/l/ and /r/ production by Korean and Japanese speakers of English :

What factors are influential for the production?

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<초 록>

한국인과 일본인의 /l/ 과 /r/ 발음:
발음에 어떤 요소가 영향을 미치는가?

박시균

본 논문은 한국인과 일본인이 영어 유음 /l/과 /r/을 발음하는데 있어서 어떤 요소들이 가장 큰 영향을 미치는가를 알아보는데 중점을 두고 있다. Park & Ingram (1995)에서는 한국인과 일본인의 영어 발음인지(perception) 실험을 통해 동 문제에 대해 분석을 해 보았는데 본 논문에서는 같은 주제를 발음 실험을 통해 그 해답을 찾고 있다. 실험의 결과는 언어 의존적인 요소인 모국어 음운 체계의 영향뿐만 아니라 언어 독립적인 요소인 화자(speaker), 유음이 나타나는 위치(position), 유음의 유형(type) 그리고 영어 유음을 발음하는 각 개인 등의 요소들이 모두 한국인과 일본인의 영어 유음 /l/과 /r/ 발음에 영향을 미치고 있음을 보여 주고 있다. 이는 인지 실험에서도 드러난 바로 인지와 발음은 서로 밀접한 관계를 맺고 기제가 일어나고 있음을 보여 준다.

1. Introduction

In recent years, there have been a number of experimental studies on /l/ and /ɹ/ perception by English learners whose native language does not possess both /l/ and /ɹ/ phonemes, such as Japanese (Mochizuki, 1981; Logan et al., 1991; Lively et al., 1993), Cantonese (Henry & Sheldon, 1983, 1986), and Korean (Gillette, 1980; Park & Ingram, 1995; Ingram & Park, 1998). Their main concerns were to elucidate which factor plays a main role between prior learning of native phonology and innate difficulty/easiness of L2 sounds /l/ and /ɹ/ due to the difference of acoustic cues of them.

In particular, Dissosway-Huff et al. (1982) and Henry & Sheldon (1986) presented conflict findings. While the former one suggested that language-independent acoustic effects may outweigh the influence of language-specific L1 phonological constraints in the acquisition of a new sound contrast, the latter one presented findings that language-specific L1 phonological contrasts may be more important factor than language-independent acoustic effects in L2 sound acquisition.

The cross-language comparison based on English /l/ and /ɹ/ perception by Korean and Japanese listeners of English (Park & Ingram, 1995; Ingram & Park, 1998) revealed that although language-independent acoustic cues of both approximants played the minor role, listeners' prior L1 phonological learning was dominant in their perception of English approximants /l/ and /ɹ/ (Korean 80.92 %, Japanese 70 % over English /l-ɹ/ containing words).

As a successive study of /l/ and /ɹ/ perception by Korean and Japanese learners of English (Park & Ingram, 1995), this article verifies the efficiency of L2 learners' prior L1 phonological learning in production, using /l/ and /ɹ/ production data by Korean and Japanese speakers of English.

2. Comparison of liquids in the three languages (AE[1], Korean, Japanese)

In Australian English, two approximants, a retroflex or bunched /ɹ/ and an alveolar lateral /l/, exist as separate phonemes. Thus, Australian native speakers of English distinguish the central approximant /ɹ/ from the alveolar lateral /l/ in whatever

1) In this article, AE means Australian English.

positions where the l/r distinction occurs. Australian English retains an /l/-/r/ contrast in the three environments: absolute initial (e.g., read-lead), initial cluster (e.g., broom-bloom), and medial (e.g., correct-collect) positions. However, as a non-rhotic dialect it does not possess the /l/-/r/ contrast in word final and word final cluster positions, unlike American English.

Japanese possesses only one liquid, usually phonemicised /r/. This phoneme seems to have a range of phonetic variants from a slightly retroflexed lateral approximant to an alveolar tap or flap (Tsuzuki, 1992). This phonetic variation occurs depending upon different speakers and phonological environments. Japanese speakers may use the phonemicised liquid /r/, which has a range of phonetic variants, as perceptual and productive representation for English /l/ and /r/ when they listen to or produce English utterances which contain English liquid /l/ or /r/. Since there is no clear conscious distinction among different variants of /r/ in Japanese, the native speakers of Japanese will have a great degree of difficulty in distinguishing English /l/ from /r/. Hence, Japanese native speakers will have considerable difficulties when perceiving and producing English liquids in all positions (initial, consonant cluster, and medial positions) in AE. Moreover, Japanese /r/ occurs only in syllable initial position and there is no C + liquid consonant cluster structure in Japanese phonotactics. As there is no structure corresponding to the English cluster in Japanese, more difficulties in cluster position can be predicted.

Korean also phonologically possesses a single liquid, which is phonemicised /l/. However, the Korean liquid can occur in syllable initial and syllable final positions. Unlike Japanese /r/, Korean /l/ has two clear allophones, a flap [ɾ] and an alveolar lateral [l]. These two allophones are in complementary distribution in medial and syllable final positions. Medially, the [ɾ] is produced between vowels and, in syllable final position, the clear alveolar lateral [l] (unlike English velarised dark /l/) occurs unconditionally. Also, one characteristic of the distribution of Korean liquid variants is in the geminate context, where a liquid in coda position is followed by a liquid in onset position in the next syllable. In this position, a long alveolar lateral is invariably produced. The selection of a long alveolar lateral in this geminate context in Korean affects positively how Korean speakers identify and produce English /l/ and /r/ in medial position. When the Koreans hear English /r/, they convert it into the [ɾ], perceptual representation for the /r/ in their native language, and English /l/ into [ll], perceptual representation for the /l/, in medial position. This fact is also attested in the Korean orthographic system's handling of English loan words, such as:

'orange' '오렌지' [o$_{\underline{r}}$en$_{\underline{r}}$i]
'Olympic' '올림픽' [o$_{\underline{l}}$imp^{h}ik].

Korean, as in Japanese, does not have a C + liquid cluster structure in its phonological system. Thus, Koreans will have more difficulty identifying English /l/ and /r/ in this position than in medial position. However, as they will apply the same perceptual representation pair of [ɾ] and [ll] to English /r/ and /l/ respectively after resyllabification by vowel epenthesis in order to preserve native Korean CV(C) syllable structure in cluster position, their difficulties in perceiving and producing English /l/ and /r/ will be considerably less than will be those of Japanese listeners in this position.

However, in the case of word initial position, the situation is quite similar to that of Japanese speakers. In this position, Korean does not have any specifically designated allophones of its phonemicised liquid /l/. As in Japanese, since there is no clear conscious distinction between the two different variants [ɾ] and [l] of the Korean liquid; whatever phonetic variation occurs depending upon different speakers in word initial position (Lee, H-Y., 1993), the Koreans may have a great degree of difficulty in identifying and producing English /l/ and /r/. Therefore, in this position, the identification and production performance of Korean listeners may be predicted to closely approximate that of Japanese listeners.

The exemplars of l/r containing words in all three positions are tabulated at Table 1.

<Table 1> l/r containing words representation in the three languages (Korean, Japanese, English)

	English	Korean	Japanese
initial	read	리드 [ɾidɯ]	リ-ド [ɾi:do]
	lead	리드 [ɾidɯ]	リ-ド [ɾi:do]
cluster	clip	클립 [k^{h}ɯllip]	クリップ [kuɾi?pu]
	grip	그립 [kɯɾip]	グリップ [guɾi?pu]
medial	very	베리 [peɾi]	ベリ [beɾi]
	pelican	펠리컨 [p^{h}ellik3n]	ペリカン [peɾikaɲ]

3. Prediction

My predicted transfer effects stress that L2 learners' performance will be based on the extent to which the L1 provides listeners with appropriate perceptual/productive models for the English /l/ - /r/ contrast in various environments, rather than the precise phonological mechanisms by which the match to native targets is obtained. For example, process of vowel epenthesis and resyllabification will likely apply automatically when Japanese and Korean listeners produce English /l-r/ cluster stimuli. But, more importantly, for the prediction of their respective production performance, Korean provides its native listeners with a perceptual/productive model for the /l-r/ production by virtue of its contrast between single and geminate liquids in intervocalic position, whereas Japanese does not provide its speakers with such a model (see Figure 1).

