

The Electropalatographic Evidence of the Korean Flap: An Intervocalic Korean Liquid Sound*

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ABSTRACT

The intervocalic Korean liquid sound has been recognized as a flap in the studies of the Korean language. But there has been very little experimental data corroborating it. The electropalatographic (EPG) experiment was conducted to test this. The subjects were one Korean speaker and one native English speaker who had a pseudopalate and did the EPG experiment at the UCLA phonetics laboratory. The spectrographic evidence of the flaps in both the English t-flap and the Korean liquid flap was also sought. The English and Korean flaps were between mid/low back vowels so that the vowels themselves would not affect palatal contacts of the tongue. The results confirmed that the Korean liquid is realized as a flap in intervocalic position with many similar properties to English flap in both EPG and spectrographic data. The Korean initial liquid sound in borrowed words such as “rotary” and “radio” was also a flap. But the Korean liquid in the word-final and geminate positions was a lateral as in words “dol” (stone), “dollo” (with stone), “nal” (day) and “nallara” (carry). The intuitive theory of the Korean liquid flap was proved by the EPG and spectrographic data.

Keywords: Electropalatography (EPG), Pseudopalate, Spectrogram, Korean Flap, Korean Liquid

1. Introduction

It is well accepted that there are three allophones in the Korean liquid sound, [r], [l], [ɾ] (S.-O. Lee, 2001, p. 54; H.-Y. Lee, 1996). A unique characteristic in the Korean liquid sound is that the intervocalic liquid is a flap (Park, 1999, p. 89; H. Kang, 1999, p. 3; H.-S. Kang, 1999, p. 7). This is also true in the Japanese liquid (Riney et al., 2000, p. 717). But there have not been phonetic tests of the Korean liquid flap by the electropalatographic method. This paper purports to test the phonetic evidence of the intervocalic Korean liquid flap by using the electropalatographic method and by

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spectrograms. For a comparison the English *t*, *d*-flap was tested by the same methods.

The production of a flap is characterized as a single tap made by the tip of the tongue on the alveolar ridge with the side rims usually contacting lightly the upper molars. Bauer et al. (1980) defines a flap as “a voiced stop which is articulated by rapidly tapping the tip/blade of the tongue against the alveolar ridge” (p. 38). Ladefoged (2001) states that in American English when the *t* occurs before an unstressed vowel as in *pretty* or *better*, “it sounds like a very short *d*” (p. 73). A flap is easily identifiable through phonetic displays including spectrograms and through dynamic palatography. The closure for a flap is very short, much shorter than that of a stop, and formant transitions between the flap and adjacent vowels are rapid. The invention of dynamic palatography has allowed for a precise description of the articulation of a flap.

2. Methods

For a comparison, English flap was tested by the same method that Korean liquid flap was tested.

2.1 Subjects

The subjects were one American English speaker for the English flap and one Seoul dialect speaker for the Korean flap. Both were males in their early thirties.

2.2 Words for Experiments

The words used for both English and Korean flap sounds were all natural words carefully selected so that the target sounds are between mid/low back vowels. This environment was chosen due to minimize the palatal contact attributed to adjacent vowels. The corpora for the two languages appear in Table 1 (English) and Table 2 (Korean). Each word was pronounced ten times in randomized order.

Table 1. Test Words for the English Flap

Test words	Target sounds
a <i>motor</i> show	[ɾ]
Are you from <i>Ottawa</i> ?	[ɾ]
Say <i>Adam</i> , Dad.	[ɾ]
Say <i>atom</i> , Dad.	[ɾ]
What's your <i>motto</i> ?	[ɾ]

Table 2. Test Words for the Korean Liquid Sound

Test words	Target sounds
idol (this stone)	[l]
idolo (this road)	[r]
idollo (with this stone)	[l]
inal (this day)	[l]
inala (this country)	[r]
nallala (carry)	[l]
jeonyoknol (dusk)	[l]
ibalam (this wind)	[r]
nollada (surprised)	[l]
oladio (Oh radio) (for EPG)	[r]
iladio (this radio) (for CSL)	[r]
olotali (Oh rotary) (for EPG)	[r]
ilotali (this rotary) (for CSL)	[r]

2.3 The Recording Method

Each of the English and Korean subjects had his own pseudopalate and recorded words using Kay Palatometer and CSL at the UCLA phonetics laboratory. The words were recorded at normal speed. The EPG multiple screen of time varying displays shows pictures at every 10 milliseconds automatically captured by the Palatometer.

3. Results

Both the electropalatographic and spectrographic data showed that the intervocalic Korean liquid sound was a flap, while the liquid in the word-final and geminate positions was a lateral. The comparison of English and Korean flap showed similarity in their behavior of the tongue contact.

