Phonetic factors influencing /l/-rhoticisation in Greek

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1. Background

- Rhotics and laterals tend to alternate cross-linguistically [1,2].
- Alternation of the two sounds, i.e. rhoticisation and lambdacisation, occurs preferentially in perceptually weak positions – coda, intervocalic position, unstressed syllables.
- Rhoticisation seems to be much more frequent than lambdacisation.
- All Greek dialects show /l/-rhoticisation in word-internal coda ([3]) : «αδελφός» - «αδερφός», «ήλθα» - «ήρθα», etc.

Phonetic factors potentially influencing rhoticisation:

- Duration: Laterals are thought to rhoticise when shortened.
- Word stress: Rhoticisation occurs most often in unstressed environments where segmental reduction is expected, e.g. in Southern Italian dialects [4].
- Word-internal coda: Velar or labial consonants following /l/ favour rhoticisation, so e. g. in various Italian dialects [4].

2. Method

a) Speaker and listeners

- young male speaker of Standard Thessaloniki Greek, highly educated
- 21 native Greek listeners from Greece and Cyprus (age 18-37)

b) Stimuli

Non-sense words with VLV or VLCV structure containing
- /l/ or /r/,
- /a, i, u/ in a symmetrical vowel context,
- /p, t, k/ (in VLCV words only),
- stress on the first or last syllable.

All words were presented in Greek script in a word list read three times.

VLV		VLCV					
/VlV/	/VrV/	/VlpV/	/VrpV/	/VltV/	/VrtV/	/VlkV/	/VrkV/
ála	ára	álpa	árpa	álta	árta	álka	árka
alá	ará	alpá	arpá	altá	artá	alká	arká
íli	íri	ílpi	írpi	ílti	írti	ílki	írki
ilí	irí	ilpí	irpí	iltí	irtí	ilkí	irkí
úlu	úru	úlpu	úrpu	últu	úrtu	úlku	úrku
ulú	urú	ulpú	urpú	ultú	urtú	ulkú	urkú

Table 1: non-sense words used in the experiment

- Three variants of tokens containing /l/: 1. original length, 2. shortened to 75 ms, 3. shortened to 30 ms.
- Where available, two variants of tokens containing /r/: 1. tap, 2. approximant.

c) Acoustic characteristics of the speaker's laterals and rhotics

a) Laterals:

- **Degree of darkness/clearness**: moderately dark laterals in /a, u/ contexts (Δ F2-F1 1041 Hz and 1146 Hz, respectively); extremely palatalised with /i/ (Δ F2-F1 2147 Hz). Vowel context had thus a highly significant influence on the lateral's quality (ANOVA, $p < 0{,}0001$), cf. fig. 1.
- **Duration**: 129,6 ms (σ 17,9 ms) in intervocalic position, 112,1 ms (σ 15,1 ms) in internal coda. The difference between the two positions was highly significant (Student's t-test, $p < 0{,}001$). No other factors had a significant influence on duration.
  N.B.: In spontaneous speech, Greek /l/ has a duration of 60-80 ms [5].

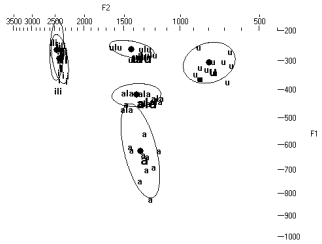

Fig. 1: F1 and F2 values at midpoint of the vowels /a, i, u/ and the lateral in /a, i, u/ intervocalic context. Graphic created using Peter Ladefoged's PlotFormant Programme.

b) Rhotics

- Realisation as either tap or approximant (only in internal coda). See fig. 2.

