

A STUDY OF ENGLISH PHONOLOGY LEARNING : A CROSS-SECTIONAL STUDY IN THE JAPANESE SETTINGS

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Summary

The aim of this study was to describe and explain the process of the learning of English phonology by Japanese learners who are learning English in the Japanese formal education settings. To fulfill this goal, we designed a cross-sectional experiment involving 3 variables: linguistic features, time and degree of attentiveness. The findings are as follows:

- (1) The learners developed various kinds of interlanguage performance rules as a transitional strategy, which included not only L₁-based but also more advanced transitional rules.
- (2) The improvement of pronunciation over time was accounted for in terms of 'wave theory'.
- (3) The effect of the time factor on performance was found to be strong.
- (4) The degree of attentiveness had no effect on performance.

1. Background of the study

It has long been empirically evident that the phonological system is one of the most difficult areas for Japanese learners of English and this recognition has led many applied linguists as well as English teachers to attempt the description and explanation of this phenomenon. Among many attempts made in the past, the most productive analysis as well as scientific in approach was contrastive analysis of the structures of L_t and L₁.

The contrastive analysis, which was most influential, roughly, during 1959's and 1960's in Japan, was methodologically based on (American) structural linguistics and its aim was to pinpoint the difficult parts of the L_t structure and predict their relative difficulty for the learners. As a procedure for this aim, first, the structures of L_t and L₁ were analysed and compared and, based on this comparison the patterns which were most obviously different from each other were extracted. The underlying assumption of this approach was that the learners' difficulty with pattern can be accounted for in terms of the difference between the two systems. In other words it was assumed that the learners' difficulty is a function of the structural difference between the

two systems.

This assumption was to some extent proved to be valid by experiment: some contrastive analysis was found to be successful in predicting difficult points for the learners. Kleinjans (1959), for example, succeeded in predicting the difficult patterns of the noun modification structure of English. He compared the noun-head modification structure of English (L_t) and Japanese (L_1) and, based on the comparison, classified the patterns into four groups, according to the predicted difficulty for Japanese learners. Then, he gave a test on these patterns to Japanese students and checked its predictability against the test results. It was found that the prediction highly correlated with the test results. Kleinjans' study can be taken as an example of the predicted success of contrastive analysis in language learning.

Another well-known contrastive study of English and Japanese, this time, in phonology, was done by Kohmoto (1969). Kohmoto, after a comprehensive contrastive study of English and Japanese phonological structures, predicted vocalic intrusion/addition in the pronunciation of English consonant clusters and final consonants by Japanese learners, and checked its explanatory potential against the results of the test he gave to the subjects. (There seem to be some deficiencies in the sampling method and number of the subjects in this test. The number of the subjects was only 5 and their proficiency level varied from undergraduate to graduate level.) The test items consisted of 16 final consonants and 7 CC patterns. The test results showed that all the error performances can be accounted for in terms of vocalic intrusion/addition, as predicted, except for /sn/ and /sk/ patterns, where 3 cases of lengthening /s/ was observed for /sn/ and 2 cases for /sk/.

Kohmoto's results almost perfectly support the transfer hypothesis based on the $L_t - L_1$ contrastive analysis. His study was generally taken as an example of the explanatory power of contrastive studies in language learning. However, there may be some experimenter's 'bias' involved here as well as the bias caused by the small, heterogeneous subjects. Generally, we tend to see what we *want* to see. Since transcription of phonetic performance is an essentially subjective matter, it is likely that their transcription was influenced by this basic assumption (the transcription was done by two people, including Kohmoto). However, it should be noted that even in the contrastive analysis-favoured experiment, some transitional performances between the transfer of Japanese structure and the target performance, were observed, i. e., lengthening a consonant. This means that contrastive analysis cannot perfectly predict and explain the learner's performance rules, and, further, it suggests there is room for an alternative approach.

Corder (1967) was perhaps the first to introduce a new dimension of transitional competence and set up a new framework for the study of this phenomenon. This includes in its framework not only learner's transfer errors (explainable on contrastive analysis assumptions) but also other various interlanguage strategies. In this framework,

the main concern is the transitional nature of the learner's interlanguages which approximate gradually to the target linguistic system. A learner's errors were taken as evidence of the system of the language that he is using at a particular point in the course,¹ and now, attempts are made to classify the nature and structure of the learner's transitional process of language learning/acquisition.

One of the interesting studies made under the framework of 'interlanguage' was Dickerson's (1975) longitudinal studies of the acquisition of the English phonology system by Japanese learners in an intensive course.

Dickerson, under the influence of a biological assumption, "ontogeny recapitulates phylogeny", was interested in the relationship between the way a second language is acquired and the way language changes in society and found that both processes have something in common. Dickerson studied the <<1>> variability of Japanese learners of English in an intensive course in U. S. A. and he concluded that one can apply the same wave theory Labov proposed in his analysis of language (pronunciation) change in a society to this process of learning /1/ phoneme pronunciation. Further, he claimed that the wave mechanism applied to the acquisition of /1/ is not unique to Japanese learners nor to the (1) word class, but it has proved to be the case in other word classes and in the case of learners from other language backgrounds.

Another important point he makes is that the learner's phonological system is a system of variable rules. Sound system learning proceeds by the systematic application of modification rules which gradually approximate to the target rules. Thus, Dickerson claims that the learner's phonological system is not an interlanguage as it is defined in static terms (competence rules) and rejects the notion of 'error analysis' in favour of 'variability analysis'.

2. The aims of the study

With this approach as background, we aimed in the present study, to describe and explain the process of the learning of features of English phonology by Japanese learners who have received their formal English language teaching in Japan. To state it more specifically, our aims were :

- (1) To describe and explain the process by which Japanese learners learn the pronunciation of selected consonant cluster patterns and simple final consonants.
- (2) To describe and explain the transitional strategies employed by learners to approximate their pronunciation to the target performance.
- (3) To examine the variability of performance related to the degree of

1. S. P. Corder. "The Significance of Learner's Errors" *Error Analysis* Ed. J. C. Richards (London: Longman, 1974), p. 25.

attentiveness.

In this study our main concern was in the transitional nature of the interlanguage performances of Japanese students.

3. Method

3.1 Three factors involved in the experiment

To fulfill the aforementioned aims, we designed an experiment which involved three factors, (1) linguistic features; (2) degree of attentiveness, and (3) developmental stages. In designing an experiment, basically, we followed Dickerson's study, but some important modifications were made to achieve our own goals.

First, the testing area was changed from <<1>> to initial and final consonant clusters (including single final consonants). Then, the settings of L₂ learning were changed: in Dickerson's study, the subjects were Japanese students attending an English course in U. S. A. not in Japan. It is generally agreed that there are great differences in learning conditions between Japanese learners in U. S. A. and Japanese learners in Japan, in the quality and quantity of the teachers/models, the student's motivation, etc. Consequently, Dickerson's finding could not simply be extended to Japanese EFL settings. In this sense, it is worth trying the same kind of follow-up study in Japanese EFL settings. The significance of the present study lies in its attempt to check the relevance of Dickerson's assumption for Japanese settings.

The last important modification was the addition of a new factor, the degree of attentiveness. In his experiment, Dickerson used dialogues and word lists as a test format and asked the subjects to read for recording. In doing this he assumed their reading to be inattentive performance without making any distinction between dialogue reading and word reading. In the present study, we wanted to test the learner's attentive performance rules and inattentive performance rules for the same linguistic features. By so doing we hoped to see the difference between these rules, and also their relative relevance to the study of phonology acquisition/learning.

In analysing the data, we followed basically Dickerson's quantitative method for analysing the process of Japanese students' acquisition of /l/ phoneme. We expected that Labov's wave theory hypothesis would help to explain the acquisition process of the English consonant cluster patterns. We expected ontogeny to recapitulate phylogeny.

In the following three sections, the three factors of this experiment will be described in detail, with examples.

3.1.1 Linguistic features

We are here concerned only with the pronunciation of consonants, in particular the pronunciation of certain English initial and final consonant clusters and final single consonants. Syllable structure is one of the areas in which English and Japanese

differ most strikingly. The Japanese phonological system allows only a CV syllable structure (except in the case of /n/), whereas English phonological rules allow a range of structure such as :

$$\left\{ \begin{array}{c} C \\ CC \\ CCC \end{array} \right\} V-$$

$$-V \left\{ \begin{array}{c} C \\ CC \\ CCC \\ CCCC \end{array} \right\}$$

From among many possible consonant combination structures, we selected at random three realisations of consonant clusters for each of the four possible consonant patterns, C, CC, CCC and CCCC. All the four patterns occur in the final position and furthermore, the CC and CCC patterns also occur in the initial position. Thus we had three examples of the realisations for each of the 4 final consonant cluster patterns and 2 initial patterns, in total 6 patterns. The following are the linguistic realisations of consonant clusters randomly selected for the purpose of the present study.