3.1 The EPG Evidence of the English Flap

A characteristic of the English flap sound seen in the EPG data was a complete blockage of air passage by the tongue tapping the alveo-palatal area and the side rims lightly contacting the upper molars (Figure 1). Compared with the flap, the EPG data of the /l/ show a blockage only on the alveolar ridge, while the /r/ had the palatal contact only on the velum area (Ahn, 2001) as shown in Figure 1. The EPG data of the English flap showed that the t's and d's in words motto, Adam, atom, motor and Ottawa were all flapped as shown in Figure 2 and Table 3. This was supported by all ten tokens of each word (Table 3). One characteristic found was that the tongue contact points for both English and Korean flaps were on the alveo-palatal area and the upper molars

(Figure 2) as compared with those of the English lateral which contacted mainly the alveolar ridge (Ahn, 2001).

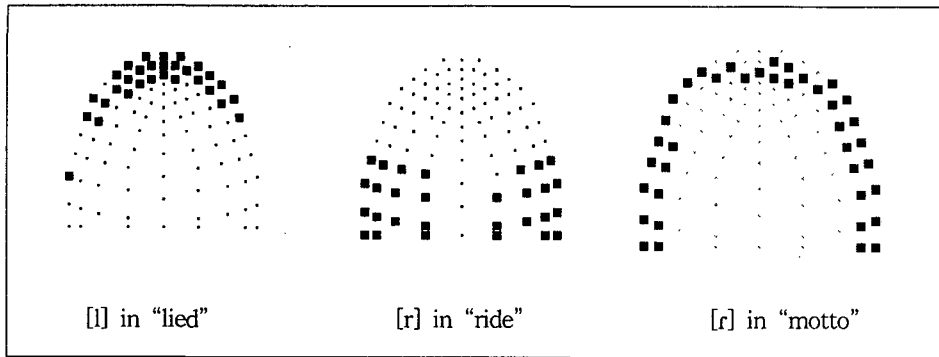


Figure 1. The tongue contact points of [l] in "lied," [r] in "ride" and [r] in "motto"

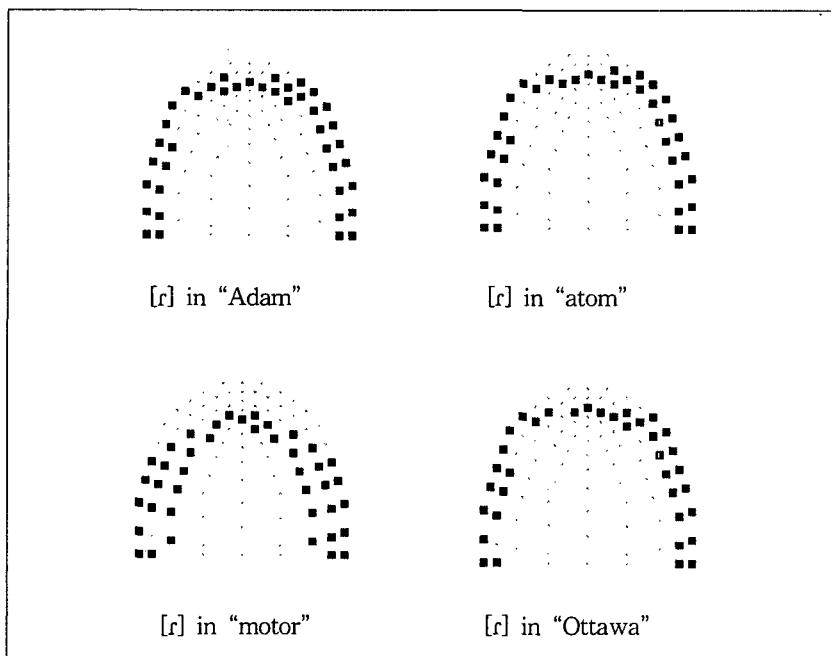


Figure 2. The tongue contact points of the English flap in words "Adam," "atom," "motor" and "Ottawa"

The EPG multiple screen of [r] in *motto* and *Ottawa* shows evidence of t-flapping in the [a]-[o] and [a]-[ə] environments as shown in Figures 3 and 4.