	Korean	Japanese
English Stimuli	[p^hlei] [p^hrei]	[p^hlei] [p^hrei]
epenthesis/resyl.	ɯ ɯ	u u
Native modelling	[p^hɯllei][p^hɯɾei]	[p^huɾei][p^huɾei]

<Figure 1> Phonotactic constraints for English consonant clusters

However, the fact that neither language possesses liquid clusters will make production of the English /l-r/ contrast equally difficult for both language groups in this environment.

Hence, in calculating predicted difficulties of /l-r/ production by Korean and Japanese listeners in the three environments (see Table 2), I have weighted the effects of Phonotactic constraints less than the effects of absence of an appropriate L1 perceptual/productive model for the foreign sound contrast[2].

2) The weighting (0.5) for phonotactic constraints is arbitrary. However, provided it is less than the weighting assigned to the model effect (1), the predicted rank ordering of difficulties will not be affected.

<Table 2> The predicted difficulty of /l-r/ production

(key to added values)

+1 = no L1 perceptual/productive representations corresponding to English l/r

+0.5 = vowel epenthesis (= phonotactic constraints)

L1 background	Phonological environment			
	w.initial	ini.clu.	medial	Overall
	CV	CCV	VCV	Mean
Korean	1	0.5	0	0.5
Japanese	1	1.5	1	1.17

0 = least difficult → increasing number = increasing difficulty

Table 2 allows us to predict the Koreans' better performance in an overall sense, than that of the Japanese (0.5 vs. 1.17). Moreover, if we compare the predicted indices for the predicted ease of /l-r/ distinction between Korean and Japanese across individual phonological environments, we may be able to observe the gap between the two language speakers' performance in production of English /l/ and /r/. In cluster and medial positions the index differences are 1 and 1 respectively so that there will be strong perception differences here between Korean and Japanese speakers, whereas in word initial position, there will be no significant difference of performance of English /l-r/ production between the speakers of either language (the index difference: 0).

As a result, transfer effects, based on phonotactics constraints and L1 perceptual/productive models for foreign sounds yielded the following predictions:

(Between Language Groups)

1. Initial position: Kor = Jap
2. Cluster position: Kor > Jap
3. Medial position: Kor > Jap

Overall : Kor > Jap

(Within Language Group)

Korean: Medial > Cluster > Initial

Japanese: Initial = medial > Cluster.

4. Experiment

Unless there are special counter reasons, the production process of L2 learners for liquid consonants might exploit identical features which they use in the process of perception of /l/ and /r/. That is to say, the Korean and Japanese learners' production outcome of English liquids would mirror that of their perception.

To ascertain the /l-r/ perception difference between Korean and Japanese speakers of English (see Park & Ingram, 1995), the production test was designed and conducted. In this experiment there were three main aims. The first was the comparison of the influence of different native language backgrounds and language-universal effects. Second was the effects of experience in the L2 speaking environment for L2 learners. Third was the measurement of L2 learners' performances, in a different environment, for producing the target sounds, AE liquid consonants /l/ and /r/. The procedure of the experiments was designed in order to meet these aims.

4.1. Materials

Since, many scholars insist that the style of speech production strongly influences the L2 learners' performance of L2 pronunciation, three different styles of production of l/r sounds by Korean and Japanese speakers were selected in our experiment. Firstly, a word list reading test was conducted. This test might be regarded as a test in which the L2 learners should pay the strongest attention to their pronunciation rather than paying attention to the meaning of the words. The test words used in this test were identical to those which were used in Perception tests of Park & Ingram(1995).

Secondly, a sentence reading test, which had the target l/r content words in each sentence, was performed. Even though the word list reading test required much stronger attention to the target words, this test was still in line with strong attention required to the l/r content words.

Thirdly, a 'natural' sentence reading test was invented for the purpose of reducing the L2 learners' attention level to l/r content target words by selecting sentences which did have some l/r content words which, however, were not target words from the L2 learners' point of view.

In the word list reading test, thirty test words that have been used in Perception test (see Park & Ingram, 1995) were utilized (see Table 3).

<Table 3> Test words

initial	cluster	medial
read	broom	lorry
lead	bloom	lolly
row	fruit	mirror
low	flute	miller
rock	crime	correct
lock	climb	collect
right	pray	arrive
light	play	alive
red	grass	berry
led	glass	belly

The sentence reading test also included the test words used in the word list reading test. Several examples are shown in Table 4 (In the test, there were no underlines under the target words).

<Table 4> Test sentences

I was reading the book leading the people. (initial)
Climbing the mountain is the best way to blow away all the crimes. (cluster)
If your word is correct, I will collect a postage stamp. (medial)

The third 'natural' sentence reading test was conducted by forcing the subjects to read the test sentences where the target l/r containing words were not easily recognisable. A total of 40 l/r containing words (10 initial, 14 medial, 16 cluster) were examined. The number of words in each position was balanced, namely 5r/5l containing words in initial position, 7r/7l in medial, and 8r/8l in cluster. Several examples are presented in Table 5 (In the test, there were no underlines under the target words).

<Table 5> Test sentences (for 'natural' reading test)

An animal which is raised at home with a dog is a cat. (initial)
When I feel sleepy, I go to bed. (cluster)
Toothpaste is usually in a tube. (medial)

4.2. Procedure

The production test was conducted in a quiet room of the University of Queensland. The subjects were tested one at a time. Individual subjects were asked to read the test material aloud. The recording level was adjusted appropriately to meet each subject's voice level. The order of test material was 1) 'natural' sentence list, 2) sentence list, 3) word list. Each section (list) was printed on different pages for the purpose of collecting better test data. Also, there was a break time between sections 1) and 2).

In word list reading, the subjects repeated each word five times, and in sentence list reading (including 2) and 3)), they read the identical test sentence twice by which the examiners could discern the articulatory characteristics of the Korean and Japanese subjects with regard to l/r production.

When each subject read the test material, his/her voice was recorded to a cassette tape. A high quality microphone (Sony model ECM-30) and a portable cassette tape recorder (Marantz model CP230) were utilized for recording. The total required time of the production test for one subject was approximately 10 minutes.

4.3. The subjects

The number of subjects were 20. A total of four groups, Korean Experienced (KE), Korean Inexperienced (KI), Japanese Experienced (JE), and Japanese Inexperienced (JI), participated in the Production test. Each group consisted of 5 members (see Table 6).

The subjects belonging to the Experienced groups (KE, JE) were mostly lecturers teaching Korean or Japanese at the University of Queensland and Griffith University, two workers for companies, and one postgraduate student. They had lived for more than 5 years in Australia at the time of the test and their daily basis of primarily used language was English. Their age range fell mostly in their 30s and 40s except for two subjects who were in their 20s. On the other hand, the inexperienced members of the other two groups (KI, JI) were all students studying English (Elicos students) for the purpose of entering regular undergraduate or postgraduate courses at the University of Queensland. At the time of the test, their residential period in Australia was less than one year. Although, they had to use English in their regular classes, they seemed to use their L1 (Korean or Japanese) amongst themselves after school. Also, most of the subjects responded to a question on the questionnaire that their primarily used language was their L1.

<Table 6> Subject groups and description

Group	Description	Age	No	Sex	Occupation	English experience
KI	Korean: Less English Exp.	24-28 X=26	4 1	M F	University students	Less than 1 year in English envir.
KE	Korean: More English Exp.	25-38 X=32	4 1	M F	3 Teachers 2 Businessmen	More than 5 years in English envir.
JI	Japanese: Less English Exp.	21-23 X=22	1 4	M F	University students	Less than 1 year in English envir.
JE	Japanese: More English Exp.	33-44 X=38	1 4	M F	Teachers of Japanese	More than 5 years in English envir.

4.4. Analysis

The recorded data on the cassette tapes of the 20 subjects were later replayed and narrowly transcribed (phonetic level) by the author and an Australian phonetician, separately. The transcriptions of each examiner were compared and the discrepant parts were re-transcribed by the two and determined after the recomparison of their transcription.