(1) Final position		linguistic realisation	
		part 1	part 2
-C #	/p/	map	cap
	/d/	card	sand
	/tʃ/	church	match
-CC #	/ls/	pulse	else
	/pt/	stepped	stopped
	/ft/	sniffed	laughed
-CCC #	/kst/	next	text
	/lpt/	helped	helped
	/spt/	grasped	claspd
-CCCC #	/ksθs/	sixths	sixths
	/lfθs/	twelfths	twelfths
	/ksts/	texts	texts
(2) Initial position			
# CC-	/sp/	span	spin
	/kr/	cream	Christmas
	/pl/	plus	play
# CCC-	/spr/	spray	spring
	/spl/	splinter	split
	/str/	straight	stray

3.1.2 Difference in attention

In dealing with the analysis of learner's language, Widdowson proposes a distinction between expression rules and reference rules. Expression rules characterise what the learner *does* while reference rules characterise what a learner knows.² In other words the former rules govern communicative use when the speaker's attention is on the *content* of speech and the latter govern linguistic usage when his attention is on the linguistic form. Richards (1973) makes a similar distinction between competence errors and performance errors, as does Dickerson between variability analysis and error analysis.

In this experiment we wanted to see the difference between the two rules with regard to the same linguistic features. We found, however, that it was not easy to test the speaker's expression rules in the language by controlled test. So we had to content ourselves with attempting to test the two types of rules governing attentive and inattentive performance. Inattentive performance is observed when the subject's attention is distracted by a special testing technique. These are not, strictly speaking, real communication situations, but we hoped that the results would give some insight into the attentive/inattentive performance rules.

In order to test the subject's inattentive performance and to compare it with his attentive performance, we devised a "guised test",³ in which the real testing points are guised by underlining the feigned, dummy word. For example, when we wanted to see the inattentive performance rule of /p#/ we put it into a sentence like "Tom, here's your cap" and underlined here's thus guising the real testing point, *cap*. By underlining the dummy words, we hoped and assumed that the subject would pay attention to it and thus his pronunciation of *cap* would reveal the subject's inattentive performance rule. Although this is not a natural communication situation, we think that in practical terms this is one of the best methods of eliciting the controlled response of inattentive performance under experimental conditions.

In order to see the difference between the two distinct performance rules, we divided the test into two parts, one for the attentive performance rules and the other for inattentive performance rules. In the former test the testing points were explicitly

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2. H. G. Widdowson. "The Significance of Simplification". (mimeographed paper), p. 3.
 3. "Guised test" is a technique employed by Gardner & Lambert (1972) in their study on bilingualism to elicit the subject's stereotypes toward French and English-speaking people. For this test recordings were made of the four fluent English-French bilinguals who read the same passage once in English and again in French. Then the subjects were asked to rate the personality of the speakers. In this test it was hoped that the student was thinking that he was evaluating the speaker's personality but was evaluating the *guises* of accents. The significance of this technique lies in the fact that it can test the testing points without being detected by the subject. (The technique of 'guised test' is fully explained in Gardner & Lambert (1972, pp. 97-104).

shown to the subject while in the latter, they were 'guised' by intentionally underlining the dummy testing points. In part 1, the subject was asked to pronounce a list of 18 isolated words each containing one testing point. Here we expected that the subject would pay the maximum attention to those words and thus pronounce them with most care. In part 2, the same testing points were tested, but this time, by the guised technique, the testing point was obscured. To do this, we needed two words which contain the same testing points (consonant cluster pattern) in almost the same phonological environment. Thus, we asked the subject to pronounce *map* in part 1, and, in part 2, "Tom, here's your cap" (*cap* is testing point) for C# pattern.⁴ The following are the list of words and sentences used for the test of attentive performance rules (part 1) and inattentive performance rules (part 2).

Part 1	Test of attentive performance	Part 2	Test of inattentive performance
1 -C#(F)	{ /p/ map /d/ card /tʃ/ church	Tom, <u>here's</u> your (cap).	
		You can't build a <u>house</u> on the (sand).	
		He <u>lit</u> a (match).	
2 #CC-(I)	{ /sp/ span /kr/ cream /pl/ plus	The car <u>went</u> into a (spin).	
		(Christmas) is <u>coming</u> .	
		Shall we (play) <u>volleyball</u> ?	
3 -CC#(F)	{ /ls/ pulse /pt/ stepped /ft/ sniffed	What (else) do you <u>want</u> ?	
		The car (stopped) at the <u>post-office</u> .	
		He (laughed) a <u>lot</u> .	
4 #CCC-(I)	{ /spr/ spray /spl/ splinter /str/ straight	(Spring) is <u>coming soon</u> .	
		The <u>wood</u> (split) into two parts.	
		The (stray) dog was <u>dirty</u> .	
5 -CCC#(F)	{ /kst/ next /lpt/ helped /spt/ grasped	He <u>read</u> the (text).	
		He (helped) her mother with the <u>work</u> .	
		He (clasped) the ball in his <u>hand</u> .	
6 -CCCC#(F)	{ /ksθs/ sixths /ltθs/ twelfths /ksts/ texts	Five-(sixths) is greater than <u>one-third</u> .	
		He changed the <u>fraction</u> into (twelfths).	
		The <u>required</u> (texts) were on the reading list.	
Keys:	C: Consonant	(cap) indicates a testing point in the	
	F: Final position	guised test.	
	I: Initial position		

4. In the British tradition, the underlining of a word of a sentence is conventionally taken as a mark for a stress contrast. In Japan, however, there is not such a tradition and therefore it is unlikely that an underlined word is pronounced as a tonic word with sentence stress.

3.1.3 Time

The third factor involved in the experimental is *time*. In order to investigate the developmental process of language acquisition, it is best to employ a longitudinal approach. In other words, ideally, we have to observe the linguistic development of the learner over a period of time long enough to check differences in the learner's linguistic performance. One of the main disadvantages of this approach, however, is that it takes a long time, at least several years.

To overcome this difficulty, we employed a cross-sectional approach in which we sample the performance data of different groups of individuals at several levels of English language learning and took the sequence to represent the development of one individual learner. A cross-sectional approach will best fit the study of pronunciation, since it can reasonably be considered as similar across individual learners within same L₁ community, due to the predictable nature of pronunciation and the strong influence of L₁ on the L₂ sound system. However, this approach, although convenient for handling the problem in a limited time, has the inherent danger of taking an irrelevant sequence as if it were the "natural" sequence. In this sense, sampling of the population is crucially important for the success of the experiment. In sampling the data, we tried to take recordings of six pronunciation performances for each of the three different levels of English language ability, (1) the elementary stage, (2) the intermediate stage and (3) the advanced stage. The subjects for each of the three stages are as follows:

Time 1 (Elementary stage): 2nd year students of a senior high school in Kagoshima (T₁) (17 year old, 5th year of formal English language education). They are students of Kinkowan High School, Kagoshima.

Time 2 (Intermediate stage): 3rd year university students (21 years old, 9th year (T₂) of formal English language education). They are students of University of Kagoshima, School of Education.

Time 3 (Advanced stage): Japanese students at the University of Edinburgh. The (T₃) subjects' age varies between 20-40, and their specialisation from applied linguistics to sociology. All of them experienced their formal English language education in Japan up to at least university level.

As for the quality of the subjects, we tried to secure students at a level slightly above the average in each case.

3.1.4 Matrix for the analysis of data

The present experimental design consisting of the three factors can be summarised in the following matrix:

Feature stage(time)	Attentive rule						Inattentive rule					
	-C#	#CC-	-CC#	#CCC-	-CCC#	-CCCC#	-C#	#CC-	-CC#	#CCC-	-CCC#	-CCCC#
1												
2												
3												

3 times (stages) × 6 features × 2 styles = 36 components

3.2 Administration of the test

General instructions for the administrators were as follows:

- (1) Select 6 homogeneous students in the lower half of the top third of the class.
- (2) Hand the test sheets to the subjects beforehand and give them a chance to practice once or twice silently.
- (3) Ask the subjects to read (pronounce) the test items and record their performance.
- (4) When any of them has difficulty in reading the items, please tell them how to read them but never give them a pronunciation drill on them. You may find the test item difficult to read for some of the subjects. In that case, you may teach the meaning of the words and sentences and how to read.
- (5) After conducting the test, please send back the recorded cassette tape.

The administration of the test was the most difficult part of the experiment. Since all the tests except for the advanced learners had to be administered in Japan it was extremely difficult to control the experimental conditions. In particular, the sampling of the subjects rested solely upon the cooperation of the administrators in Japan. To get the maximum out of their cooperation, I explained in my personal letter to them the aims of the experiment and asked their help, but I did not mention anything about the technique of the guised test, (part 2 of the test) since I was afraid it would affect the administrators and tempt them to give the subjects hints about the testing points.