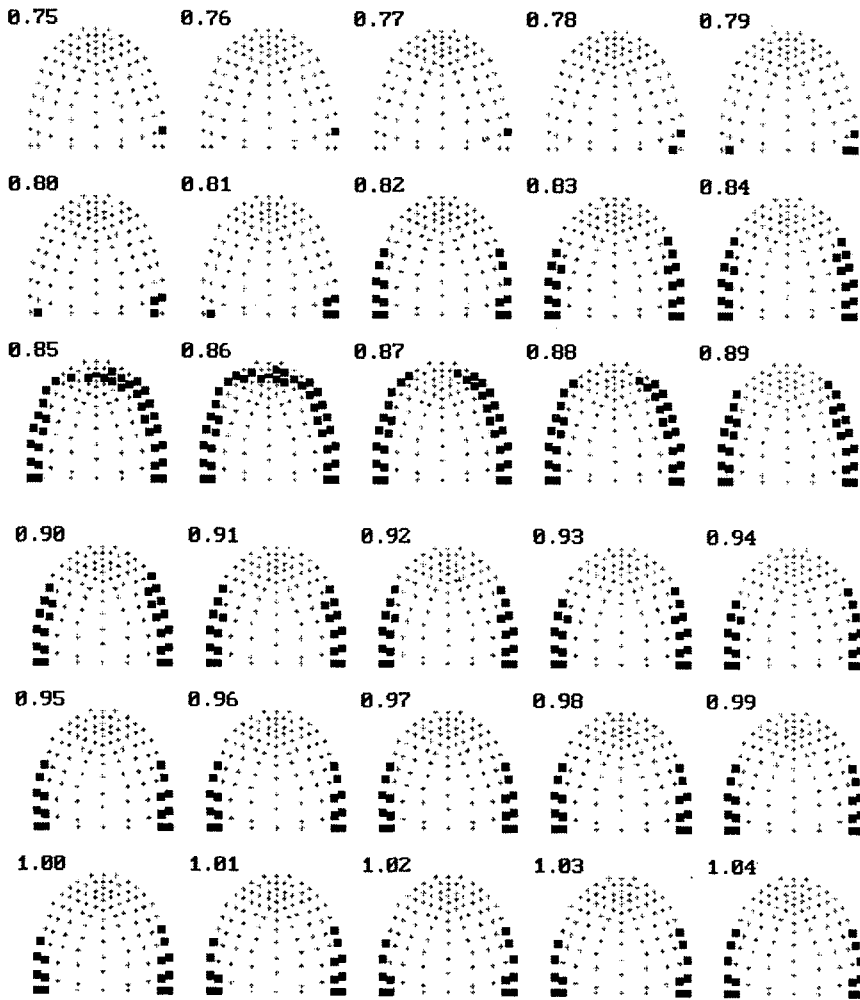


Figure 3. The EPG multiple screen of [r] in the word “*motto.*” At 0.75sec, there is no palatal contact for [a] in [mɑˈro]. Full palatal contact on the alveo-palatal area and on the upper molars for [r] is made at 0.86sec. After 0.87sec, the tongue begins to be released for the following vowel /o/.