The finally determined transcribed data were typed onto the PC and saved in the form of ASCII computer files. These computer files were analysed by statistical programs, State view and S-plus.

4.5. Results and discussion

Before going into the results, presenting the agreement rate of l/r transcription between the two investigators would provide quite helpful information to the readers.

In Table 7, Korean Groups' l/r production was highly agreed by the two transcribers, while Japanese groups' l/r production marked a lower agreement rate between the two investigators' transcription. The reason for lower agreement on the Japanese groups' l/r production was in the obscure production of /l/ or /r/ by the Japanese groups. The two investigators faced a number of in-explicit l/r tokens from the l/r production of the Japanese groups, when they transcribed these tokens. This outcome seems to be related to the status of liquid in their L1. They have only one

liquid phoneme which is not close to either English /l/ or /r/ (Best, 1994). When the two investigators faced these obscure tokens, the discrepancy of transcription appeared.

<Table 7> The agreement rate of l/r transcription between the two investigators ([ɹ][3] and [ɾ] were calculated as a phoneme /r/)

	S1	S2	S3	S4	S5
KE 98 %	100	100	97.5	92.5	100
	S6	S7	S8	S9	S10
KI 95.1 %	95	100	86	94.3	100
	S11	S12	S13	S14	S15
JE 92.7 %	92.5	98.3	78.6	98	96
	S16	S17	S18	S19	S20
JI 84.3 %	75	88	100	94.3	64.4

Taking individual subjects into account, the accuracy of l/r production of each subject and the agreement rate between the two investigators were in direct proportion. That is to say, if one subject performed quite satisfactorily in l/r production, the agreement rate was also high, on the other hand, if one subject recorded lower accuracy in their l/r production, the agreement rate was also low. This result might be interpreted that if L2 learners well know how to distinguish and produce English /l/ and /r/, their production of /l/ and /r/ would be quite explicit and distinguishable, but if L2 learners do not possess any clear cues to distinguish English /l/ and /r/, their production of /l/ and /r/ would be in-explicit and obscure. Bearing this in mind, let us turn to the results of l/r production by Korean and Japanese speakers of English.

4.5.1. Phonetic level

In the previous section (2.), it was claimed that, even though there is only one phoneme 'ㄹ', phonemicised /l/, as a liquid sound, a flap [ɾ] and an alveolar lateral

3) Symbol [ɹ] represents retroflexed or bunched approximant. Since retroflexed [ɹ] and flap [ɾ] are both allophones of phoneme /r/ in Australian English, I will calculate these two phones as the phoneme /r/ in phonemic level.

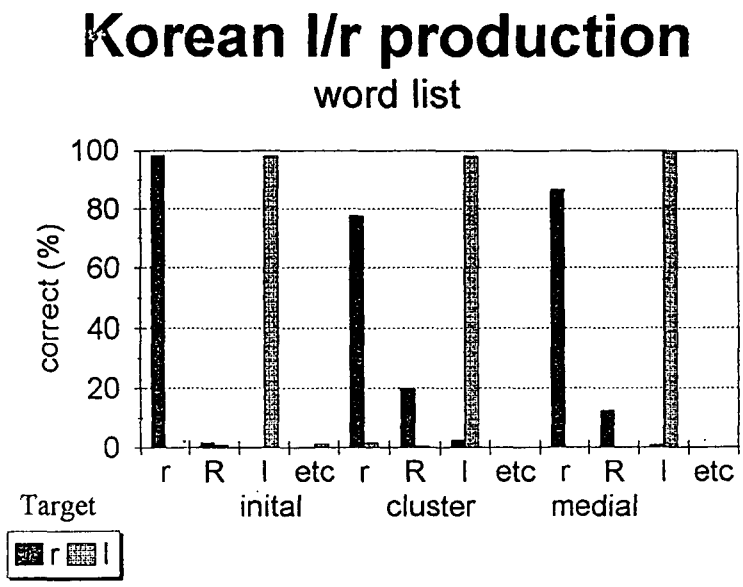
[l] are two clear allophones of a phoneme /l/ in Korean and that they are in complementary distribution. Also, it was asserted that when the Koreans hear English /r/, they convert it into the [ɾ], the perceptual representation of /r/ in their native language, and English /l/ into [ll], the perceptual representation of /l/, in medial and consonant cluster positions, in which re-syllabification by vowel epenthesis occurs in advance.

In line with the cases of perception, the classification of production selected the division of [ɹ] and [ɾ] sounds for the /r/ phoneme, since the possibility of production of flap [ɾ] as a Korean counterpart of the English /r/ phoneme in substitution for the retroflex or bunched [ɹ] strongly existed.

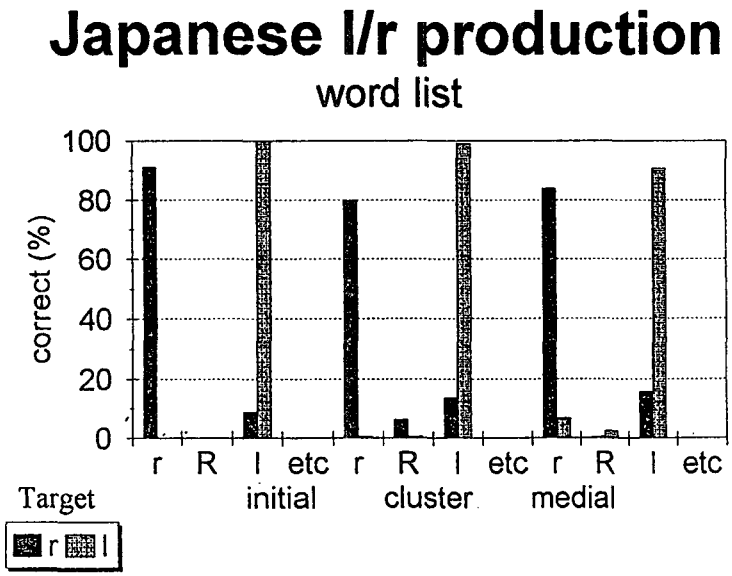
Japanese liquid, usually phonemicised /r/, was described to have a range of phonetic variants from a slightly retroflexed lateral approximant to an alveolar tap or flap. Therefore, as in the case of Korean subjects, Japanese subjects might produce [ɹ], [ɾ] and [l] depending upon different speakers and conditions.

On the whole, the l/r production result of Korean and Japanese speakers of English were arranged based on three different phones [ɹ], [ɾ], and [l] at phonetic level.

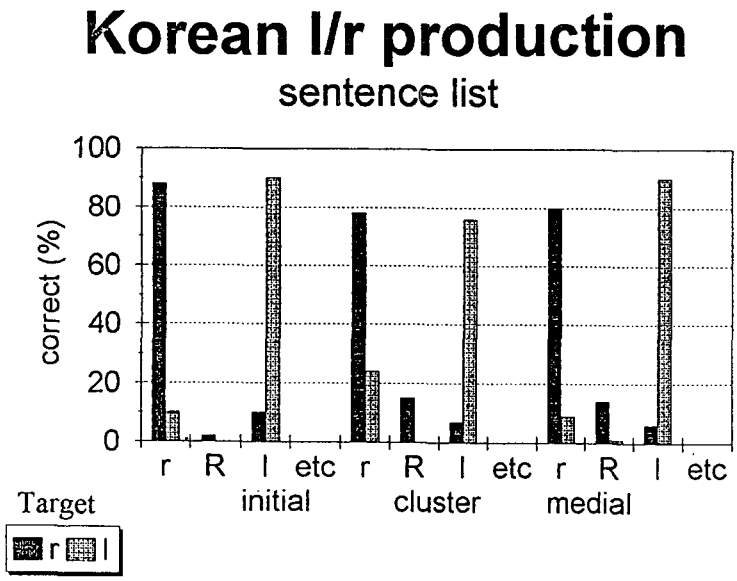
The transcription result of l/r production is in Figures 2 to 7.



