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A Phonological Analysis of Decoding Errors

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The present paper aims at investigating and exploring some perspectives of the contribution of phonology to the acquisition of a second language. In the course of our research, the phonological difference in the syllabification systems of English and Japanese is carefully analyzed. The focus of our research was to do a phonological analysis of decoding errors. First, we defined the consonant-vowel [CV] tier in the phonological process of syllabification. We also clarified the difference of syllabification system between English and Japanese. Second, we attempted to discuss the phonological intervention from the source language (L1) of Japanese to the target language (L2) of English in terms of the phonological analysis of data taken from Japanese learners of English at the university level. We also attempted to explain adequately the phonological background to the production and comprehension errors in the process of second language acquisition in terms of the transfer of vowels and consonants between the two languages. Third, in our rather detailed data-analysis, we discussed the similarity or closeness of vowels and consonants in variant words to those in a target word. This paper concludes that the number of syllables and the shared phonological features between a target word and its variant word play an important role in determining the degree of similarity between the two words.

Key Words : syllabification, source language, target language, vowel(s), consonant(s), distinctive feature(s)

1. 0 Introduction

Through language we are able to formulate values, to exchange our ideas and knowledge, and to inherit the variety of our conventional values of culture. Thus language is very important for human survival as it is a major means of communication.

Two types of participants are involved in the linguistic process of communication. One is an encoder or an addresser and the other a decoder or an addressee. In the actual communication between the two, the encoding process is considered to be that of production and the decoding process to be that of comprehension and understanding. In the encoding process, the phonological and segmental elements of phonemes are successively combined to make up a meaningful sequence of a word or a sentence. In the decoding process, a decoder or a listener is expected to comprehend correctly and immediately what is produced by an encoder on the levels of phonological perception and grammar. In order to do so, he/she is first and foremost required to carry out the cognitive task of analyzing the phonological sequence of words or sentences where a sequence of segmental elements of vowels and consonants is meaningfully organized.

A learner of a language tends to make a number of linguistic errors which turn out to be negative evidence in the developmental stage of language acquisition (Pinker 1989 : 10). It is also the case in the process of second language acquisition. A Japanese learner of English tends to make rather common errors in pronunciation and comprehension. It is because their production or comprehension process of English segmental phonemes inevitably takes place under the influence of his/her native source language of Japanese. In other words, some linguistic aspects of Japanese

intervene more or less in the process of production and comprehension of English produced by a Japanese learner of English.

In the consonant alternation, for example, *clothe* [klouð] is often comprehended as *close* [klə uz/klouz] by a Japanese learner of English. As is well known, words such as *rice* [raɪs] and *lice* [laɪs], *right* [raɪt] and *light* [laɪt] are often confused in so far as [r] and [l] are not to be strictly distinguished from each other in Japanese. Furthermore, one-syllable words such as *strong* [strɔŋ] and *and* [æ/ənd] tend to be pronounced as multiple-syllable words in Japanese such as [sɯ-to-ro-N-gɯ] and [a-N-do].

Phonological errors of this kind are inevitable in the course of second language acquisition to the effect that the English syllabification system is quite different from the Japanese one in terms of the possible combination of consonants and vowels. What is important is to explain adequately the theoretical background of the production and comprehension errors in the process of second language acquisition. Decoding errors which we deal with in this paper are phonological, focusing upon the comparative analysis of syllabification between Japanese and English.

According to Wolfram and Johnson (1982 : 84), "the syllable, rather than the morpheme, should be the basis for determining the acceptability of sound sequences and for understanding phonological patterns." This research aims at making some contribution to explore the phonological aspect of the difference of the syllabification system between the source language (L1) of Japanese and the target language (L2) of English in terms of the acquisition of second language acquisition. In this paper, we will first discuss the syllabification system in terms of the [CV] (consonant-vowel) tier in the cluster of phonological segments both in English and Japanese. Second, we will analyze the process of intervention from the source language to the target language in terms of the phonological analysis of syllabification. Third, we will make a rather detailed data-analysis of the decoding errors taken from the learners of English at university level, focusing upon the variety of vowels and consonants in a target word and its variant words. Finally, we will attempt to make clear what kind of methodological bridging is useful in the acquisition of L2 in terms of the difference of the syllabification system between English and Japanese.
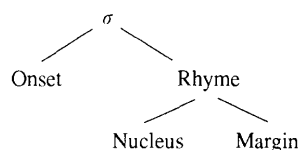
2. 0 Syllabification
2. 1 [CV] Tier

The phonological representation has so far been figured out in terms of the linear string of phonological segments. However, the segmental analysis had a tendency to ignore the significant role of syllabification which we assume is the key term of the characterization of sound system both in Japanese and English.