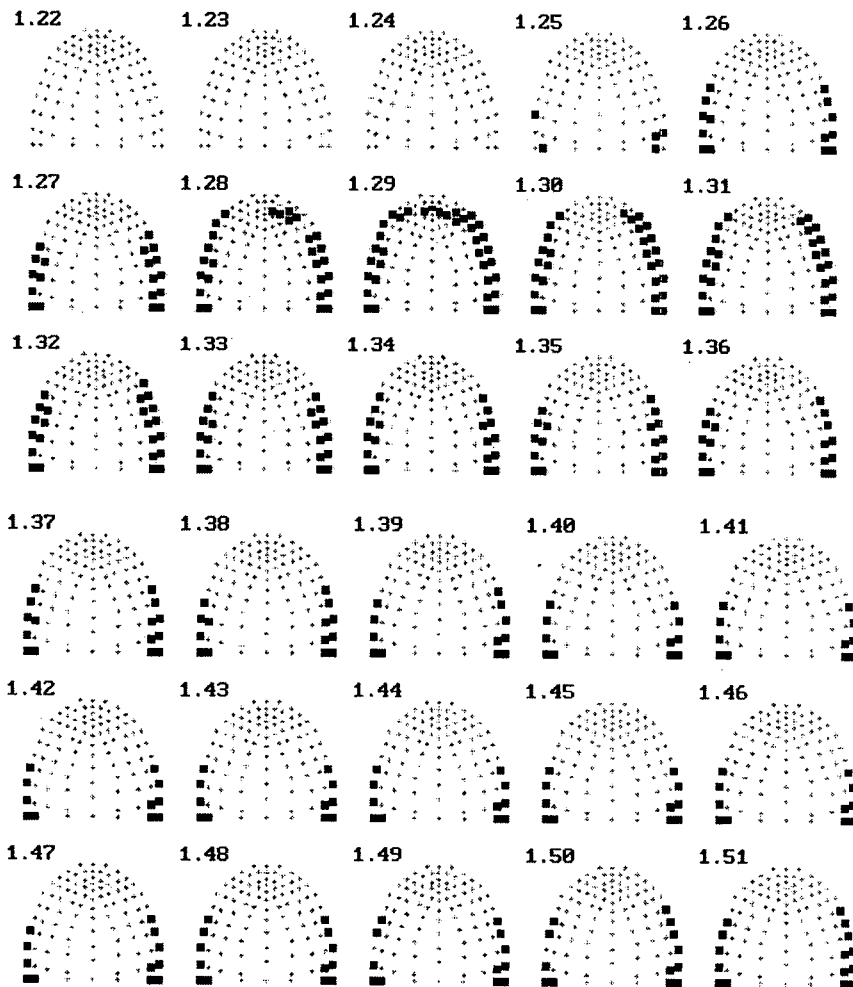


Figure 4. The EPG multiple screen of [r] in the word "Ottawa." At 1.22sec, there is no palatal contact for /α/ in [ɑ'rowə]. Full palatal contact for [r] is made at 1.29sec. After 1.30sec the tongue begins to be released for the following mid back vowel /ə/.

3.2 The EPG Evidence of the Korean Flap

The intervocalic liquid in such words as *dolo* ("road"), *nala* ("country") and *balam* ("wind") was proved to be a flap by EPG with a complete blockage by the tongue on the alveo-palatal area and on the upper molars as shown in Figure 5 and Table 4. The initial [l] in borrowed words such as *ladio* and *lotali*, which are Korean transcriptions of *radio* and *rotary*, was also proved to be a flap (Figure 5). The duration of Korean liquid flap measured at the peak contact in EPG was very short (10ms-40ms) which is identical to that of the English flap (20ms-40ms) (Table 3 and 4). In the words, *dol* ("stone"), *nal* ("day") and *noI* ("dusk"), the EPG data show that the word-final Korean liquid is a lateral, with sides of the tongue open as shown in Figure 6. Its duration of palatal

contact was 90-240ms (Table 5). The geminate liquid where a liquid in the coda position is followed by a liquid in the onset position in the next syllable as in words *dollo* (“with stone”), *nallala* (“carry”) and *nollada* (“surprised”) was also a lateral with sides open in all ten tokens of each word as shown in Figure 7 and Table 5. Its duration of palatal contact was 90-160ms (Table 5). Its contact area is much broader and more anterior relative to singleton lateral. Figure 14 shows relative brevity of the flap in English and Korean relative to the length of the lateral in Korean.

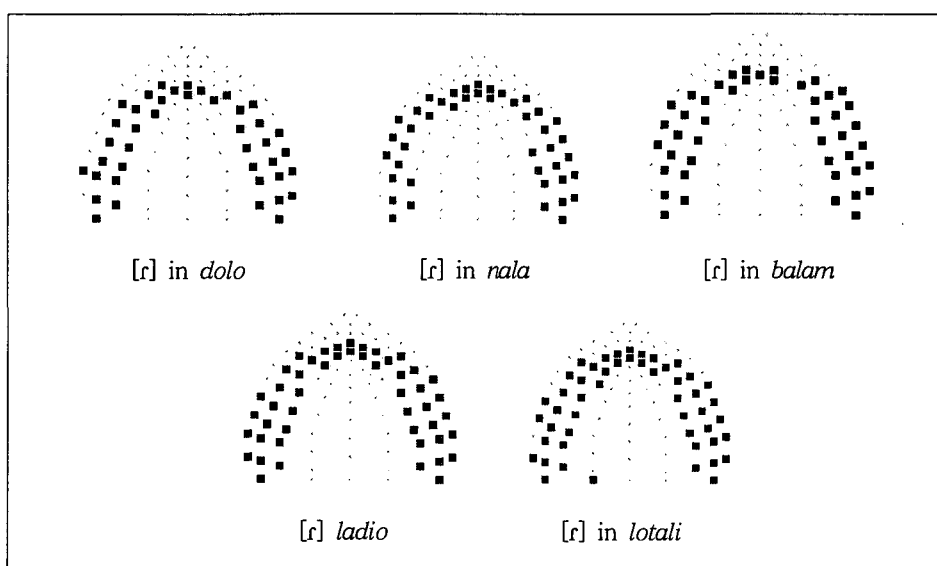


Figure 5. The tongue contact points of the intervocalic Korean liquid flap [ɾ] in *dolo* [doro] (“road”), *nala* [nara] (“country”), *balam* [baram] (“wind”), and the word-initial [ɾ] in borrowed words *ladio* [radio] (“radio”) and *lotali* [rotari] (“rotary”)