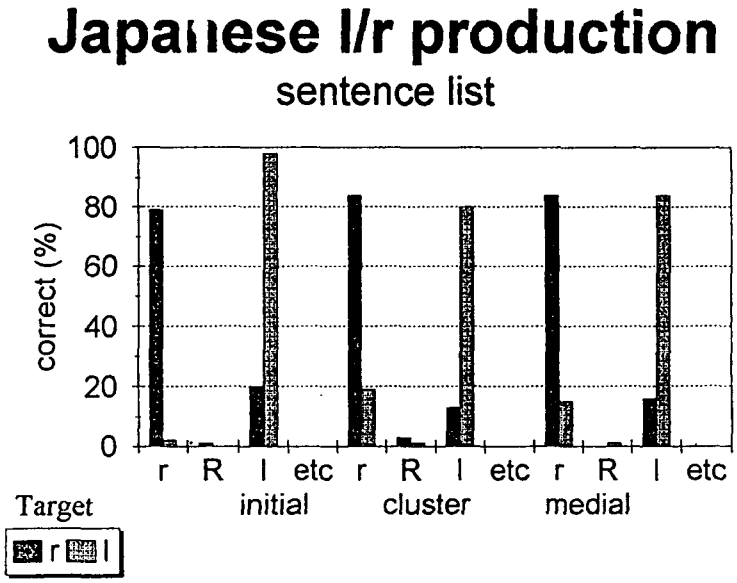
<Figure 2> Korean production (Word List)



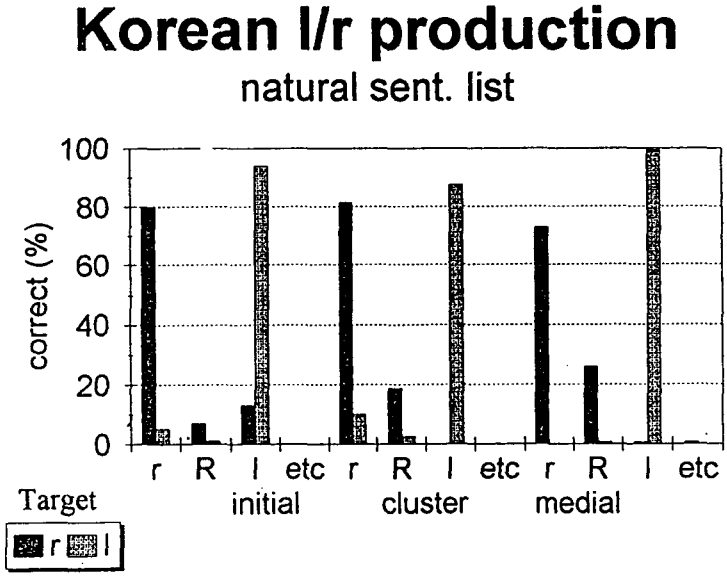
<Figure 3> Japanese production (Word List)



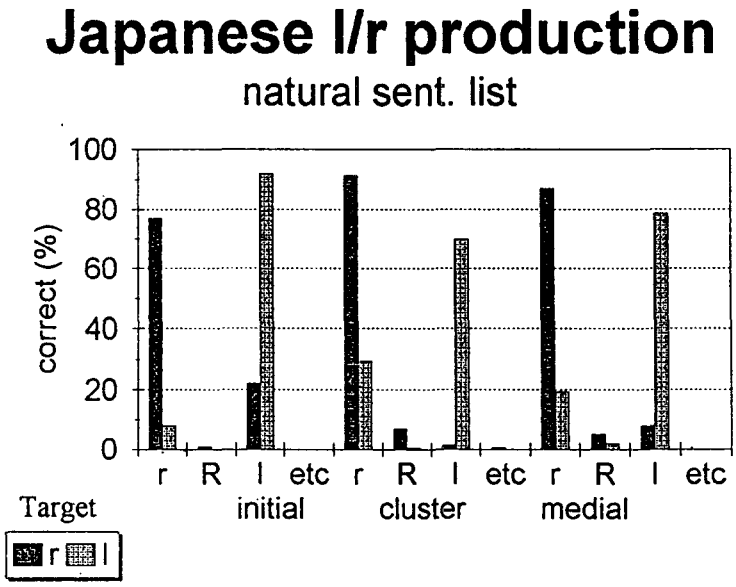
<Figure 4> Korean production (Sentence List)



<Figure 5> Japanese production (Sentence List)



<Figure 6> Korean production (Natural Sentence List)



<Figure 7> Japanese production (Natural Sentence List)

◉ The frequency of [ɾ]

Through all the three tests, the frequency of [ɾ] occurrence was higher in the case of Korean subjects than that of Japanese subjects. This fact might be interpreted that Korean speakers used flap [ɾ] as the substitution sound of retroflex [ɹ] more frequently than Japanese speakers. This result seems also to reflect the Korean phonological situation in that Korean phonology possesses [ɾ] as the designated counterpart of the phoneme /ɾ/. On the other hand, Japanese speakers' reduced frequency of the production of flap [ɾ] sound, regardless of the existence of this sound as a phonetic variant, appears to demonstrate that if a sound, such as [ɾ], is not a designated counterpart of an L2 sound, such as English /ɹ/, this sound is unlikely to be used frequently as a substitution for the corresponding L2 sound.

◉ The consideration of position

Both the Korean and Japanese subjects produced flap [ɾ] less frequently in initial position. At this position, Korean speakers as well as Japanese do not have any clear distinguishable counterpart over AE l/r phonemes. This might be the main reason for

the rare occurrence of flap [ɾ] in the performance of Korean subjects at this position.

Considering cluster and medial positions, Korean subjects demonstrated a relatively high percentage of [ɾ] production in all three tests while Japanese subjects showed the highest percentage of flap [ɾ] production at cluster position throughout the three tests. The high percentage of [ɾ] production of Korean subjects at cluster and medial positions may be attributable to the existence of [ɾ] as a counterpart of English /r/ in their L1.

In addition, there seems to be another language-universal reason that the /r/ phoneme immediately after a consonant in a consonant cluster is apt to be pronounced as flap [ɾ] since the articulation of the preceding consonant is likely to create a difficult condition[4] for L2 learners to articulate the retroflex or bunched [ɹ]. The high percentage of flap [ɾ] production of Japanese subjects at this position supports this interpretation.

As described above, the flap [ɾ] of Korean is a definite counterpart of the English central approximant /r/ phoneme and one of several phonetic variants of the Japanese liquid, phonemicised /ɾ/. Hence, the exemplars of flap [ɾ] in the Production test can be combined into phoneme /r/ at the phonological (phonemic) level. The combined calculation of [ɾ] and [ɹ] production exemplars as members of the phoneme /r/ would provide a much clearer figure of l/r distinction of Korean and Japanese subjects at the broadly classified phonological level.

4.5.2. Phonological (phonemic) level

◉ Overall

The production data were analysed in a five factor ANOVA (Analysis of Variance). The independent variables were 1) the language background of the speakers (Kor or Jap), 2) speaker's experience in an English speaking environment (namely in Australia), 3) the phonological environment (initial, cluster, medial), 4) the type of liquid (/l/ or /r/), and 5) the different test types (word, sentence, natural sentence). Also there was one dependent or response variable, the percentage of correctly

4) Amongst several consonant cluster combinations, 'br' (broom) and 'gr' (grass, group) cluster showed high frequency of [ɾ] occurence from both the Korean and Japanese groups' production results. This fact seems to cast a possibility of the existence of an easiness hierarchy for producing retroflex or bunched [ɹ]. These two combinations, if there is a hierarchy, would belong to the difficult combination to produce retroflex or bunched [ɹ].

produced tokens. Table 8 shows the summary of the ANOVA of the /l-r/ production data of Korean and Japanese subjects.

As in the Perception test (Park & Ingram, 1995), language dependent phonological transfer effects will be revealed in main and interaction effects involving the Language factor (La), such as 'La * Po' or 'La * Tp', in the ANOVA.

On the other hand, effects which operate at the language-independent phonetic level, namely at the level of articulation of phonetic features, will be reflected in main and interaction effects involving 1) Type of liquid (/l/ or /r/) and 2) Position (initial, medial, cluster), excluding interactions with La factor.

As an important factor, which was previously commented on, the influence of different type of tests in relation to the subjects' attention to their /l-r/ production will be reflected in main and interaction of Context (Cont) factor.

