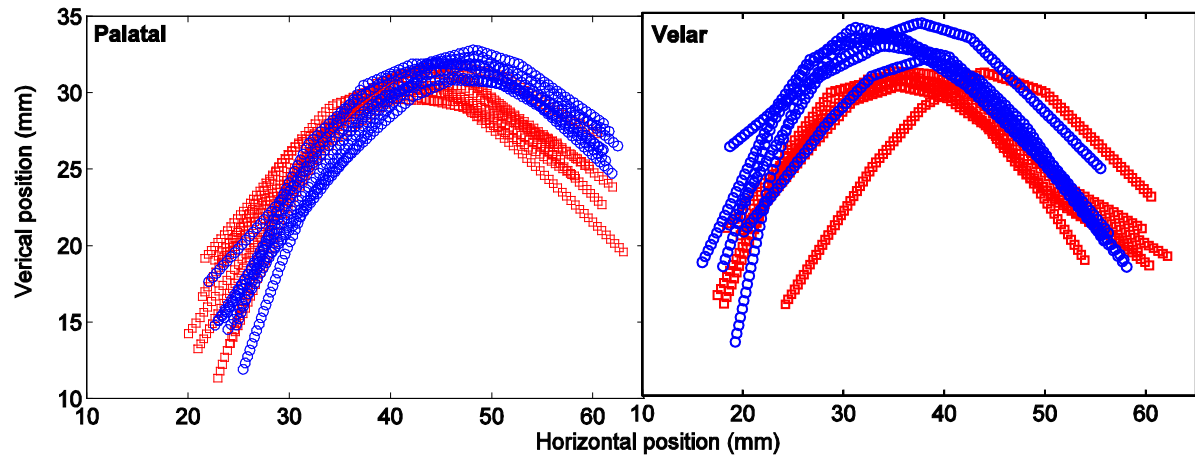
Robert Mailhammer<sup>1</sup>, Mark Harvey<sup>2</sup>, Tonya Agostini<sup>1</sup>, Jason A. Shaw<sup>1</sup>

<sup>1</sup>Western Sydney University, <sup>2</sup>Newcastle University

Australian languages often have labial, palatal, and retroflex approximants. In addition, Iwaidja, an Australian language spoken in North-Western Arnhem Land, has a velar phoneme that has been analysed variably as either an approximant /ɥ/ (Evans 2009: 160) or a fricative /ɣ/ (Evans 2000: 99). This phoneme has a limited distribution, occurring only between [+continuant] segments. Across Australian languages, velar approximants commonly surface as an allophone of the velar stop in intervocalic position, where stops, particularly velar and labial stops, tend to undergo lenition. To ascertain the phonetic nature of the velar approximant in Iwaidja, in particular its status as an approximant (c.f. fricative) and its relation to lenited stops, we conducted the first instrumental phonetic investigation of Iwaidja, acquiring both acoustic and ultrasound data.

Ultrasound images and synchronized audio were collected in a field setting on Croker Island in the Northern Territory, Australia. Four speakers (1 female) participated in the study. Materials were designed to elicit the velar consonants [g, ɥ/ɣ], and also, as a comparison, the palatal stop-approximant contrast [ɟ, j]. Target words containing /g, ɥ/ɣ, ɟ, j/ in intervocalic position were elicited using objects pictured on a computer monitor. Ultrasound and audio data were recorded while participants named the pictures in a standardised carrier phrase. Ultrasound recordings were made with a GE 8C-RS ultrasound probe held at a 90 degree angle to the jaw in the mid-sagittal plane with a lightweight probe holder (Derrick et al., 2015). The probe was connected to a GE Logiq-E (version 11) ultrasound machine. Video output from the ultrasound machine went through an Epiphan VGA2USB Pro frame grabber to a laptop computer, which used FFMPEG running an X.264 encoder to synchronize video captured at 60Hz with audio from a Sennheiser MKH 416 microphone.

Preliminary analysis (see figure) indicates a clear distinction between articulation of consonants previously analysed as stops (blue circles) and as approximants (red squares) at both palatal (left panel) and velar (right panel) places of articulation. The figure compares edgetracks (Li et al. 2005) of 6-8 tokens per contrast in the same [...a\_a...] context. The origin of the plot is the posterior portion of the tongue. The stop [ɟ] (blue circles, left panel) differs from the approximant [j] (red squares, left panel) in being more front and slightly higher. The right panel shows the stop-approximant contrast at the velar place of articulation. Although the velar series is more variable than the palatal series, the velar stop is, on average, higher (~2mm) than the velar approximant. Acoustic data provides clear evidence of closure for palatal stops but not for velar stops. The height of the tongue for /ɥ ~ ɣ/ is similar to the vowel /u/ in our data. Although more analysis is required, preliminary results suggest that the velar contrast, which has been analysed as /g/ vs /ɥ/ or /ɣ/, is more accurately characterized as a contrast between /g/, which lenites to [ɥ], and a vowel /a/.



**Selected References:** Derrick, D., C. Best, R. Fiasson. (2015) Non-metallc ultrasound probe holder for co-collection and co-registration with EMA. *Proceedings of ICPHS*; Evans, N. (2000). Iwaidjan, a very un-Australian language family. *Linguistic Typology*, 4(2), 91-142.; Evans, N. (2009). Doubled up all over again: borrowing, sound change and reduplication in Iwaidjan. *Morphology* 19, 159-176; Li, M., Kambhamettu, C., & Stone, M. (2005). Automatic contour tracking in ultrasound images. *Clinical linguistics & phonetics*, 19(6-7), 545-554.