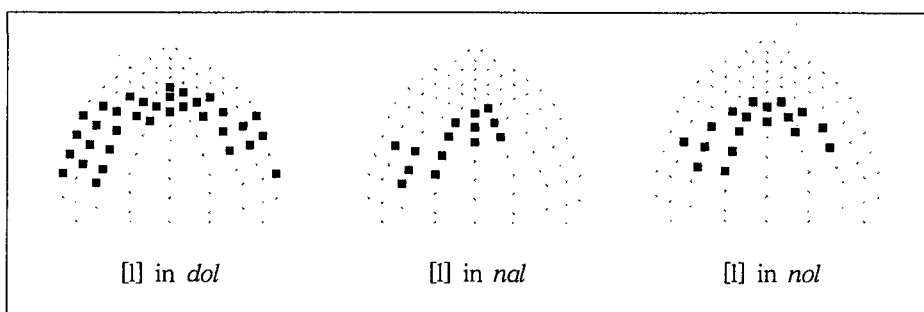


Figure 6. The tongue contact points of word-final liquid [l] in *dol* [dol] (“stone”), *nal* [nal] (“day”) and *nol* [nol] (“dusk”)

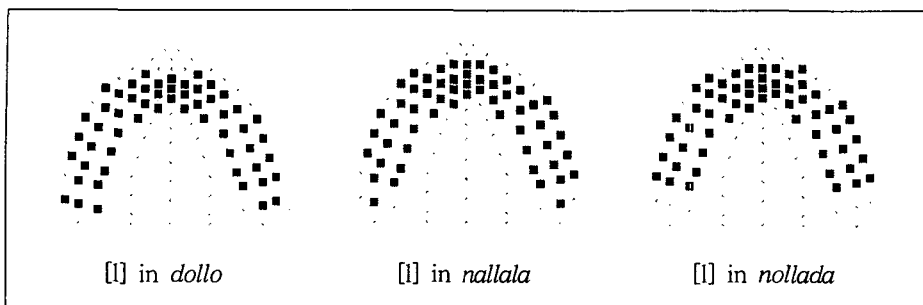


Figure 7. The tongue contact points of the Korean geminate [l] in words *dollo* [dolo] (“with stone”), *nallala* [nalara] (“carry”) and *nollada* [nolada] (“surprised”)

The EPG multiple screen of [r] in *dolo* in Figure 8 shows evidence of flapping of the intervocalic Korean liquid in the /o/_o/ environment.

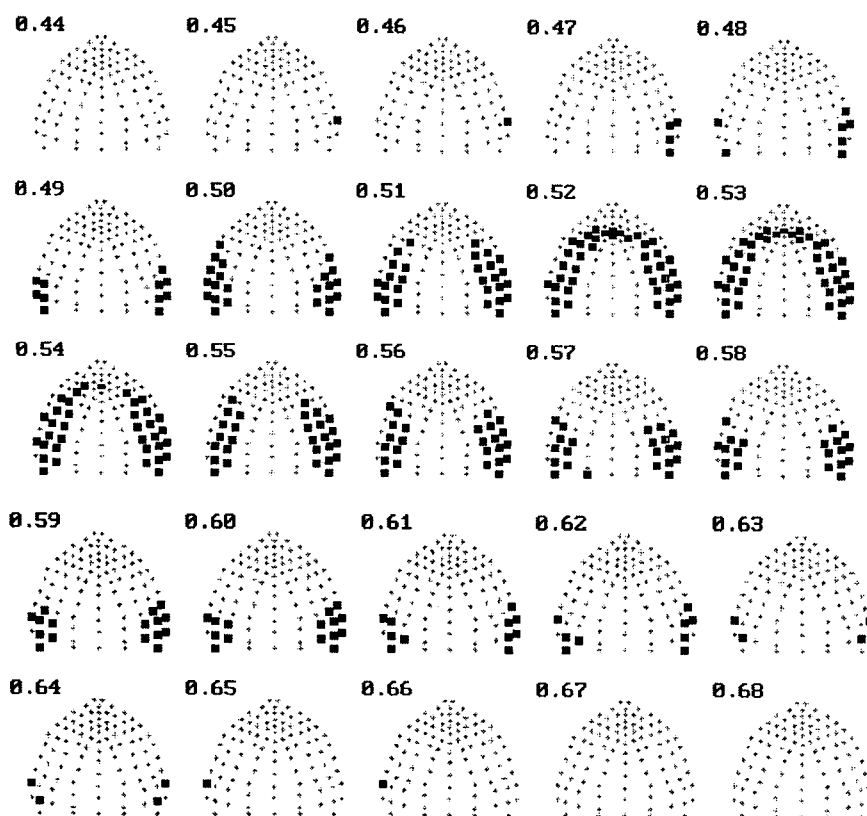


Figure 8. The EPG multiple screen of [r] in *dolo* [doro] (“road”). At 0.44sec, there is no palatal contact for the first /o/ in [doro]. At 0.52sec a complete blockage is made for [r] on the alveo-palatal area and on the upper molars. At 0.67sec, the tongue is completely released for the following Korean back vowel /o/.