4. Results and discussion

4.1 Phonetic transcription of the performances

Each of the pronunciation performances was transcribed by the experimenter using a cassette tape recorder, then it was checked again with the help of Mr. A.

Kemp, a phonetician of Edinburgh University, this time using a repeater-combined tape-recorder.⁵

In making phonetic transcriptions of the subjects' performance, we employed a broad notation system when it was a standard one and when it was considered to be transitional performance worth noticing, we adopted a narrow notation system, thus trying to describe the nature of the transitional performance in detail. For example, *plus* is usually pronounced by a native speaker as [plʌs] with an aspiration. When the subject's performance was a standard one with an aspiration, we transcribed it as [plʌs] without any diacritic mark of aspiration while, when a performance was a transitional one with voiced [l], we added a diacritic [̤] for voicedness as [l̤]. Since [l] is a voiced consonant in itself, this is redundant. However, we employed this system to show explicitly the deviant transitional character of the performance. The main diacritics used in transcribing transitional performances are as the following.

Diacritics	Indication
[i̥]	Voiceless [i]
[(l)]	Weakened & shortened [l]
[()]	Omission of the expected consonant
[r̤]	Voiced [r] where assimilated voiceless [r] is expected as standard
[t ^h]	Excessive, more aspiration than is expected in the standard performance
[l:]	More lengthened [l] than in standard performance (this mark is also used when a performance is standard)
[l̇]	Slightly more lengthened than in the standard performance

The phonetic transcriptions of the T₁, T₂, and T₃ performances, are shown in Table 1, Table 2 and Table 3, respectively.

In evaluating and classifying the pronunciation performances, we used Mr. Kemp's pronunciation as the target pronunciation. We asked him to pronounce the test items himself and to transcribe them in narrow transcription. In our evaluation, the nearer the subject's performance approximates to Mr. Kemp's, the nearer his pronunciation is to the target. The target performance is shown in Table 4 in both broad notation and narrow notation. The transcribed data was then analysed from the

5. Acknowledgements are due to Mr. A. Kemp for his invaluable assistance in the phonetic transcription required for the present study.

Table 1. Performance of T₁ learners

subjects		features						
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	
Part 1	1	p	p	p	p	p	p	
	2	d	d	d	d	d	d	
	3	tʃ	tʃ	tʃi	tʃ	tʃ	tʃi	
	4	sp	sp	sp	s·p	sp	sp	
	5	kr	k _v (r)	kr	kt	kr _v	kr·	
	6	pl	pl _v	pr _v	pl	pr _v	pl·	
	7	ls	ls	ls	ls	ls	ls	
	8	pt	pt	pt	put	put	pt	
	9	ft	ft	f:t	ft	ft	ft	
	10	spr	spr·	sp _r	sp _r	sp _r	sr _r	
	11	spl	spr	spr	spl	spr	spl·	
	12	str	str·	str·	(s)tr·	stur	str	
	13	kst	kst	kst	kust	kst	kst	
	14	lpt	lpt	lpt	lpt	lpt	lpt	
	15	spt	s(p)t	spt	spt	spt	spt	
	16	ksθs	kuθ	kusθ	ks:	kstu _n	kus:	kstθ _n
	17	lfθs	lfθ·	lfθ·	lfs _n	lfθ()	lfs:u	lfts _n
	18	ksts	ksts	kusts	kist	kuts _n	kst()	ksts
Part 2	1	p	pΦ	p	p	p	pu	
	2	d	d	d	d([[san]])	— ([[san]])	—	
	3	tʃ	tʃi	tʃi	tʃ	tʃ	tʃi	
	4	sp	sp	sp	sp	sp	sp	
	5	kr	kr _v	kr _v	kr	kr _v	kr·	
	6	pl	pl _v	pl _v	pl	p(l) _v	p(d)	
	7	ls	ls	ls	ls	ls	ls	
	8	pt	pt	pt	pt	pt	pt	
	9	ft	ft	ft	ft	ft	ft	
	10	spr	sp _r	sp _r	spw	sp _r	sp _r	
	11	spl	spl·	spl	sp(l)	spr	sp(l)	
	12	str	str·	str·	(s)tr·	()tr·	stur	
	13	kst	kst	kst	kust	kust	kst	
	14	lpt	lpt	lpt	lpt	lpt	lpt	
	15	spt	spt	sptu	sptu	spt	sptu	
	16	ksθs	kθs	kst	ks:	kutθ _n	kus:	ks _n
	17	lfθs	kfθ()	lfs _n	lfs:	lft()	lfs	lfts _n
	18	ksts	ksts	ksts	kist	kst	kst	ksts

Table 2. Performance of T₂ learners

subjects			features					
			No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Part 1	1	p	p	p	p	p	p	p
	2	d	d	d	d	d	d	d
	3	tʃ	tʃi	tʃ	tʃi	tʃi	tʃ	tʃ
	4	sp	sp	s:p	s:p	s:p	sp	sp
	5	kr	kr	kr:	kr:	kl:	kr	kr
	6	pl	pl	pl:	pl	pl	pl	pl
	7	ls	ls	ls	ls	ls	ls	ls
	8	pt	pt	pt	pt	pt	pt	pt
	9	ft	ft	ft	ft	ft	ft	ft
	10	spr	sp _r	sp _r	sp _r	spr	spl:	spl:
	11	spl	spl:	spl:	spl	spl	spl:	spl:
	12	str	str	str	stu _r	st _r	st _r :	str
	13	kst	k ^h st	kst	kst	kst	kst	kst
	14	lpt	lpt	lpt	lpt	lpt	lpt	lpt
	15	spt	spt	spt	spt	spt	spt	spt
	16	ksθs	kisθ	ks	kθs	kθ:	ksθ	kht _{vⁿ}
	17	lfθs	lfθ()	lfθ()	lfθs	lvs	lfs	lfs
	18	ksts	kists	kist	kst ^h	ksts	kst ^h	kst ^h
Part 2	1	p	p	p	p	p	p	p
	2	d	d	d	d	d	d	d
	3	tʃ	tʃ	tʃ	tʃi	tʃ	tʃ	tʃi
	4	sp	sp	s:p	s:p	sp	sp	sp
	5	kr	kr	kr _v	kr	kr	kr	kr
	6	pl	p(1)	pl _v	pl _v	p(1)	p _r	pl
	7	ls	ls	ls	ls	ls	ls	ls
	8	pt	pt	pt	pt	pt	pt	pt
	9	ft	ft	ft	ft	ft	ft	ft
	10	spr	sp _r	spr	spr	spr	spr	spl:
	11	spl	spil	spl:	spl:	sp _r	sp _r	spl:
	12	str	s(t)r	str:	st _r :	st _r	str	st _r
	13	kst	kst	kst	kst	kst	kst	kst
	14	lpt	lpt	lpt	lpt	lpt	lpt	lpt
	15	spt	spt	spt	spt	spt	spt	spt
	16	ksθs	ks	kθs	kθs	kst	ksθ	kθt _n
	17	lfθs	lfs	lfθ()	lfts	lfs:	lfs	lft _n
	18	ksts	kst	kust	kst ^h	ksts	kist ^h	kist ^h

Table 3. Performance of T₃ learners

Subjects			features					
			No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Part 1	1	p	p	p	p	p	p	p
	2	d	d	d	d	d	d	d
	3	tʃ	tʃi	tʃi	tʃ	tʃ	tʃ	tʃ
	4	sp	sp	sp	sp	s'p	sp	sp
	5	kr	kr _v	kr	kr	kr _v	kr _v	kr
	6	pl	pl	pl'	pl	pl _v	pl _v	pr _v
	7	ls	ls	ls	ls	lus	ls	ls
	8	pt	pt	pt	pt	pt	pt	pt
	9	ft	ft	ft	ft	ft	ft	ft
	10	spr	spr	sp _r	spr	sp _r	spr	spr
	11	spl	spl'	spl'	spl	spl	sp(1) _v	spr'
	12	str	str	st _r	str	st _r	str	s() _r
	13	kst	kst	kst	kst	kst	kst	kst
	14	lpt	lpt	lpt	lpt	lpt	lpt	lupt
	15	spt	spt	spt	spt	spt	spt	s ²
	16	ksθs	ks:	ks:	ksθ	ks:	ks	kθ
	17	lfθs	lfθs	lfs:	lf:	lf:	lfθ()	lfθ()
	18	ksts	ksts	ksts	ksts	ksts	kst	ksts
Part 2	1	p	p	p	p'	p	p	p
	2	d	d	d	d	d	d	d
	3	tʃ	tʃi	tʃ	tʃ	tʃ	tʃ	tʃi
	4	sp	sp	sp	sp	sp	sp	sp
	5	kr	kr	kr	kr	kr	kr	kr
	6	pl	pl	pl _v	p(1) _v	pl _v	p(1) _v	p(1)
	7	ls	ls	ls	ls	ls	(1)s	ls
	8	pt	pt	pt	pt	pt	pt	pt
	9	ft	ft	ft	ft	ft	ft	ft
	10	spr	spr	spr	spr	sp _r	spr	spr
	11	spl	spl'	spl	spl	spl'	spl	spl
	12	str	str	()tr	str	st _r	s()r	s()r
	13	kst	kst	kst	kst	kst	kst	kist
	14	lpt	lpt	lpt	lpt	lpt	lpt	lpt
	15	spt	spt	spt	spt	spt	spt	spt
	16	ksθs	ksis	ks:	ks:	kθs	ks:	ksθ
	17	lfθs	lfθs	lfs	lf:	lf:	lfθ()	lfθ()
	18	ksts	kist	ksts	kst()	ksts	()st	kst

