

The acoustic and articulatory characteristics of the lateral /l/ in Najdi Arabic (NA)

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In many varieties of English [1, 2], laterals typically show a clear–dark contrast that can pattern in a categorical (e.g. clear /l/ in onset, dark in coda position) as well as a gradient manner (as a function of phonological and morphological contexts). This patterning is thought to emerge from the presence of two gestures in /l/ articulation, an apical and a dorsal one, and from variation in their magnitude and temporal co-ordination [2]. Arabic is usually described as having a ‘clear’ /l/ in all positions apart from when in co-articulation with a neighbouring emphatic (pharyngealized sound) [3, 4]. The absence of a syllable-position contrast is thought to be due to the Arabic /l/ lacking a secondary dorsal gesture [4], but articulatory descriptions are largely absent for Arabic dialects. Preliminary acoustic and Ultrasound Tongue Imaging (UTI) work on Levantine Arabic [6] found vowel rather than syllable effects for the ‘plain’ /l/, with /a/ but not /i/ showing an earlier dorsal gesture in coda than in onset position. A dorsal gesture was also found in emphatic contexts, with anticipatory co-articulation showing stronger effects than a progressive one. This study expands this work to Saudi Arabic and uses a more time-sensitive UTI technique (60 fps) and a wider range of speakers, vowels, and emphatic contexts. The primary aim is to examine whether a dorsal gesture for Arabic /l/ is only present as a result of co-articulation with vowels and emphatics or whether it is integral to its articulation and shows the type of syllabic conditioning reported elsewhere.

Methods 30 female NA speakers who grew up in Riyadh participated in this study. The participants were recorded while producing target words with /l/ in onset and coda positions, in plain and emphatic environments, and with adjacent /i, i:, a, a:, u:, o:/. Simultaneous Ultrasound Tongue Imaging (UTI) was also carried out for 10 of the speakers. For the acoustic analysis, static measurements of F2-F1 and F3-F2 were taken at the midpoint of /l/. Linear mixed-effects models were fitted using lme4 in R with position, vowel context, and emphasis as fixed effects, and speaker and word as random intercepts. Dynamic formant trajectories (11 equidistant points across /lV/ and /lV/ intervals) will be modelled using GAMMs to capture coarticulation and emphasis spread over time. The articulatory analysis used UTI with automated tracking of tongue-surface contours, applying MFPCA to static midpoint shapes and to dynamic sequences sampled at 11 points to compare onset vs. coda /l/ in plain vs. emphatic contexts and to quantify how vowels and emphasis shape /l/ gestures across /lV/ and /lV/ intervals.

Results Lateral darkness in NA depends on the interaction of position, vowel quality, and emphasis. For high-front vowels, final /l/ after /i:/ shows significantly lower F2–F1 than onset /l/ (Estimate = –364.80 Hz, $t = -2.54$) with slightly higher F3–F2 values indicating a darker coda realization. In contrast, initial /l/ next to the central vowel (/a, a:/) tends to be darker than final /l/, although these central-vowel effects do not reach significance (all $|t| < 1.96$). Back vowels (/o:, u:/) show no significant effect in either measure. Darkening is more evident in emphatic contexts but is once again contextually driven: /l/ preceding an emphatic shows a significant F2–F1 reduction (–147 Hz, $t = -2.17$) and higher F3–F2 than a following /l/, with the latter preserving a contrast with a final plain /l/ (+208 Hz, $t = 3.06$). These results point to a stronger anticipatory effect of emphasis and to the direction of emphasis being more important than syllable position in NA.

Conclusion this study provides quantitative and systematic evidence for NA having a generally clear /l/, with some gradient but by no means allophonic variation in its realization. The strongest effect comes from emphasis spread, where a following emphatic can produce a darker initial /l/ than final /l/, overriding the expected onset–coda asymmetry. This demonstrates that pharyngealization has a more powerful influence on lateral realization than syllable position. The ongoing UTI-based analysis (to be completed in January) will determine whether this acoustic darkening corresponds to dorsal involvement, allowing us to evaluate whether NA has a purely apical system or whether it exhibits apical–dorsal coordination.

References

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