3.3 Spectrographic Evidence of the English and Korean Flap

Figure 9 compares spectrograms of /l/, /r/ and [r] in the sentence *Carry that load down the road* and the word “*motto*.” The /l/ has very low F1 and F2 at around 250Hz and 1200Hz respectively, but very high F3 in the neighborhood of 2600Hz. For the /r/, there is general lowering of F2 and F3 as shown in Figure 9. The flap, in contrast, behaves like a voiced alveolar stop with no visible formant structure during its closure, as seen in *motto* in Figure 9. The spectrograms of [r] in *Adam*, *atom*, *motor* and *Ottawa* in Figure 10 show evidence of flapping in English. The spectrograms of the Korean expression *mali paleda* (“A horse runs fast.”) in Figure 11 and *idolo*, *inala*, *iladio* (“radio”) and *ilotali* (“rotary”) in Figure 12 all show evidence of flapping in the Korean liquid (also in Kang, 1999, p. 9), while spectrograms of *idollo* and *nallala* in Figure 13 show that the geminate liquid is a lateral.

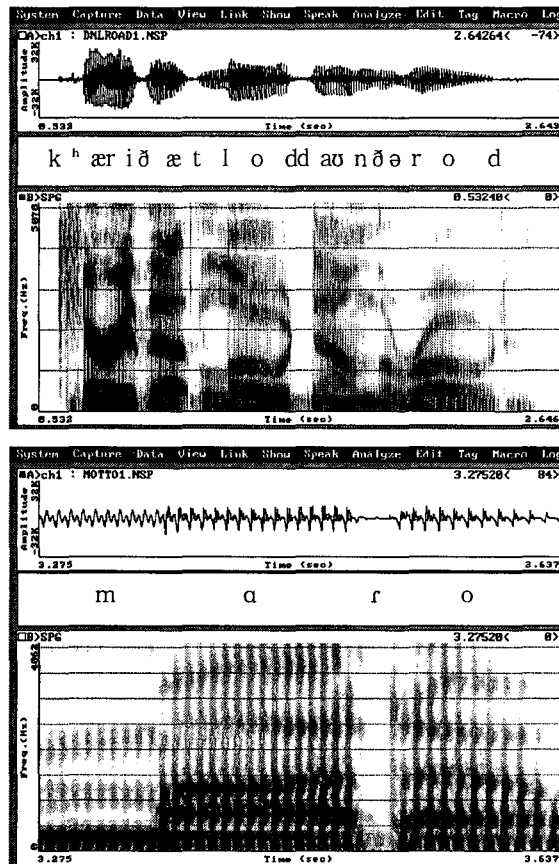


Figure 9. Spectrograms of [r] in “carry” and “road,” [l] in “load” in the sentence “*Carry that load down the road*.” (above) and [r] in “*motto*” (below)