Finally, the influence of experience in L2 speaking environment for /l-r/ production will be reflected in main and interaction effects involving the experience (Exp) factor. This can be regarded as the one which is related to L2 learners' improvability of L2 sound production.

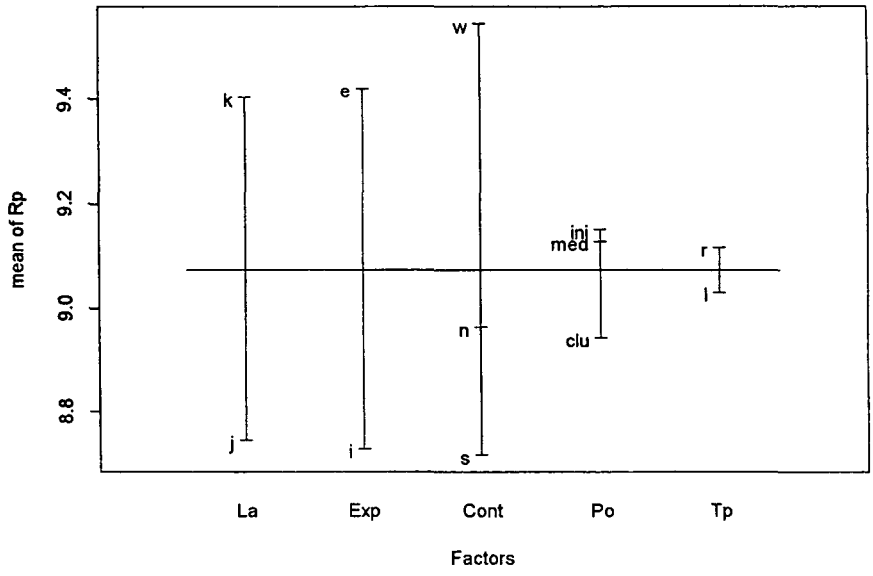
<Table 8> Production of /l/ and /r/ : Overall Analysis of Variance

Factor (Interaction)		F-ratio	P
La	Language background: Kor. or Jap.	12.68	.00043*
Exp	Experience in Eng. Speaking Env.	14.04	.00021*
Cont	Type of test : Word, Sent, Nat.Sent.	7.01	.00106*
Po	Position: Ini., Clu., Med.	0.51	.59906
Tp	Type of liquid: /l/ or /r/	0.22	.63989
Po * Tp		6.42	.00187*
Cont * Po * Tp		2.48	.04398*

Table 8 shows that La ($p<.001$), Exp ($p<.001$), Cont ($p<.01$), Po * Tp ($p<.01$), and Cont * Po * Tp ($p<.05$) are significant. Considering that Language background (La) factor is related to language dependent phonological transfer effects and that Position (Po) and Type of liquid (Tp) factors have something to do with language independent phonetic features, it should be claimed that both language dependent and language independent factors influenced Korean and Japanese speakers of English in their production of English /l/ and /r/ phonemes in the test.

On the other hand, Context (Cont) factor reflects the effects of differential test styles. Since this factor was significant, it can be said that the three different test styles caused different performance results of the subjects in each test.

Finally, as reported in Pisoni et al. (1994) and Nakauchi (1993) for /l-r/ perception by Japanese listeners and in Park & Ingram (1996) and Ingram & Park (1996) for AE vowel acquisition by Korean and Japanese learners, the improvability of L2 learners for L2 production along with their accumulation of L2 speaking experience was proved with the significant result of the Experience factor.



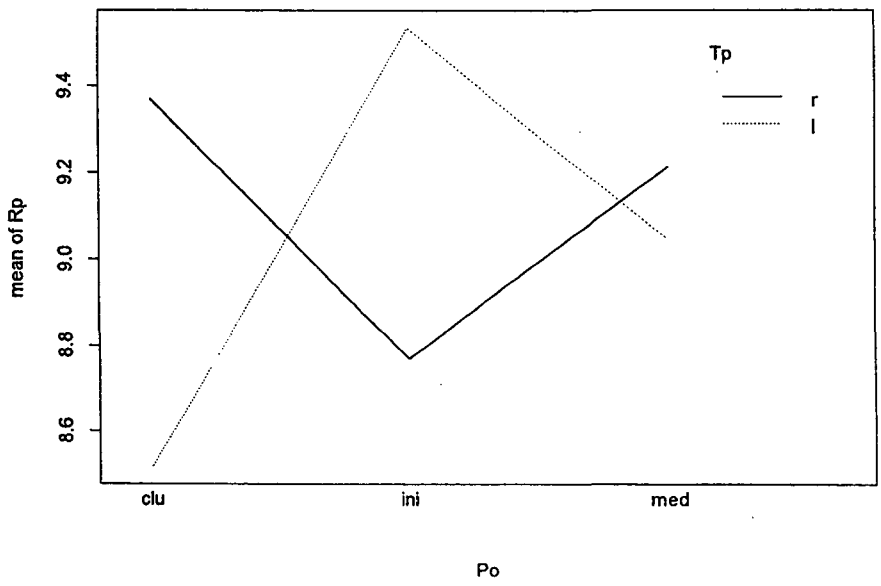
<Figure 8> Mean of responses over several factors (Overall)

Figure 8 demonstrates the differences of La, Exp and Cont factors. First of all, Korean subjects (94 %) better produced /l-r/ than Japanese subjects (87.5 %). This result is consistent with the /l-r/ perception experiment result.

The difference between experienced and inexperienced subjects was also clear. While the experienced subjects produced almost 94 % of accurate tokens, the inexperienced subjects only produced around 87 % of accurate tokens.

The order of difficulties in terms of different test types is interesting in that the natural sentence reading test (more natural test) produced higher accuracy (89.5 %) than the sentence reading test (87 %) which demands more attention to l/r content

words. This result contradicts the prediction of many scholars that the test which elicits more attention to target sounds will produce higher accuracy on the sounds in question. The factor that the sentence list test contained several l/r words (specifically minimal pairs) in a sentence might have caused more difficulties to L2 learners, since L2 learners, who did not retain the firm productive representation of English /l/ and /r/, must have been confused in selecting the correct productive mechanism for the liquids /l/ and /r/ contained in l/r content words with very short interval in a sentence. In the natural sentence list test, this kind of difficulty was almost removed. However, the word list reading test, as with the normal prediction, elicited highly accurate /l-r/ production (95.5 %).



<Figure 9> Tp * Po interaction

Figure 9 represents the interaction between Type of liquid (Tp) and Position of liquid in a word (Po). In cluster position, /r/ production (94 %) produced a much higher accuracy than /l/ production (85 %). On the contrary, initial /l/ was more accurately (95 %) produced than initial /r/ (87.5 %). Along with this outcome, it must be claimed that in initial position /l/ production is easier than /r/ production, while /r/ production is easier than /l/ production in cluster position. The cause of this result might be as follows: In initial position, /l/ articulation, which has a contacting point

around the alveolar ridge, would be easier than /ɾ/ articulation, for which a speaker has to curl up his/her tongue tip or make a bunch of the tongue body. On the other hand, in cluster position, after a contact between an upper articulator and a lower articulator (in particular alveolar ridge and tongue blade for making alveolar sounds /d, t/)[5] another contact between both articulators for making the /l/ sound would be difficult. However, /ɾ/ articulation would be relatively easy in this situation. Since both trends are not associated with the 'La' factor, they can be treated as language independent tendencies.

Since the Context ($p<.01$) factor was significant, the author intends to divide the analysis into three different test types in order to investigate the detailed differences amongst them.

◉ Word list

As expected, of the three different tests, the subjects recorded the best performance in this test. As can be seen in Table 10, La ($p<.01$), Tp ($p<.05$), and La * Tp ($p<.05$) were significant. Both Korean groups (Experienced, Inexperienced) performed extremely well (ceiling effect) at all three positions (KE: 99.6 % (initial), 97.6 % (cluster), 99.6 % (medial); KI: 98.4 % (initial), 98 % (cluster), 99.6 % (medial)) (see Table 9 & Figure 10). The outcome of Korean speakers seems to demonstrate the fact that they can satisfactorily articulate the /l/ and /r/ targets used in English with more attention to their articulation mechanism regardless of the period of exposure to an English-speaking environment. On the other hand, Japanese subjects showed a lot lower accuracy (JE: 92.4 % (initial), 96 % (cluster), 92 % (medial); JI: 98.8 % (initial), 89.6 % (cluster), 83.2 % (medial)) than Korean subjects (see Table 9). This result is consistent with the outcome of the Perception test for Korean and Japanese subjects.