Table 4. Target pronunciation

kinds of performance	Structure	Environment	Linguistic realisation		
			Orthography	Broad phonetic notation	narrow phonetic transcription of model
Attentive performance	-C	Final position	map card church	[mæp] [kɑ:d] [tʃɜ:tʃ]	[mæp ^h] [kɑ:d] [tʃɜ:tʃ]
	CC-	Initial position	span cream plus	[spæn] [kri:m] [plʌs]	[spæn] [kri:m] [plʌs]
	-CC	Final position	pulse stopped sniffed	[pʌls] [stɒpt] [snɪft]	[pʌls] [stɒpt ^h] [snɪft ^h]
	CCC-	Initial position	spray splinter straight	[sprei] [splɪnt] [streɪt]	[sprei] [splɪnt] [streɪt ^h]
	-CCC	Final position	next helped grasped	[nekst] [helpt] [græspɪt]	[nekst ^h] [helpt ^h] [græspɪt ^h]
	-CCCC	Final position	sixths twelfths texts	[sɪks:] [twelfs:] [teksts]	[sɪks:] [twelfs:] [teksts]
Inattentive performance	-C	Final position	cap sand match	[kæp] [sænd] [mæt]	[kæp ^h] [sænd ^h] [mæt]
	CC-	Initial position	spin Christmas play	[spɪn] [ˈkrɪsməs] [pleɪ]	[spɪn] [ˈkrɪsməs] [pleɪ]
	-CC	Final position	else stopped laughed	[els] [stɒpt] [lɑ:ft]	[els] [stɒpt ^h] [lɑ:ft]
	CCC-	Initial position	spring split stray	[sprɪŋ] [splɪt] [streɪ]	[sprɪŋ] [splɪt] [streɪ]
	-CCCC	Final position	text helped clasped	[tekst] [helpt] [klæspɪt]	[tekst ^h] [helpt ^h] [klæspɪt]
	-CCCC	Final position	sixths twelfths texts	[sɪks:] [twelfs:] [tek:s]	[sɪks:] [twelfs:] [tek:s]

viewpoint of (1) time effect on performances, (2) relative difficulty of linguistic features, (3) the effects of the difference of attentiveness on the pronunciation (variability analysis), and others.

4.2 Basic viewpoints for data analysis: classification and weighing of transitional strategies

In order to see the change/improvement of performance over a certain period of time, we examined all the performances and classified them into 3 types on the scale of approximation to the target. The first type of pronunciation was the one which is most heavily influenced by the phonological structure of L₁, i.e., *vocalic intrusion/addition*. Since Japanese phonological structure does not allow consonant cluster patterns or a consonant without a following vowel, it is very likely that the Japanese learners introduce the Japanese phonological structure into the English one using vocalic intrusion/addition. One example of this is [-put] instead of [pt].

The second type of performance is a transitional performance between the L₁-based pronunciation and target performance.

- (1) Consonant lengthening, e.g. [s:p] for [sp]
- (2) Consonant weakening, e.g. [sp(l)] for [spl]
- (3) Consonant omission, e.g. [s()r] for [str]
- (4) Consonant addition, e.g. [pΦ] for [p]
- (5) Failure of devoicing, e.g. [pl] for [p̚]
- (6) Excessive assimilation, e.g. [sʔ] for [spt]
- (7) Substitution of a similar consonant, e.g. [kst^h] for [ksts]

These are performances which are closer to the target pronunciation than the first type (with vocalic intrusion/addition). In this sense, they are transitional performances based on the rules of the interlanguage system, located between the target performance and L₁-based performance. They are the substitute strategies devised by the learners to approach the target.

The third type is the target pronunciation. This is native-speaker performance and needs no further comment.

Several examples of combinations of the above features were observed, such as lengthening and a failure of devoicing of a consonant. Clearly these examples are located between the first type, and the second type: they are more improved than L₁-based performance but less improved than the second type. However, since there were so few examples observed, we classified them under the category of type 1 (L₁-based type). We noted also that there are combinations of type 1 and type 2 features. These cases are definitely the least desirable performances and so we sorted them into type 1 category.

In addition to the classification and weighing of the performance, we computed *error scores* as a measure of the difficulty of a pattern. To do this we assigned the

following values to the three types of variants, and computed the error score.

Type	Value
1	2
2	1
Target	0

This means that the higher the score, the more difficult the pattern is.

4.3 Analysis of performance change and transitional strategies

First we looked for evidence of the learner's improvement in pronunciation performance as he goes up the learning stages noting also the nature of any such improvement. It is a widely shared belief among FL teachers that there is an optimal age for FL learning and the critical period is the time of puberty (about the age of 13) after which FL learning becomes extremely difficult or impossible. This critical period-by-puberty hypothesis which originates from Penfield, a neuro-physiologist in conjunction with a habit formation hypothesis, has had a strong influence on language teaching. The FLES movement, a movement for introducing FL at elementary school level, could be viewed as an outcome of these hypotheses which if true, would mean that it is almost impossible for adult learners to improve their pronunciation since this is the aspect of language performance which can most easily be controlled by habit formation. In this analysis we are concerned with the process of performance change or improvement during a certain period of time after puberty (the time covered in this analysis is roughly 12 years from 17 to 29 (average)).

4.3.1 -C# pattern

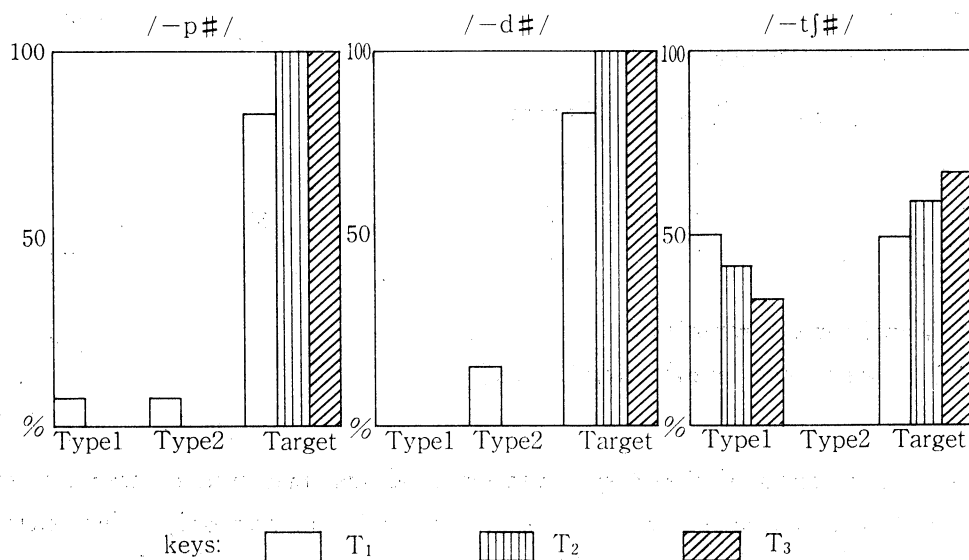
(a) Frequency distribution

		Type 1	Type 2	Target
/-p#/	T ₁	1	1	10
	T ₂	—	—	12
	T ₃	—	—	12
/-d#/	T ₁	—	2	10
	T ₂	—	—	12
	T ₃	—	—	12
/-tʃ#/	T ₁	6	—	6
	T ₂	5	—	7
	T ₃	4	—	8

(b) Transitional strategies

(1) Consonant omission: [san()] for [sand]

(2) Consonant addition: [pΦ] for [p]



Generally, the pronunciation of a consonant without a following vowel does not seem to be a difficult problem for the learners who have passed the initial stage. But this must be a trouble spot for beginners, since the phonological rules of Japanese do not allow it. However, it seems that this can be overcome in a short time. The analysis of the data shows that with few exceptions the /-p#/ and /-d#/ patterns are almost perfectly mastered by the learners. Consequently it gives us very little idea of the alternative transitional performances for this pattern. The only transitional performances observed were :

(1) the omission of the consonant in question like ⟨san()⟩ for ⟨sand⟩ and (2) addition of another consonant like ⟨-pϕ⟩ for ⟨-p⟩. The latter strategy could be understood as a variety of lengthening of a consonant since the added sound is phonetically close to that which precedes it.