A syllable is, according to Crystal (1991) "a unit of pronunciation typically larger than a single sound and smaller than a word." It is also a cluster of consonants and vowels which is featured by a maximum peak of resonance. It is in fact a real phonological notion in the course of the speaker's pronunciation in so far as it determines the metric and tonal aspect of pronunciation. Whether it is monosyllabic or polysyllabic, the phonological process of syllabification provides information about how a given word is pronounced or hyphenated in producing a message.

The nucleus of a syllable is the maximum peak of sonority, and the peak is surrounded by the onset and the coda elements. According to Katamba (1989 : 161) a syllable is the unit in terms of which phonological systems are organized and it consists of the onset and the rhyme element which also consists of the nucleus and the margin or the coda. The nucleus is the maximum peak of resonance which a vowel usually undertakes although a consonant occasionally may fill this

position in English. This is hierarchically figured out as follows:

(1)

```
                    σ
              /           \
          Onset           Rhyme
                        /        \
                   Nucleus      Margin
```

where σ stands for a syllable and the onset is the initiating segment and the margin is the terminating segment. A syllable in English consists of consonant(s) initially, a vowel at the nucleus, and also consonant(s) finally. And a vowel, being a nucleus, has the centripetal energy to realize a syllable as it is. In other words, it has a stronger prominence and longer duration than other segments. The onset and the margin can be null or a single consonant or a double or triple consonant, and the nucleus can be a monophthong or a multiple vowel of diphthong or triphthong, but it cannot be null.

2. 2 Syllabification System in English and Japanese

The basic unit of syllabification in English, on the one hand, is considered to be [CVC] where [C] can be either a single consonant or the multiple consonant of double or triple consonant placed initially or finally and [V] can be a vowel including diphthong and triphthong. On the other hand, Japanese syllabification is figured out as [CV] unit, exemplified by [ka] for a *mosquito*, [te] for *hands*, [ni] for *two*. Furthermore, a consonant cannot be a terminating element in Japanese except the Japanese unique consonant of [N]. A consonant in general must be followed by a vowel to keep the [CV] unit, which is not the case in English. Thus we roughly show below the examples of [CV] tier of syllabification in English:

(2)

V :	*a*
CV :	*tea sea pie high bee quay me sigh*
VC :	*at if on it as is in out isle ale*
CCV :	*stay play try free plea crew they*
CVC :	*cut sit did fine tool kin pen tin*
VCC :	*ink act end old ask elm apple*
CCCV :	*stray spray splay scree screw*
CCVC :	*plum truck sting brain grill glad*
CVCC :	*sickle jingle desk fiddle fund bank*
VCCC :	*uncle angle amble ample ankle*
CCCCV :	φ
CCCVC :	*strong string split splash scram*
CCVCC :	*frost flint stamp drift staple cradle*
CVCCC :	*single tinkle tumble mantle candle*
VCCCC :	φ
VCCCCC :	φ
CCCCCV :	φ
CCCCVC :	φ

CCCVCC : *strict   sprint   script   splint   scrimp*
CCVCCC : *stumble   glimpse*
CVCCCC : ϕ
VCCCCC : ϕ
CCCVCCC : *strength   sprinkle   scramble*

where V can be a diphthong or triphthong or a long vowel which is the maximum peak in syllabification. The above list suggests that the nucleus in a syllable is a vowel in English, and a single vowel does not come to the terminating place ; only a diphthong, a triphthong, or a long vowel does. Furthermore, the maximum number of sequential consonants in a syllable is roughly three whether the sequence comes before or after the vowel in so far as we do not take into consideration the morphological or inflectional suffix of [s] or [z] in grammatical number or [d] or [t] in tense.