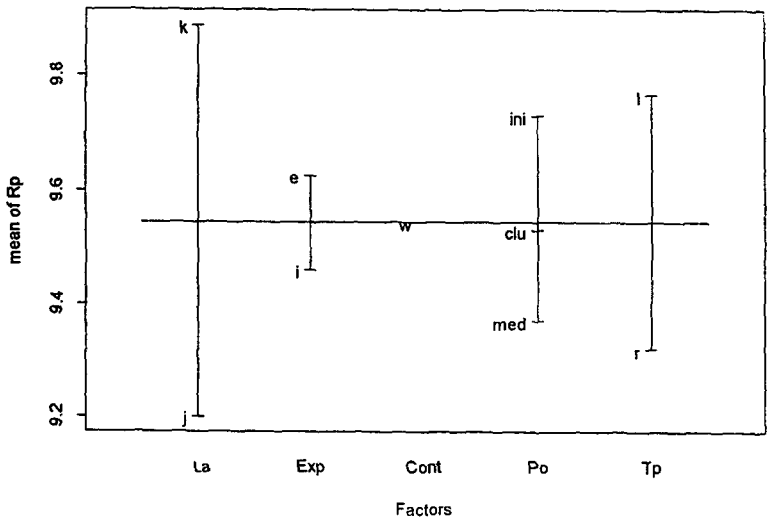
5) In English, /tl/ and /dl/ combinations are not present. This seems to be evidence that the successive articulation of an alveolar obstruent and a lateral approximant is language independently difficult.

<Table 9> Production Accuracy in the Word List test

	KE		KI		Total		JE		JI		Total	
(R)	r	l	r	l	r	l	r	l	r	l	r	l
(T)initial												
r(%)	100		100		100		84.8	15.2	97.6	2.4	91.2	8.8
l(%)	0.8	99.2	0.8	96.8	0.8	98	100		100		100	
Mean	99.6		98.4		99		92.4		98.8		95.6	
cluster												
r	95.2	4.8	100		97.6	2.4	92.8	7.2	80	20	86.4	13.6
l	100		4	96	2	98	0.8	99.2	0.8	99.2	0.8	99.2
Mean	97.6		98		97.8		96		89.6		92.8	
medial												
r	99.2	0.8	99.2	0.8	99.2	0.8	89.6	10.4	79.2	20.8	84.4	15.6
l	100		100		100		5.6	94.4	12.8	87.2	9.2	90.8
Mean	99.6		99.6		99.6		92		83.2		87.6	

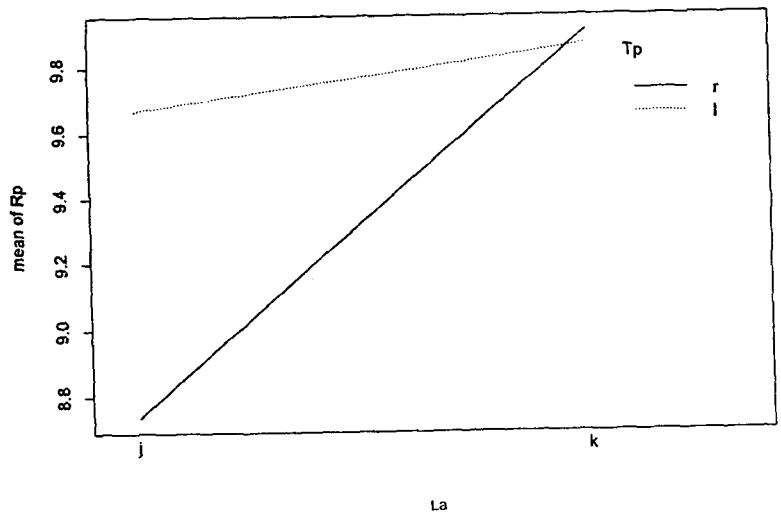
<Table 10> Production of /l/ and /r/ : word list
Analysis of Variance

Factor (Interaction)	F-ratio	P
La Language background: Kor. or Jap.	9.33	.00292*
Exp Experience in Eng. Speaking Env.	0.55	.46025
Po Position: Ini., Clu., Med.	0.86	.42707
Tp Type of liquid: /l/ or /r/	3.95	.04977*
La * Exp	0.32	.57443
La * Po	1.45	.23979
Exp * Po	0.94	.39309
La * Tp	4.69	.03287*
Exp * Tp	0.07	.79011
Po * Tp	0.23	.79881
La * Exp * Po	1.28	.28258
La * Exp * Tp	0.25	.61530
La * Po * Tp	0.18	.83311
Exp * Po * Tp	0.50	.60414
La * Exp * Po * Tp	1.07	.34724



<Figure 10> Mean of responses over several factors (Word List)

With respect to Tp factor (see Figure 11), while Korean subjects did not yield any difference between /l/ and /r/ production due to the ceiling effects, both Japanese groups (JE, JI) consistently produced a more accurate /l/ target in all three positions. This seems to demonstrate that Japanese speakers produce the /l/ liquid more often for English /l/ and /r/ when strong attention is paid to them as in the word list reading test.



<Figure 11> La * Tp interaction

◉ Sentence list

The sentence list reading test requires less attention to the target sounds from the subjects than the word list reading test. As a result of that, compared to the results of the word list test, the outcome of the sentence list presented much lower scores by both Korean and Japanese subjects (see Table 11 & Figure 12).

Table 12 shows that only one factor (Exp) is significant ($p<.01$). This appears to show that the Experience factor is a crucial one to distinguish /r/ and /l/ production (KE, JE > KI, JI). Considering that this test requires less attention than the word list test, the inexperienced subjects' worse performance is likely to be interpreted that their /l-r/ articulation mechanism is not solid and is less stable in that their less attention for /l-r/ targets caused low accuracy of production of /l-r/ content words. On the other hand, the experienced subjects are likely to have already acquired a solid articulation mechanism for /l/ and /r/.

Even though significance is marginal ($p \fallingdotseq 0.07$), Po * Tp (see Figure 13) interaction showed a similar pattern to that found in Po * Tp interaction in the overall analysis. This seems to demonstrate that, along with less attention to the target sounds, language-universal tendency, which was accounted for in the overall analysis section, appears.

<table11> Production Accuracy in the Word Sentence List test

	KE		KI		Total		JE		JI		Total	
(T)initial												
(R)	r	l	r	l	r	l	r	l	r	l	r	l
r	98	2	82	18	90	10	84	16	76	24	80	20
l	8	92	12	88	10	90	100		4	96	2	98
Mean	95		85		90		92		86		89	
cluster												
r	94	6	92	8	93	7	92	8	82	18	87	13
l	14	86	34	66	24	76	8	92	32	68	20	80
Mean	90		79		84.5		92		75		83.5	
med												
r	100		88	12	94	6	90	10	78	22	84	16
l	4	96	16	84	10	90	14	86	18	82	16	84
Mean	98		86		92		88		80		84	