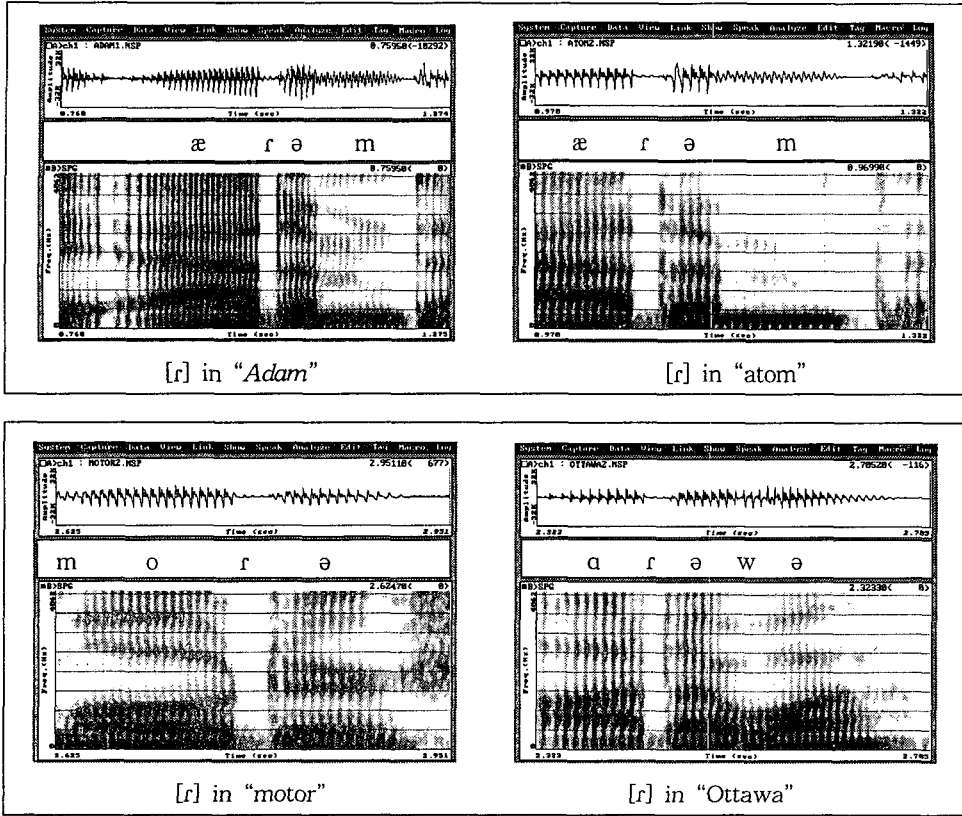


Figure 10. Spectrograms of the English flap in "Adam," "atom," "motor" and "Ottawa"

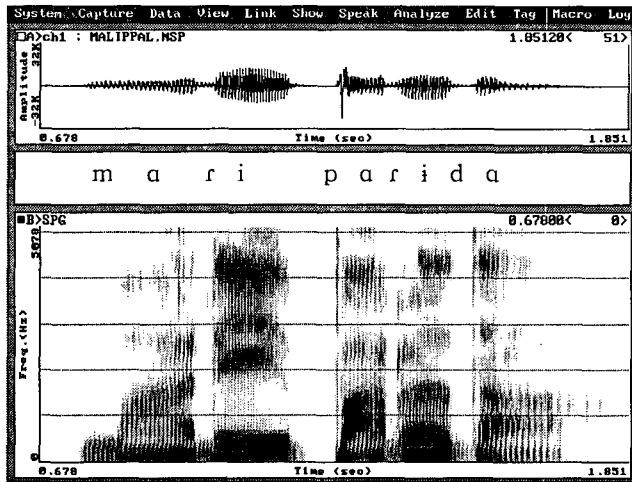


Figure 11. A spectrogram of [r] in mali paleda ("The horse runs fast.")

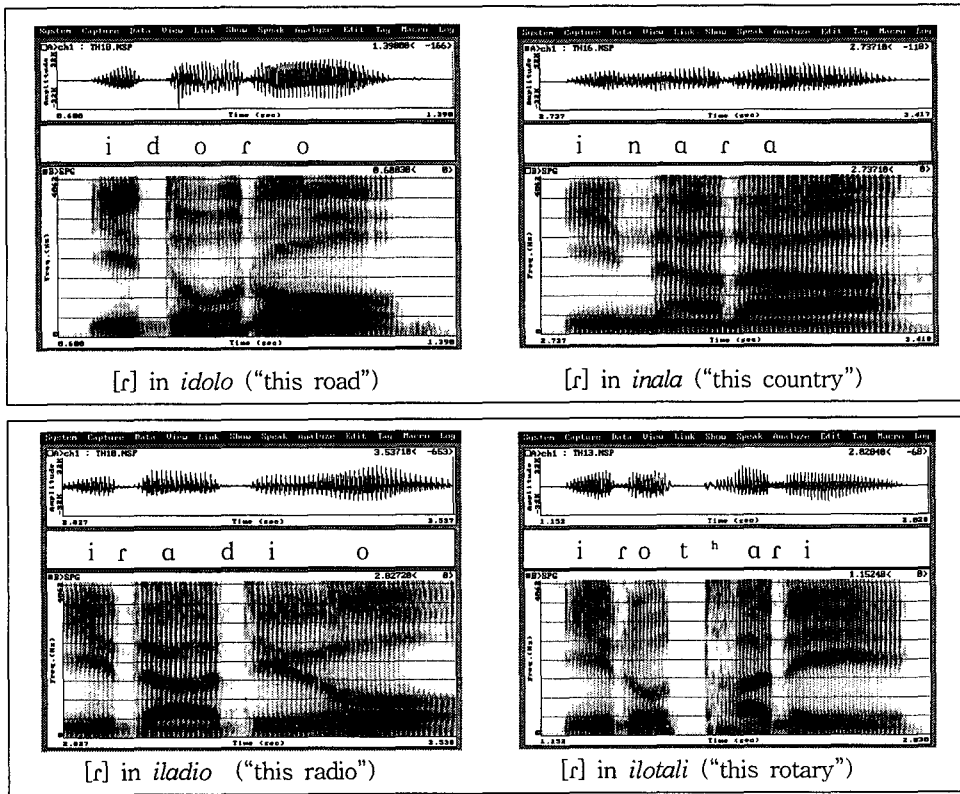


Figure 12. Spectrograms of the Korean Flap in "dolo," "nala," and in the borrowed words "iladio" ("this radio"), "ilotali" ("this rotary")