The pattern of /-tʃ#/ is, however, different from the cases of /-p#/ and /-d#/. 50% of T₁ performances are L₁-based ones, i.e., vocalic addition. Even the most advanced learners have not completely mastered this: 30% of their performances are with vocalic intrusion. Here, there were no transitional performances observed. If we note this fact along with the fact that there were few transitional performances for /-p#/ and /-d#/, we might suppose that there would not be a transitional stage in the learning of the /-tʃ#/ pattern. The learner seems to proceed directly from L₁-based performance to the target performance. This conclusion seems also to be intuitively correct.

4.3.2 #CC- pattern

The analysis of the pronunciation of consonant clusters in the initial position revealed a range of variation. This is especially the case in the realisation of /#kr-/ and /#pl-/.

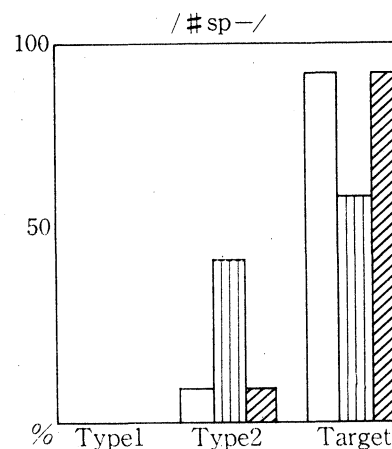
(i) /#sp-/

(a) Frequency Distribution

	Type 1	Type 2	Target
T ₁	—	1	11
T ₂	—	5	7
T ₃	—	1	11

(b) Transitional strategies

(1) Consonant lengthening: [s:p]



The pronunciation of the /#sp-/ pattern is almost mastered by learners, especially at T₁ and T₃. There was no L₁-based pronunciation and only a few examples of transitional performance strategies. All of these were lengthening of consonants (like [s:p] for [sp]). The high frequency of Type 2 errors in T₂ performance remains unexplained. Generally this may not be a difficult pattern.

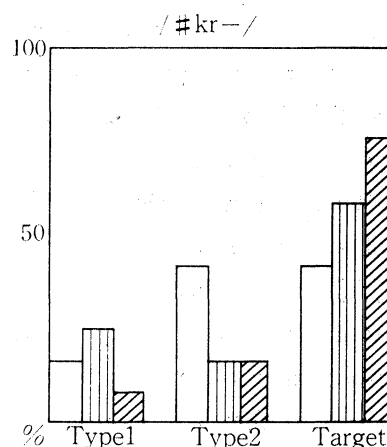
(ii) /#kr-/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	2	5	5
T ₂	3	2	7
T ₃	1	2	9

(b) Transitional strategies

- (1) Failure of devoicing: [kr̥]
- (2) Consonant lengthening: [kr̥ː]
- (3) Consonant weakening: [k(r̥)]
- (4) Combination of 2 features: [k(r̥)ː]



This is a difficult pattern for Japanese learners and the figures indicate lack of mastery, especially by T₁ learners. The frequency distribution of the performances generally indicates a normal process of phonology acquisition; the frequency of the target performance increases as the stage goes up. The frequency of Type 1 errors is higher in T₁ than in T₃ and that of Type 2 errors lower in T₃ than in T₁ but the error scores indicate that performances are slightly nearer to the target than the T₁ ones (error scores were 8 for T₂ and 9 for T₁).

Quite a few interesting interlanguage performance features were observed in this pattern. Failure to devoice /r/ is one of them. The target pronunciation of /kr/ is [kr̥] with devoiced [r̥] as a result of the assimilation caused by the preceding voiceless /k/. Many of the transitional, Type 2 errors lacked this devoicing feature, as the

result of which they sounded unnatural, although there was no vocalic intrusion. Other transitional features were lengthening of /r/: [kr̄], weakening of /r/: [k(r)],. There were no errors of vocalic intrusion. However, there were examples of the combination of Type 2 features in one performance, like [k(r̄)] in this case [r] being weakened as well as voiced. Devoicing /r/ seems here, to be the last step before the native-speaker performance for this pattern.

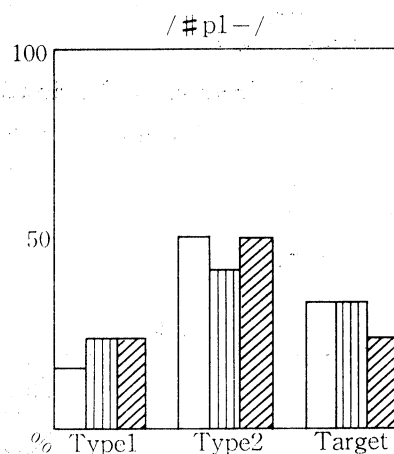
(iii) /#pl-/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	2	6	4
T ₂	3	5	4
T ₃	3	6	3

(b) Transitional strategies

- (1) Failure of devoicing: [p̄]
- (2) Consonant lengthening: [pl̄]
- (3) Consonant weakening: [p(l)]
- (4) Combination of the above two features:
[p(l̄)]



This seems to be one of the most difficult patterns for Japanese learners. The frequency of the target performance is relatively low compared with other patterns and the frequency of Type 2 errors is higher than for the target performances. Further, there is no evidence of progressive improvement over time. In fact, the error scores are 12 for T₃, 11 for T₂ and 10 for T₁.

The difficulty of the pronunciation in this pattern seems to have caused the learner to develop a variety of transitional strategies. The most striking transitional performance is the lack of devoicing. As is the case of /#kr-/ the target performance of /#pl-/ must be [pl̄] with an assimilated, devoiced [l̄]. However, many of the [l̄] were substituted by the usual voiced [l]. This failure of devoicing accounts for nearly 90% of the transitional errors. Among the other approximative strategies are lengthening of [l] like [pl̄], weakening of [l] like [p(l)], and the combination of the above-mentioned features in one performance, like [p(l̄)].

The example of combination are classified into type 1.

4.3.3 -CC# pattern

(i) /-ls#/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	—	—	12

(b) Transitional strategies

- (1) Vocalic intrusion: [put̄]
- (2) Consonant lengthening: [-f:t]

T ₂	—	—	12	(3) Consonant weakening: [ʌs]
T ₃	1	1	10	

(ii) /-pt #/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	2	—	10
T ₂	—	—	12
T ₃	—	—	12

(b) Transitional strategies

(1) Vocalic intrusion: [put]

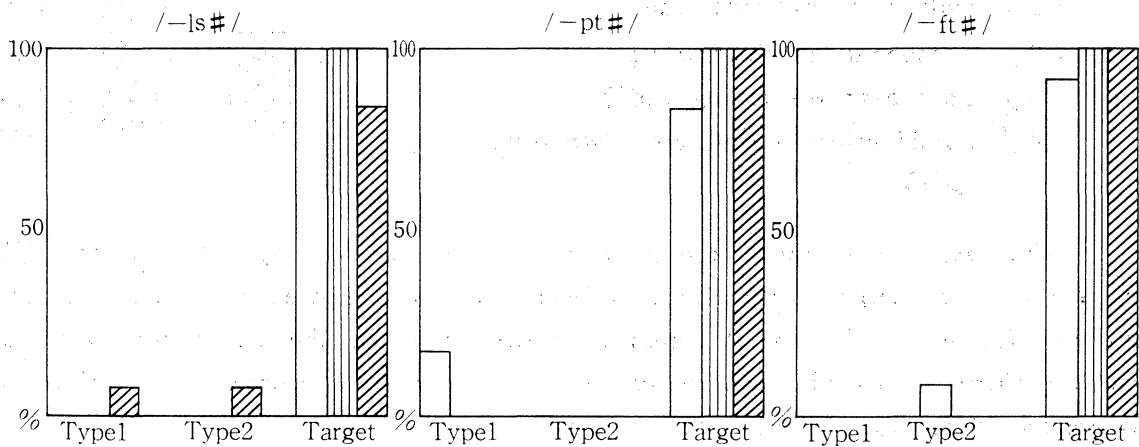
(iii) /-ft #/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	—	1	11
T ₂	—	—	12
T ₃	—	—	12

(b) Transitional strategies

(1) Consonant lengthening: [f:t]



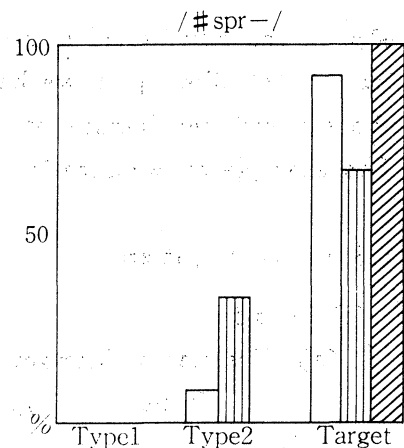
The CC consonant cluster in the final position is clearly easy for the learners at these stages, although it must be a source of difficulty to the beginners due to the difference of phonological structure between L₁ and L_t. For all of the three patterns, /-ls #/, /-pt #/, /-ft #/, all pronunciations attained the target performance with the exception of 5 errors. Most of these were L₁-based and the rest transitional, i.e., lengthening and weakening of a consonant.