The Japanese syllable system is contrastively quite different from the English one. It does not have a sequential string of consonants, and a single vowel usually comes to the terminating place. The diphthong or triphthong which makes up one syllable in English is not usually accepted in Japanese. A contracted sound (*yoo-on* in Japanese) is not a diphthong, but it is the combination of a consonant, a semi-vowel called a glide, and a single vowel, where the middle semi-vowels [y] and [w] are glides and [–vocalic].

A Japanese learner of English does not distinguish diphthongs or triphthongs which often appear in English from the combination of two vowels in Japanese. He/she has a tendency to pronounce one-syllable words such as *desk* [desk] and *drift* [drıft] as three and four syllable words such as [de-sɯ-kɯ] and [do-ɾı-Φɯ-to], and one-syllable words such as *power* [paʊə] and *fire* [faıə] as three-syllable words such as [pa-ɯ-a] and [Φa-ı-a]. Thus one-syllable words in English tend to be modified into the words with the Japanese way of syllabification in terms of the mutual difference of the unit of [CV] tier in syllabification. Notice the following table :

[Table 1]

English	Syllable No.	Japanese	Syllable No.
spring [sprıŋ]	1	[sɯ-pɯ-ri-ɴ-gɯ]	5
table [teıbl]	1	[te-i(e)-bɯ-rɯ]	4
desk [desk]	1	[de-sɯ-kɯ]	3
as [æ/ əz]	1	[a-zɯ]	2
a [æ/ ə]	1	[a]	1

The word *spring* [sprıŋ] which has the triple consonant [spr] tends to be pronounced by a Japanese learner of English as [sɯ-pɯ-ɾi-ɴ-gɯ] under the influence of syllabification from his native source language of Japanese. A vowel being followed by each segmental consonant, the former is a one-syllable word and the latter a five-syllable word. *Table* [teıbl] which is an one-syllable word tends to be pronounced as a four-syllable word [te-ı(e)-bɯ-ɾɯ]. The one-syllable word *desk* [desk] tends to be pronounced as a three-syllable word [de-sɯ-kɯ]. We often hear English one-syllable words such as *as* or *if* being pronounced as two-syllable words such as [a-zɯ] or [ı-Φɯ] in Japanese.

3. 0 Intervention

3. 1 Alternation of Consonants

The English of non-native speaker of English is the English which undergoes the intervention

from his native source language. The cognitive framework to feedback the pronunciation of his English sometimes works well, but sometimes not. It is especially the case when he produces unusual and unfamiliar segmental unit of consonants. The English word *vacation* [vəkeiʃən] is sometimes pronounced as **bacation* [bəkeiʃən] in so far as [v] in English, which is unfamiliar to a Japanese learner of English, tends to be replaced by [b]. In the course of our research, we often encountered examples of substitution of [θ] for [s] in examples such as *faith* [feiθ] for *face* [feis], *thread* [θred] for **sled* [sled], and *ethnic* [eθnɪk] for **esnic* [esnɪk]. The [+fricative] and [+dental] consonant [ð] is also substituted for the [+fricative] and [+alveolar] consonant [z] in examples such as *thus* [ðʌs] for [zas] and *clothe* [kləʊð] for *close* [kləʊz], needless to say the confusion of [l] and [r] which takes place in examples such as *late* [leit] and *rate* [reit] in English for [ɾeit] in Japanese. We also found out the word *laboratory* alternated with **raboratory* as a result of the confusion of [l] with [r]. Moreover, [f] may be also alternated with [Φ], which can be exemplified by *five* [faiv] for [Φaivɯ], simply because there is no sound [f] in Japanese which tends to be easily replaced by [Φ]. We now show below the pairing list of substitution of consonant which takes place frequently in the real sentences produced by a Japanese learner of English.