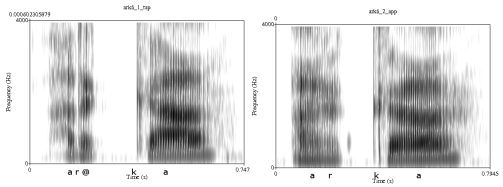

Fig. 2. Spectrogrammes of the nonsense word « arká » realised with a) a tap, b) an approximant

- Approximants were more likely to appear in /i/-context (58 %), than /a/- and /u/-contexts (28 % each)
- **Duration**: intervocalic tap: 28,5 ms (σ 10,2 ms), coda tap 21,9 ms (σ 6,7 ms), coda approximant 83,5 ms (σ 11,5 ms). Taps in the intervocalic position tended to be longer than in the coda, but this difference only reached marginal significance for the context vowels /i/ and /u/ (Student's t-test, $p < 0{,}05$ and $p < 0{,}1$, respectively).

Acoustic quality of the approximant rhotics:

/a/-context: Δ F2-F1 981 Hz

/i/-context: Δ F2-F1 1652 Hz

/u/-context: Δ F2-F1 909 Hz

See fig. 3.

Note that /r/ is much less palatalised than /l/.

Fig. 3: F1 and F2 values at midpoint of the approximant rhotic in VrCV contexts

d) Experimental setup

- Stimuli (three repetitions of each) presented in random order over headphones to listeners
- Task: identification of the nonsense words as containing either a rhotic or a lateral by clicking on the orthographic transcription of the word on a computer screen.

3. Results

a) Rhoticisation

Duration (30 ms-tokens vs. longer tokens) proved to be the most highly significant factor for /l/-rhoticisation (ANOVA, $p < 0{,}0001$), before vowel quality (ANOVA, $p < 0{,}0001$). See fig. 4 and 5.

Contrary to expectations, neither stress placement nor place of articulation of the following stop turned out to be significant.

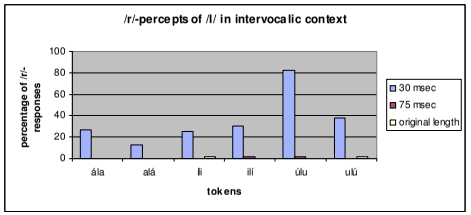

Fig. 4: /r/-percepts of /l/ in intervocalic position

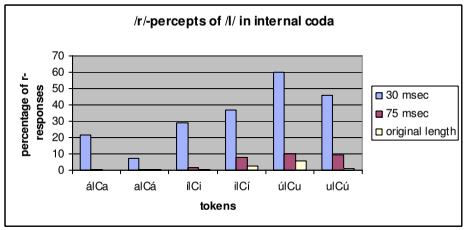

Fig. 5: /r/-percepts of /l/ in word-internal coda

b) Lambdacisation

Misperception of /r/ as /l/ occurred predominantly with the approximant rhotics. See fig. 6.

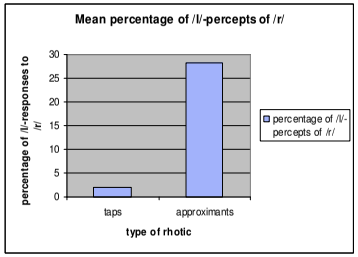

Fig. 6: /l/-percepts of /r/ according to type of rhotic

For approximant rhotics, vowel context had a significant effect on lambdacisation: 35 % misidentification in /a/-context, 10 % in /i/-context, and 54 % in /u/-context (ANOVA, $p < 0{,}05$). The difference in palatalisation may account for the low lambdacisation values with /i/.

4. Discussion

- Duration seems to be the prime factor in /l/-rhoticisation.
- In spontaneous speech, laterals may be short enough to undergo rhoticisation.
- The smaller percentages of /r/-lambdacisation in the data are in line with its greater cross-linguistic rarity compared to rhoticisation of laterals.
- Lambdacisation seems to depend not only on duration, but also on gestural reorganisation, inducing lengthening of the segment: from a tap (+ svarabhakti vowel) to an approximant realisation.
- Variation in rhotic realisation (approximants, taps, zero) has been reported for dialects with lambdacisation such as Andalusian Spanish [6].

5. References

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