4.3.4 #CCC-pattern

(i) /#spr-/#

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	—	1	11
T ₂	—	4	8
T ₃	—	0	12



(b) Transitional strategies

(i) Consonant lengthening: [spr̄]

This pattern is easy for Japanese learners at Time 1 and Time 3. The learners at T₁ and T₃ pronounced it almost perfectly: in the performance of T₂ learners, however, we noticed 4 transitional features. In fact, the error score is the highest for T₂ (4), which is counter to our expectation and to the general tendency of responses for all linguistic features. There were no Type 1 performances, neither L₁-based, nor combinations of Type 2.

(ii) /#spl-/

(a) Frequency distribution

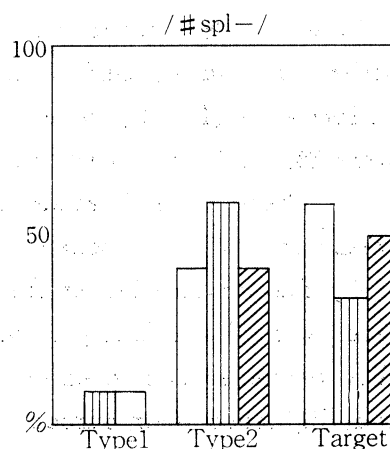
	Type 1	Type 2	Target
T ₁	—	5	7
T ₂	1	7	4
T ₃	1	5	6

(b) Transitional strategies

(1) Consonant lengthening: [spl̄]

(2) Consonant weakening: [sp(l)]

(3) Failure of devoicing: [spl̄]

(4) Combination of the above two features:
[sp(l)]

This pattern can be ranked as difficult since as the figures and graph show, this linguistic feature has not been mastered by the learners. They also indicate that the T₁ learner's performance is the best of the three groups; the frequency of the target performance is highest for T₁ and there are no L₁-based errors. The performances of T₂ learners are worst: the lowest in the target performance and highest in the Type 2 transitional errors. This is as in the case of /#spr-/, counter to our expectation and to the performer's general tendency.

The approximate performances for this pattern consist of (1) lengthening of /l/ like [spl̄], (2) weakening of a consonant like [sp(l)], (3) failure of devoicing /l/ like [spl̄] and (4) the combinations of the above features in one performance. No vocalic intrusions were noted.

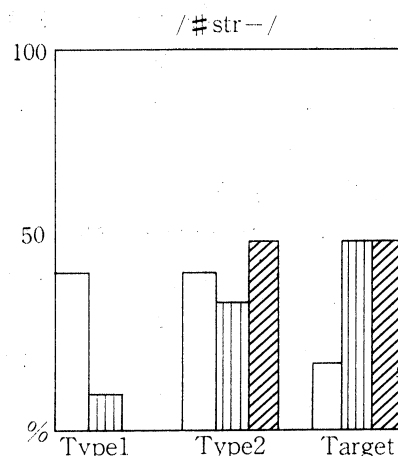
(iii) /#str-/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	—	5	2
T ₂	—	5	6
T ₃	—	6	6

(b) Transitional strategies

(1) Vocalic intrusion: [stur̄]



(2) Consonant lengthening: [str']

(3) Consonant weakening: [s(t)r]

(4) Consonant omission: [s()r]

(5) Combination of the two features: [(s)tr']

This pattern can be ranked as very difficult. The proportion of the target pronunciation is 50% for T₁ and T₃, and 16% for T₂. The distribution of performance clearly supports the wave theory although to a lesser extent than in Dickerson's case. Progressively more performances take on progressively more advanced variants as the stage goes up. As for the T₁ group, 42% of the performances were L₁-based (Type 1), 42% transitional (Type 2) and 17% were the target performance. On the other hand, in T₃ performances, 50% were transitional (Type 2) and 50% the target performance (No L₁-based performances were observed). As for T₂ groups, there were 8% of L₁-based errors, 33% of transitional and 50% of the target performances.

There were 5 kinds of errors, i.e. (1) lengthening of [r] like [str], (2) weakening of a consonant like [s(t)r], (3) omission of a consonant like [s()r], (4) the combination of the above features and (5) vocalic intrusion. The learners, faced with the difficulty of pronouncing this pattern, developed an interesting strategy: they weakened and in extreme cases, omitted one of the consonants in the cluster and thus lightened their burden.

4.3.5 -CCC # pattern

(i) /-kst #/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	4	0	8
T ₂	0	1	11
T ₃	1	0	11

(b) Transitional strategies

- (1) Vocalic intrusion: [kust]
- (2) Excessive aspiration: [k^hst]

(ii) /-lpt #/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	0	0	12
T ₂	0	0	12
T ₃	1	0	11

(b) Transitional strategies

- (1) Vocalic intrusion: [lupt]

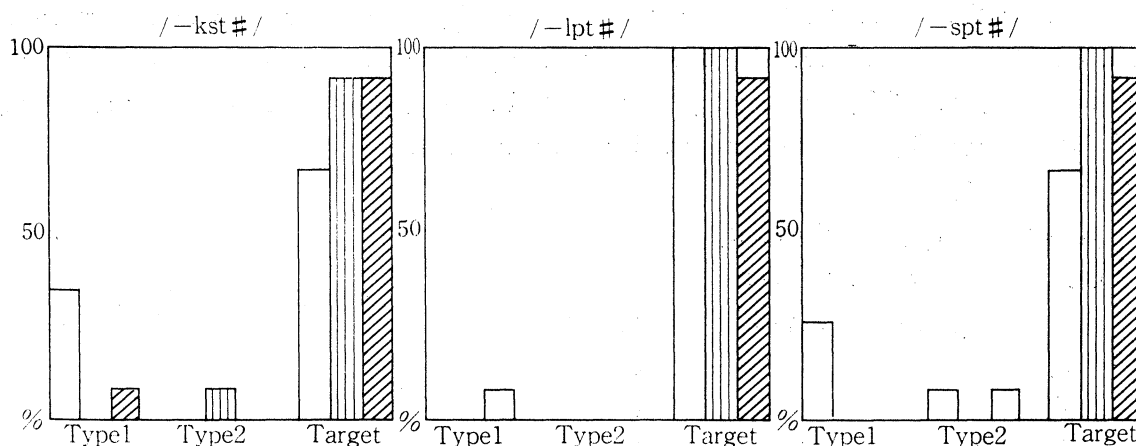
(iii) /-spt #/

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	3	1	8
T ₂	0	0	12
T ₃	0	1	11

(b) Transitional strategies

- (1) Vocalic intrusion: [sptu]
- (2) Consonant weakening: [s(p)t]
- (3) Excessive aspiration: [s^hpt]



As with CC consonant clusters in the final position, this pattern is ranked as very easy. With the exception of a few error performances, most of the pronunciations reach the target performance. Compared with the CCC pattern in the initial position, it is clear that the final position is far easier and the same comment applies to the CC patterns.

The interlanguage strategies for -CCC # patterns include:

- (1) Vocalic intrusion: [kust]
- (2) Consonant weakening: [s(p)t]
- (3) Excessive aspiration: [k^hst]
- (4) Excessive assimilation: [sʔ]

Among them, (3) excessive aspiration is an interesting interlanguage strategy used to overcome vocalic intrusion. For example, instead of using vocalic intrusion to make it easy to pronounce [kst], the learner employs a more advanced transitional strategy by excessively aspirating [k] sound like [k^hst]. This is not target performance but it is more improved than vocalic intrusion. Another interesting interlanguage strategy is (4) excessive assimilation. This is the strategy used by one of the best learners at T₃. Instead of pronouncing /-spt #/ as [spt^h] he pronounced it [sʔ] with a sound like glottal stop. This could be used in normal, hasty conversation by native speakers. Nonetheless, we classified it as an example of transitional performance, since we thought its frequency in the native speaker's utterance is lower; we look at it as a strategy to shorten the consonant cluster pattern and thus to lighten the burden.