◉ Natural sentence list

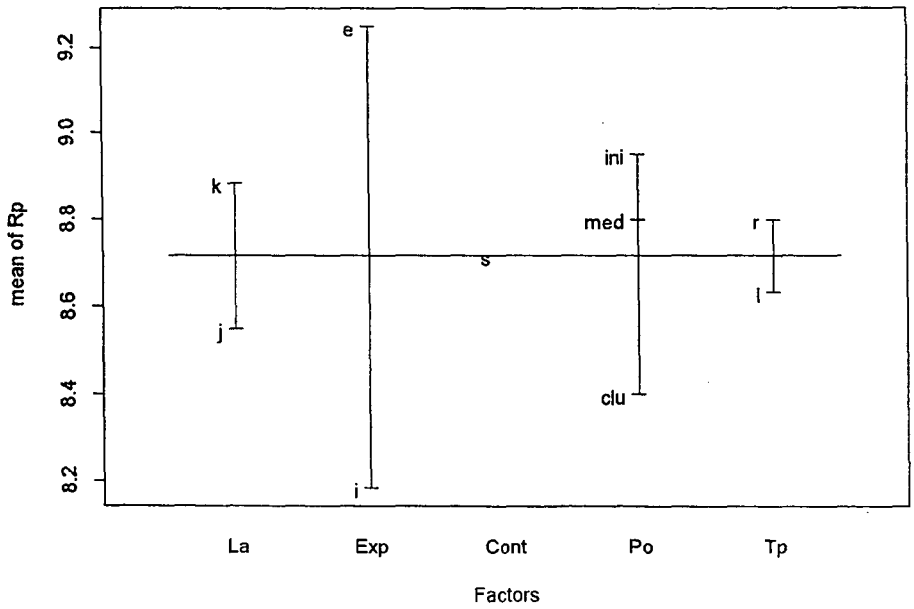
The outcome of this test must have reflected the ordinary pronunciation pattern of l/r for Korean and Japanese speakers (see Table 13 and Figure 14 for detailed results). Thus, it might be claimed that the difference amongst the four groups in this test would be more reliable.

From Table 14, La ($p<.01$), Exp ($p<.05$), and Po * Tp ($p<.01$) factors were significant. With respect to La factor, as in the word list test, Korean subjects (initial : 90.5 %, cluster : 93.75 %, medial : 98.93 %) performed better than Japanese subjects (initial : 85 %, cluster : 84.07 %, medial : 85.36 %). The Experience factor was also significant as was demonstrated in the sentence list test. The performance of experienced groups was better than inexperienced groups (KE > KI, JE > JI).

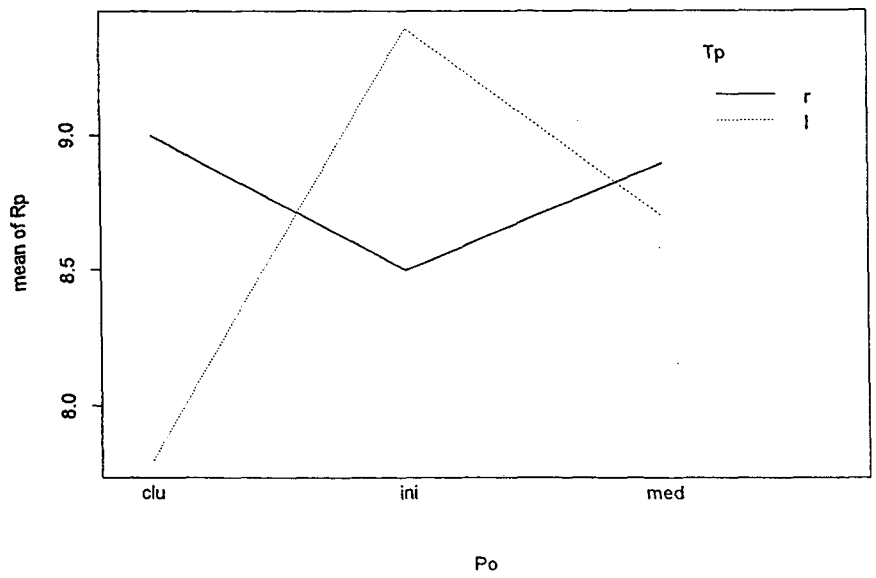
Po * Tp interaction (see Figure 15) revealed a similar pattern to that which was found overall and in the sentence list reading test. Namely, there was a lower accuracy of /l/ in cluster position and a lower accuracy of /r/ in initial position. Thus, as already pointed out, in the more natural situation with the speaker's reduced attention to his/her pronunciation outcome, language-universal factors seem to become more active.

<Table 12> Production of /l/ and /r/ : sentence list Analysis of Variance

Factor (Interaction)	F-ratio	P
La Language background: Kor or Jap	0.82	.36754
Exp Experience in Eng. Speaking Env.	8.39	.00466*
Po Position: Ini., Clu., Med.	0.79	.45449
Tp Type of liquid: /l/ or /r/	0.20	.65180
La * Exp	0.01	.92805
La * Po	0.40	.67034
Exp * Po	0.23	.79536
La * Tp	2.10	.15072
Exp * Tp	0.03	.85669
Po * Tp	2.71	.07142(marg.)
La * Exp * Po	0.20	.81507
La * Exp * Tp	0.01	.92805
La * Po * Tp	0.30	.73910
Exp * Po * Tp	1.02	.36576
La * Exp * Po * Tp	0.11	.89903



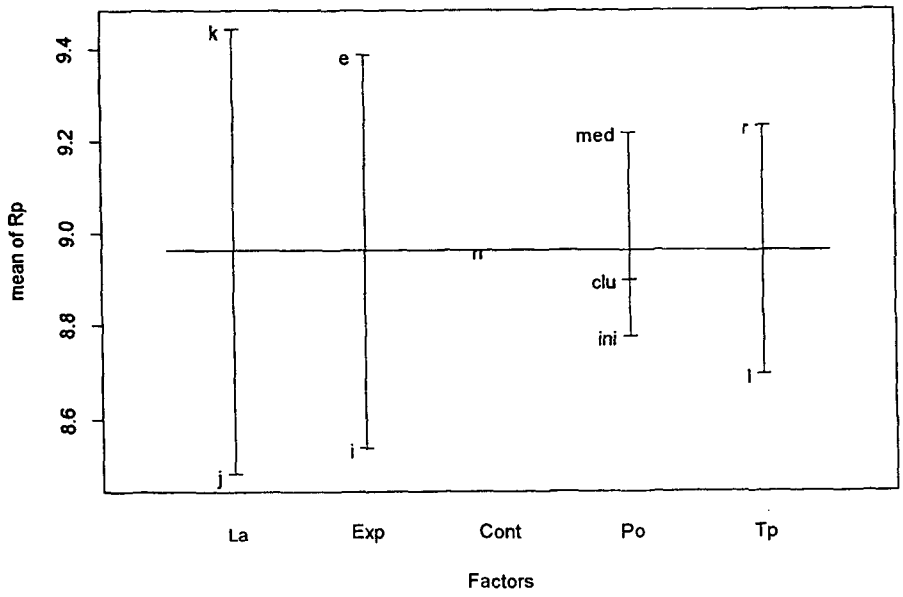
<Figure 12> Mean of responses over several factors (Sentence List)



<Figure 13> Po * Tp interaction

<table13> Production Accuracy in the National Sentence List test

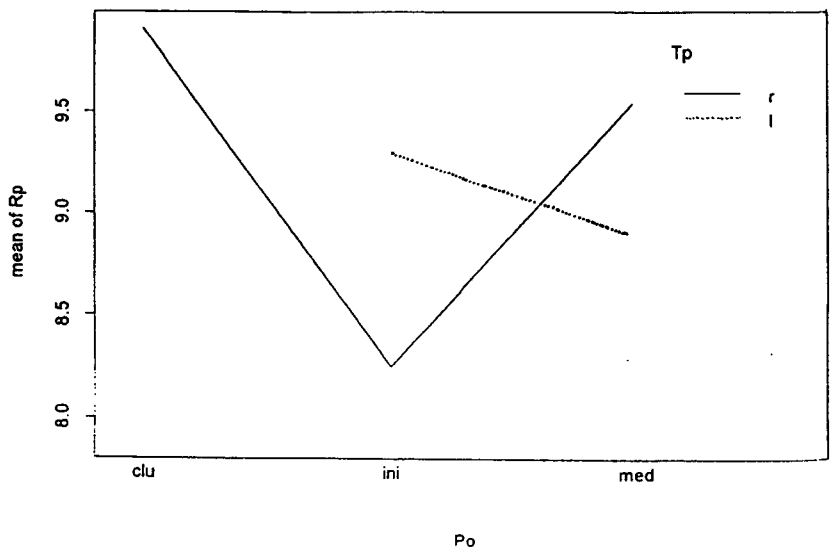
	KE		KI		Total		JE		JI		Total	
(T)initial												
(R)	r	l	r	l	r	l	r	l	r	l	r	l
r	98	2	76	24	87	13	88	12	68	32	78	22
l	6	94	6	94	6	94	100		16	84	8	92
Mean	96		85		90.5		94		76		85	
cluster												
r	100		100		100		100		96.25	2.5	98.13	1.25
l	5	95	20	80	12.5	87.5	17.5	82.5	42.5	57.5	30	70
Mean	97.5		90		93.75		91.25		76.88		84.07	
med												
r	98.57		98.57	1.43	98.57	0.71	90	10	94.29	5.71	92.14	7.86
l	100		1.43	98.57	0.71	99.29	20	80	22.86	77.14	21.43	78.57
Mean	99.29		98.57		98.93		85		85.72		85.36	