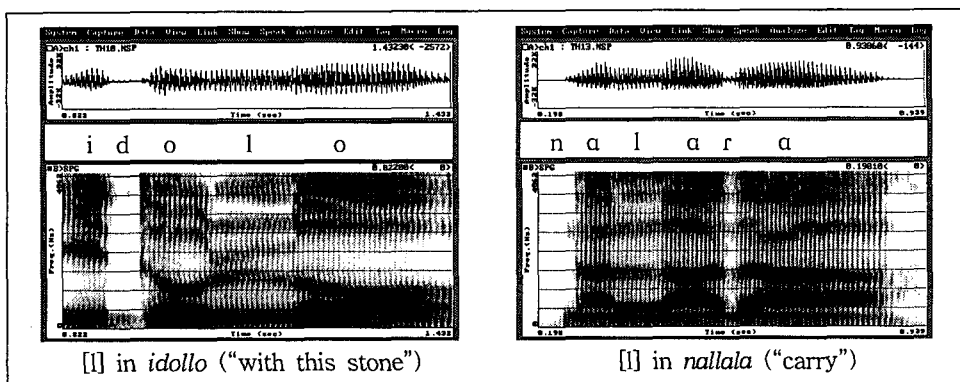


Figure 13. Spectrograms of the Korean geminate liquid in "idollo" and "nallala"

Table 3. The English flap supported by EPG and its duration of palatal contact

Test words (N)	[ɾ] (Number of tokens supporting)	Duration of palatal contact
Adam (10)	10	20-30 ms
atom (10)	10	20-30 ms
motor (10)	10	20-40 ms
motto (10)	10	20-30 ms
Ottawa (10)	10	20-30 ms

Table 4. The Korean flap supported by EPG and its duration of palatal contact

Test words (N)	[ɾ] (Number of tokens supporting)	Duration of palatal contact
ladio ("radio") (5)	5	20-40 ms
lotali ("rotary") (5)	5	20-40 ms
dolo ("road") (10)	10	10-40 ms
nala ("country") (10)	10	10-30 ms
baram ("wind") (10)	10	10-30 ms

Table 5. The Korean word-final and geminate liquid supported by EPG and its duration of palatal contact

Test words (N)	[l] (Number of tokens supporting)	Duration of palatal contact
dollo (10)	10	130-160 ms
nallala (10)	10	90-120 ms
nollada (10)	10	90-130 ms
dol (10)	10	130-240 ms
nal (10)	10	180-210 ms
nol (10)	10	90-210 ms

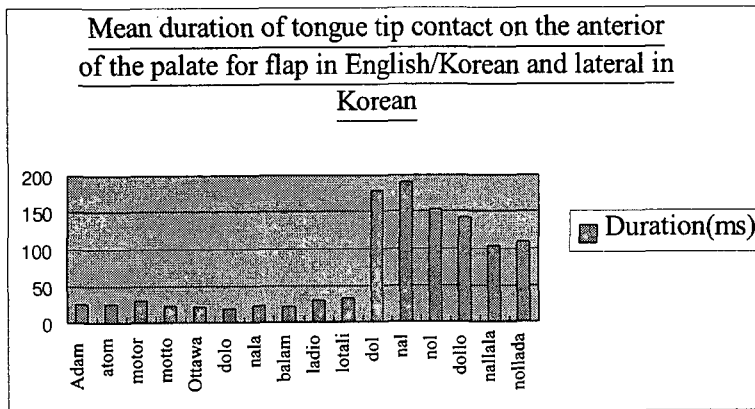


Figure 14. Mean duration of the tongue tip contact on the anterior of the palate for English flap in *Adam*, *atom*, *motor*, *motto*, *Ottawa*, Korean liquid flap in *dolo*, *nala*, *baram*, *ladio*, *lotali* and the Korean lateral in *dol*, *nal*, *nol*, *dollo*, *nallala*, *nollada*.

4. Conclusion

This study examined the evidence of the intervocalic Korean liquid flap by electropalatographic and spectrographic experiments. Both methods showed the evidence that the intervocalic Korean liquid is a flap which is phonetically quite similar to the American English flap, involving a rapid tongue tip gesture to meet the anterior portion of the hard palate, preceded and followed by phases of contact between the tongue and the molars. The Korean word-initial liquid in borrowed words such as “radio” and “rotary” was also found to be a flap, while the word-final and geminate allophones were shown to be laterals. The Korean flap had a very short duration of the palatal contact (10–40ms) and behaved like a voiced alveolar stop in the spectrograms with no visible formant structure. This study fills the gap between the theory and the phonetic reality.

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