4.3.6 -CCCC # pattern

Classification and evaluation of the performance of this pattern was complicated, since we thought there was more than one target performance for this pattern. The target pronunciations of the patterns for this structure, especially when pronounced in a hurry, necessarily involve contextual assimilation since some constituent consonants are phonetically similar. In fact some performances of this pattern can only be classified as a CC structure. In /-ksθs/ we judged [-ks:], [ks_θ] and [ks:] as a standard perform-

ance ([s̺] indicates dental [s]). In the case of [ks̺], the four-consonant pattern is reduced in the actual performance, to two consonant patterns. In /-lfθs #/, we decided [lfs:] and [lfs] as target performance. In the case of /-ksts #/, we took [ksts] and [k:s] (long [k] plus [s]) as standard performance.

(i) /-ksθs #/

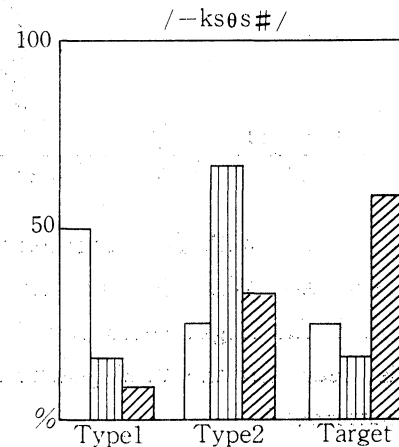
Target: [ks:], [ks], [ks:]

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	6	3	3
T ₂	2	8	2
T ₃	1	4	7

(b) Transitional strategies

- (1) Vocalic intrusion: [kus:]
- (2) Consonant omission: [kstθ()]
- (3) Near vowel substitute: [kht]
- (4) Combination of the two features:
[kusθ()]



The figures indicate that this is a very difficult pattern for the learner at these stages. The frequency of the target performance occurrences is very low, this being the case especially for T₁ and T₂ learners. The distribution of performances indicates that the wave motion underlies the acquisition process for this pattern. As is clear from the graph, the frequency of Type 1 errors is highest for T₁, the frequency of Type 2, transitional performance, highest for T₂ and the frequency of the target performance highest for T₃. This means that the higher the stage, the more advanced variants it has.

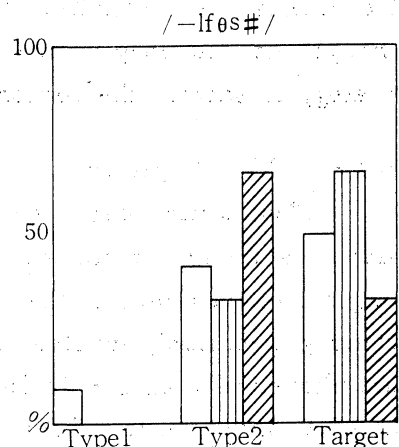
The transitional performance includes: (1) vocalic intrusion (Type 1), (2) omission of consonants (Type 2), (3) near-vowel substitute (Type 2), (4) combination of the two in one performance (Type 1). Among these, it is worth noting that the near-vowel substitute is a strategy employed by the learner to avoid vocalic intrusion. Instead of pronouncing [s] with vocalic intrusion, the learner developed a way to pronounce as [h̺], a voiced [h], which is a vowel-like consonant, thus facilitating easier pronunciation.

(ii) /-lfθs #/

Target: [lfs:] [lfs]

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	1	5	6
T ₂	0	4	8
T ₃	0	8	4



(b) Transitional strategies

- (1) Consonant omission [lfθ()]
- (2) Replacement: [lf:]
- (3) Vowel addition: [lfs:u]

The figures indicate that this is a difficult pattern: only 50% of the performances were the target pronunciation. However, they seem to have passed the stage of L₁-based performance: there was only one Type 1 performance. About 50% of the performances were substitute strategies for L₁-based performance, vocalic intrusion. This means that they are at the intermediate stage between the L₁-based performance and the target pronunciation.

The frequency of performance distributions ran counter to the general tendency and our expectation. The T₃ group marked the highest frequency for Type 2 errors and the lowest frequency for the target performance. Indeed, the T₃ group marked the highest error score of 8 while the error score of the T₁ and T₂ groups were 7, 4 respectively. Perhaps from their experience of communication in English, they tried to simplify the cluster in their own way while T₁ and T₂ learners tended to pronounce it as they had been taught. Four transitional performances [lf:] by T₃ learners could be understood in this context. Although it is very likely that [θ] sound will be replaced by [f] in the English speaking environment, this is not the case in Japan. It will account at least partly for the high error score of the advanced learners.

Other transitional strategies found for this pattern are omission of consonants, like [lfθ()], and vocalic addition like [lfs:u].

(iii) /-ksts #/

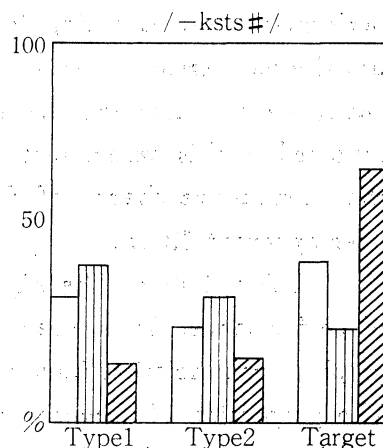
Target: [ksts] [k:s]

(a) Frequency distribution

	Type 1	Type 2	Target
T ₁	4	3	4
T ₂	5	4	3
T ₃	2	2	8

(b) Transitional strategies

- (1) Vocalic intrusion: [kists]
- (2) Consonant omission: [kst()]
- (3) Excessive assimilation: [kst^h]
- (4) Combination of two features [kist()]



As the figures show, this is a very difficult pattern. More than half of the performances showed transitional features. Yet, the T₃ group's performances were outstanding among the three groups. The T₂ and T₁ groups are still at the transitional stage. This is especially the case for the T₂ group which marked the highest frequency for both Type 1 and Type 2 performance.

It is quite possible that pronunciation of this pattern was influenced by its

linguistic realisation form, *texts*. This word is directly borrowed from English into Japanese and its pronunciation is adjusted into Japanese phonological structure. Thus, in Japanese *texts* is pronounced [tekusto]. Therefore, it is easy for Japanese to introduce Japanese phonological structure into English for these words. The high frequency of Type 1 performances could be accounted for by this explanation. The interference from a particular word is certainly undesirable in assessing the general difficulty of the pattern. This type of undesirable interference would be avoided by using a word which is not borrowed into Japanese. However, since this pattern allows a very limited number of linguistic realisations, it was impossible to find such a word.

The transitional strategies for this pattern include (1) vocalic intrusion, (2) consonant omission, (3) excessive assimilation and (4) combination of more than one feature. Excessive application is an interesting transitional strategy. Instead of employing vocalic additional strategy, the learner used a more advanced strategy of excessive aspiration of the final consonants.

4.4 Time effect across linguistic features and difference of attentiveness.

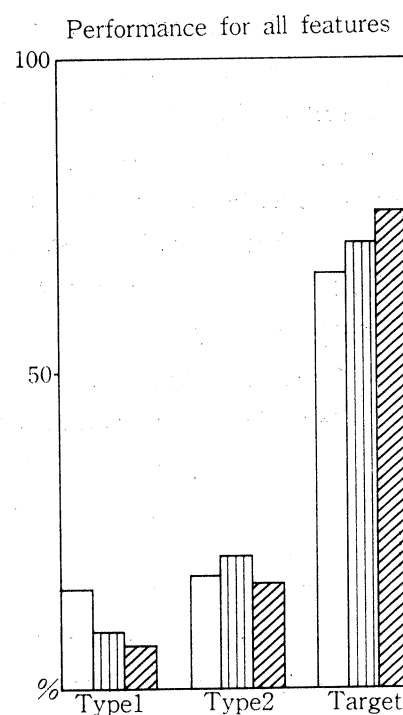
Table 5 Time effect

	Type 1	Type 2	Target
T ₁	36(17%)	39(18%)	141(65%)
T ₂	20(9%)	45(21%)	151(70%)
T ₃	15(7%)	36(17%)	165(76%)

So far we have examined the time effect on performance for each linguistic feature and the transitional performances for the target pronunciation. Next, we will examine the effect of the three factors involved in this experiment. First, we shall consider the quantitative change of those performance features over apparent 12 years.

Table 5 shows the effect of time for each type of performance. As is clear from the figures and graphs, pronunciation improves as learning develops.