<Figure 14> Mean of responses over several factors (Nat. Sent. List)

<Table 14> Production of /l/ and /r/ : natural sentence list
Analysis of Variance

Factor (Interaction)		F-ratio	P
La	Language background: Kor or Jap	7.49	.00737*
Exp	Experience in Eng. Speaking Env.	5.87	.01727*
Po	Position: Ini., Clu., Med.	0.57	.56743
Tp	Type of liquid: /l/ or /r/	2.39	.12556
La * Exp		0.36	.54929
La * Po		0.44	.64381
Exp * Po		1.54	.21937
La * Tp		1.20	.27540
Exp * Tp		0.19	.66180
Po * Tp		6.48	.00230*
La * Exp * Po		0.15	.85676
La * Exp * Tp		0.51	.47609
La * Po * Tp		1.10	.33561
Exp * Po * Tp		1.66	.19638
La * Exp * Po * Tp		0.08	.92087



<Figure 15> Po * Tp interaction

◉ Individual subjects

One way ANOVA reveals that Subject factor was significant (F-ratio=17.22, p<.0001). For detailed analysis, Tables 15 and 16 were prepared.

The broad trend was that the experienced subjects outperformed the inexperienced subjects in both the Korean and Japanese groups (KE:KI 97.72%:93.59%, JE:JI 91.86%:85.45%). However, it was revealed that the difference of articulatory ability of respective subjects played an important role in achievement of the l/r target in production, regardless of their resident period in a L2 speaking community (Australia). In the case of the Korean

subjects, S4, who belonged to the KE Group, marked 88.97% accuracy lower than the mean of the KI Group (93.59%) while S7 (KI Group member)'s accuracy (99.31%) was higher than the mean of the KE Group (97.72%). This situation also occurred for the Japanese subjects. S13 (JE Group member) correctly produced English l/r liquids only 71.72 % which was lower than the mean of the JI Group (85.45%). Alternately, two JI Group members S18(98.62%) and S19 (97.59%) achieved a much higher accuracy than the mean of the JE subjects (91.86%).

This outcome seems to demonstrate that not only the experience factor but also individual ability must be considered in measuring the L2 learners' perceptual and productive ability of L2 sounds.

5. General discussion

Through the /l-r/ production experiments for Korean and Japanese subjects, it was proved that, as in the /l-r/ perception, not only language dependent factor (prior phonological learning of the L1) but also language independent (Speaker, Position, Type) and individual (Subject) factors were affective in Korean and Japanese subjects' /l-r/ production as reported in AE vowel acquisition.

In the perception area of /l-r/ sounds, Gillette (1980), and Lively et al. (1993) reported the efficiency of concentrated training of English /l/ and /r/ in the most difficult phonological environments. This can be interpreted that with more contact time, the L2 learners can identify /l/ and /r/ sounds satisfactorily. In the l/r production experiment, the importance of contact time to L2 sounds was proved by a positive result of the Experience factor. Although the experiment designed by the authors did not include a training factor for the subjects, the better result of experienced subjects

in the test seems to support the importance of training in an indirect way. Pedagogically, this connotes the strong possibility that the training of l/r production and perception for L2 learners who do not possess l/r distinction in their L1s, such as the Koreans and the Japanese, will improve their ability to produce and perceive these two sounds.

<table 15> Analysis of Variance : Korean subjects

		S1	S2	S3	S4	S5	total	S6	S7	S8	S9	S10	total
word(/25)													
ini	r	25	25	25	25	25		25	25	25	25	25	
	l	25	25	25	24	25		24	25	22	25	25	
clu	r	25	25	25	19	25		25	25	25	25	25	
	l	25	25	25	25	25		24	25	21	25	25	
med	r	25	25	25	25	25		25	25	25	25	24	
	l	25	25	25	25	25		25	25	25	25	25	
S.total		150	150	150	143	150	743	148	150	143	150	149	740
(%)		100	100	100	95.33	100	99.07	98.67	100	95.33	100	99.33	98.67
Sent.(/10)													
ini	r	10	9	10	10	10		9	10	8	6	8	
	l	10	10	10	6	10		7	10	10	8	9	
clu	r	10	10	10	7	10		8	10	10	10	8	
	l	10	10	10	3	10		8	10	5	1	9	
med	r	10	10	10	10	10		7	10	10	9	8	
	l	10	10	10	8	10		10	10	7	5	10	
S.total		60	59	60	44	60	283	49	60	50	39	50	250
(%)		100	98.33	100	73.33	100	94.33	81.67	100	83.33	65	86.67	83.33
Nat.													
ini	r	10	10	10	9	10		10	10	10	3	5	
(/10)	l	10	10	10	7	10		9	10	10	8	10	
clu	r	16	16	16	16	16		16	16	16	16	16	
(/16)	l	16	16	16	12	16		15	14	11	9	15	
med	r	14	14	14	13	14		13	14	14	14	14	
(/14)	l	14	14	14	14	14		14	14	14	13	14	
S.total		80	80	80	71	80	391	77	78	75	63	74	367
(%)		100	100	100	88.75	100	97.75	96.25	97.5	93.75	78.75	92.5	91.75
Total		290	289	290	258	290	1417	274	288	268	252	275	1357
(%)		100	99.66	100	88.97	100	**97.72**	94.48	99.31	92.41	86.9	94.83	**93.59**

<table 16> Analysis of Variance : Japanese subjects

		S11	S12	S13	S14	S15		S16	S17	S18	S19	S20	total
word(/25)													
ini	r	25	25	6	25	25		25	22	25	25	25	
	l	25	25	25	25	25		25	25	25	25	25	
clu	r	25	25	16	25	25		11	25	25	25	14	
	l	24	25	25	25	25		25	25	25	25	24	
med	r	24	24	14	25	25		9	17	25	25	23	
	l	25	25	22	24	22		22	21	25	22	19	
S.total		148	149	108	149	147	701	117	135	150	147	130	679
(%)		98.67	99.33	72	99.33	98	93.47	78	90	100	98	86.67	90.53
Sent.(/10)													
ini	r	10	10	4	9	9		6	5	10	8	9	
	l	10	10	10	10	10		10	9	10	10	9	
clu	r	9	10	7	10	10		5	7	10	10	9	
	l	8	10	8	10	10		1	7	10	10	6	
med	r	10	10	5	10	10		2	7	10	10	10	
	l	8	10	9	8	8		10	4	8	10	9	
S.total		55	60	43	57	57	272	34	39	58	58	52	241
(%)		91.67	100	71.67	95	95	90.67	56.67	65	96.67	96.67	86.67	80.33
Nat.													
ini	r	10	10	4	10	10		0	5	10	10	9	
(/10)	l	10	10	10	10	10		10	6	10	8	8	
clu	r	16	16	16	16	16		15	14	16	16	16	
(/16)	l	11	16	7	16	16		0	3	14	16	13	
med	r	13	12	14	12	12		10	14	14	14	14	
(/14)	l	10	14	6	14	12		6	9	14	14	11	
S.total		70	78	57	78	76	359	41	51	78	78	71	319
(%)		87.5	97.5	71.25	97.5	95	89.75	51.25	63.75	97.5	97.5	88.75	79.75
Total		273	287	208	284	280	1332	192	225	286	283	253	1239
(%)		94.14	98.97	71.72	97.93	96.55	**91.86**	66.21	77.59	98.62	97.59	87.24	**85.45**

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