The proportion of target performances increases as the learning stage goes up: 65% for T₁, 70% for T₂ and 76% for T₃. (The proportion increases by about 5% in each case.) On the other hand, the L₁-based (Type 1) pronunciation features progressively decrease as the stage rises: the proportion of Type 1 performance is 17% for T₁, 9% for T₂, and 7% for T₃. Further, the proportion of Type 2 performance was highest for the T₂ stage, indicating their transitional nature. All these indicate the general tendency that progressively more performances take on progressively more advanced variants approaching the target performance. In this sense we could conclude that the



wave mechanism generally underlies Japanese learners' learning behaviour when they learn English phonology. This means that Dickerson's finding was confirmed in Japanese settings.

However, when we examine the learning behaviour for each pattern, the learning behaviour for 10 out of 18 patterns cannot be explained by wave theory. They are: /#sp-/, /#pl-/, /-ls #/, /#spl-/, /#spr-/, /-kst #/, /-lpt #/, /-spt #/, /-lfθs #/, /-ksts #/. The error score for these patterns does not decrease as stage rises. This means their performances did not take on the advanced variants as stage rose. One of the possible reasons for this is faulty sampling technique. As is stated in 3.1.4, sampling of the population is crucially important for cross-sectional experiment. In this experiment, the pronunciation level of T₁ subjects was slightly higher while that of T₂ slightly lower than we had expected. As the result, T₂ performance tended to be more L₁-based (less advanced) than T₁ performances. (In 5 out of the above 10 patterns, the error score was higher for T₂ than for T₁.) This means that pronunciation ability does not correlate one hundred per cent with general English ability, for the general English ability of T₂ group was certainly higher than that of T₁ group.

Another possible reason is the small size of samples used for this experiment. The number of subjects is very small for such an experiment, only 6 for each learning stage. In a small scale experiment, it is very likely that one deviant performance can affect the total performance more than in a large-scale experiment. In this sense it would have been more desirable if we could have secured larger samples.

4.5 Effect of linguistic features on performance across time and degree of attentiveness

Table 6. Effect of linguistic features

	Type 1	Type 2	Target	Score	Mean
value	2	1	0		
-p #	1	1	34	3	
-d #	-	2	34	2	12
-tʃ #	15	-	21	30	
#sp-	-	7	29	7	
#kr-	6	9	21	21	20
#pl-	8	17	11	33	
-ls #	1	1	34	3	
-pt #	2	-	34	4	3
-ft #	-	1	35	1	
#spr-	-	5	31	5	
#spl-	2	17	17	21	18
#str-	6	16	14	28	

-kst #	5	1	30	11	
-lpt #	1	0	35	2	7
-spt #	3	2	31	8	
-ksθs #	9	15	12	33	
-lfθs #	1	17	18	19	28
-ksts #	11	9	16	31	

In order to get an indicator of difficulty of each pattern, we calculated the error scores (ES) for each pattern. (As for error score, see 4.2). As is shown in Table 6, the error score varies, pattern to pattern, from 2 to 33, which indicates that the effect of this factor on performance was strong. Based on this error score, the consonant patterns are classified in three categories, (1) very difficult, (2) difficult and (3) easy. Patterns whose error scores are more than 15 are ranked as *very difficult*, patterns whose error scores are from 14 to 10 are ranked as *difficult*, and patterns whose scores are lower than 10 are ranked as *easy*. The classification of patterns is as follows.

(1) Very difficult pattern ($ES \geq 15$)

/tʃ #/, / # pl/, / # str/, /ksθs #/, /ksts #/

(2) Difficult pattern ($14 \geq ES \geq 10$)

/ # kr/, / # spl/, /kst #/, /lfθs #/

(3) Easy pattern ($9 \geq ES$)

/p #/, /d #/, / # sp/ /ls #/, /pt #/, /ft #/ / # spr/, /lpt #/, /spt #/

As for the environment of these patterns, the patterns in the initial position are more difficult than those in the final position. The mean error score for consonant clusters in the initial position was 19, while the mean for the final position patterns was 12.5. Further, if we compare the two environments for the same pattern, it is more evident that the initial position is more difficult than the final position. For example, for the CC pattern, the error score for the initial position was 20 (mean) while that for the final position was 3. For the CCC pattern, the error score for the initial position was 18 while that for the final position was 17.

The length of the pattern (the number of consonants) does not seem to affect the difficulty of performance. The mean error scores for C, CC, CCC and CCCC pattern are, 12, 11.5, 12.5 and 28 respectively.

4.6 Effects of degree of attentiveness on performance

The factors of attentiveness/inattentiveness, counter to our expectation, had no effect on performance. Table 7 shows the error score of attentive performance and inattentive performance for each pattern and the mean score for each performance. The mean values for attentive performance and inattentive performance are both 7, showing no difference.

There are several possible reasons for this. Firstly, although we hoped and assumed in this test design that the testing point was understood by the subjects in part 1 and not in part 2, it is quite possible that this was not the case. In part one, the test items are shown in citation form, but this does not necessarily mean that the testing points are clear to the subjects. They might have taken the vowels as the testing point and concentrated on them since vowels are the usual testing points in the Japanese entrance examination.

Strictly speaking what we did by using citation forms was only to narrow the possibility of testing areas. Possibly this might have affected the performances of the subject.

Secondly, there was a difference in testing conditions between part 1 and part 2 of the test. In part 1, the subject was asked to pronounce the words in isolation, while in part 2 he was asked to pronounce the sentence in which the word for testing was embedded. It is quite possible that the pronunciation of a single word is different from that of a word in the sentence. This difference of testing conditions might have

Table 7. Effect of degree of attentiveness on performance

	Attentive performance				Inattentive performance			
	Type 1	Type 2	Target	Error Score	Type 1	Type 2	Target	error Score
/-p #/	0	0	18	0	1	1	16	3
/-d #/	0	0	18	0	0	2	16	2
/-tʃ #/	7	0	11	14	8	0	10	16
/ #sp-/	0	5	13	5	0	2	16	2
/ #kr-/	5	5	8	15	1	4	13	6
/ #pl-/	3	9	6	15	5	8	5	18
/-ls #/	1	0	17	2	0	1	17	1
/-pt #/	1	0	17	2	0	1	17	1
/-ft #/	0	1	17	1	0	0	18	0
/ #spr-/	0	4	14	4	0	1	17	1
/ #spl-/	1	8	9	10	1	9	8	11
/ #str-/	3	8	7	14	3	8	7	14
/-kst #/	1	1	16	3	4	0	14	8
/-lpt #/	1	0	17	2	0	0	18	0
/-spt #/	0	2	16	22	3	0	15	6
/-ksθs #/	6	6	6	18	3	9	6	15
/-lfθs #/	1	9	8	11	0	8	10	8
/-ksts #/	5	4	9	14	6	5	7	17
Total				132				129
Mean				7				7

affected the test performances.

Thirdly, although it is an almost unavoidable aspect of an experiment, the testing situation itself possibly forced the subjects to be attentive to their whole performance. Therefore, their performance was never inattentive. To elicit inattentive performance under testing conditions is extremely difficult, almost impossible because the subjects are aware of being assessed.

It would be extremely difficult to overcome the third problem, but it is possible to overcome the first two problems and to improve the experiment. Our suggestion is to try another similar experiment by using in part 1 the same sentence form in which the testing point is embedded and underlined with an explicit description of the testing point.

5. Conclusion

The aim of this study was to describe and explain the process of the learning of English phonology by Japanese learners. To fulfill this goal, we made various analyses of tape-recorded pronunciation performance from various viewpoints. To conclude, we will summarise the main findings.

(1) The learners at every stage of learning developed various kinds of interlanguage performance rules as a transitional strategy to the target performance. They are: (1) vocalic intrusion/addition, (2) consonant lengthening, (3) consonant weakening, (4) consonant omission, (5) consonant addition, (6) failure of devoicing, (7) excessive assimilation, (8) substitution of similar consonant (replacement) and (9) combination of two features. This result is strikingly different from Kohmoto's (1969) result, and supports Dickersons (1975) view that language learning is not controlled by a theory of positive and negative transfer.

(2) The pronunciation performance showed improvement as learning develops and this improvement/change was generally accounted for in terms of wave theory. This generally means that Dickerson's view of the wave mechanism as an explanatory power in language learning was verified in Japanese settings. However, there were more than half of the patterns the pronunciation of which could not be explained by the wave mechanism. This was ascribed to a small sample size and sampling error inherent in the cross-sectional method.

(3) The effect of the time factor on performance was found to be quite strong. It was also found that the difficulty of consonant cluster patterns was not determined by the length of cluster (the number of consonants) but by the environment of the pattern (final/initial position) and also by the inherent structure of the pattern itself.

(4) The factor of the degree of attentiveness, counter to our expectation, had no effect on performance. This was ascribed to the deficient response-eliciting

technique and based on this judgement, a suggestion was made to improve the experiment.

(5) It was found that general English ability does not perfectly correlate with pronunciation ability.

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