[Table 2]

Alternation		English	Japanese
a. [v] vs. [b]	*vacation*	[vəkeiʃən]	[bəkeiʃən]
b. [θ] vs. [s]	*ethnic*	[eθnɪk]	[esnɪk]
c. [ð] vs. [z]	*clothe*	[kləʊð]	[kləʊz]
d. [l], [r] vs. [ɾ]	*light* *right*	[lait] [rait]	[ɾait]
e. [f] vs. [Φ]	*fine*	[fain]	[ΦaiN]

3. 2 Liaison

Liaison is a type of phonological transmission between segmental sounds, especially the combination of a terminating consonant in a word and a fronting vowel in its following word. This combination functions to realize a new [CV] unit in real conversation. English has a phonological feature of this phenomenon, although Japanese does not have it.   For example, the English prepositional phrase *out of* comes to be pronounced as [aʊ, tɒv] and the three-syllable phrase *Here it is* as [hiə, ɾi, tiz]. Notice the following :

(3) a.   This   is   an   apple.
     b.   [ðɪs]   [ɪz]   [æn/ən]   [æpl] .

(3a) is a common English sentence, and (3b) is a sequence of the phonetic symbols of each word in this simple sentence. However, the real pronunciation of this sentence is not like that in (3b). It is rather like the following :

(4) [ðɪ] [sɪ] [zə] [næpl]

where liaison works. The consonant [s] in *this* and the fronting vowel [ɪ] in the following word *is* is phonologically combined to make up another [CV] syllabification unit of [sɪ]. The same kind of phenomenon takes place in [zə] which consists of [z] in *is* and [ə] in *an* and in [næpl] which consists of [n] in *an* and [æpl]. The Japanese language does not have such a phonological phenomenon of liaison to the effect that a Japanese word generally does not end up with a

consonant. Consequently, it is difficult for a Japanese learner of English to grasp correctly liaison which takes place very often in the quick stream of English segmental sounds.

3. 3   Overgeneralization of Vowels

The Japanese language has five main vowels such as [i], [e], [a], [o], and [ɯ], and all of them are monophthongs. Contrastively, the English language has more than a decade of single vowels, aside from diphthongs and triphthongs. Thus inevitably the confusion of vowels takes place very often in utterances produced by a Japanese learner of English. The confusion caused by the difference of vowel system between the two languages can be considered to be overgeneralization of vowels. For example, the monophthong [i] in Japanese can be either [i] or [ɪ] in English, [e] in Japanese can be [e] or [ɛ] in English, and [a] in Japanese can be [a] or [ɑ] or [ʌ], or [æ] or [ə] in English, and so forth. Here we see the phenomena of phonological interlanguage in terms of the syllabification system of production and understanding between English and Japanese. As a matter of fact, there is no distinction in Japanese between [i], [e] and [u] which are featured by [+tense] and [ɪ], [ɛ], and [ʊ] which are featured by [+lax]. Thus, as is shown below, we can predict, taking Wells (1990) into consideration, that a number of English monophthongs can be alternated with one of the five single vowels in Japanese.

[Table 3]

English Monophthongs	Japanese Monophthongs
[i] in *key* or *happy*	[i]
[ɪ] in *kit* or *pity*	
[e] in *dress* or *bed*	[e]
[ɛ] in *air* or *yet*	
[ɑ] in *father* or *start*	[a]
[æ] in *bad* or *trap*	
[ʌ] in *love* or *strut*	
[ə] in *about* or *comma*	
[o] in *goat* or *force*	[o]
[ɔ] in *boy* or *decoy*	
[ɒ] in *cold* or *thought*	
[u] in *goose* or *annual*	[ɯ]
[ʊ] in *foot* or *stimulus*	

Nevertheless the process of vowel alternation is more complex than we imagine. A vowel is alternated with another vowel in various ways. Here we assume is a matter of phonological territory of phonemic field which is very much cognitive in its perceptual process of understanding. As for the vowels, they are varied. We henceforth take advantage of the symbol v for a single vowel, v̆ for a diphthong and v̄ for a long vowel.

The target word *plum-met* [plʌmit] wih the syllable structure (<ccvc-vc>) was first given to the subjects and it has the vowel [ʌ]. There are also variant words about this target word ; e.g. *profit* [prɒfit], *promise* [prɒmis], and *planet* [plænit]. In this case [ʌ] in *plummet* is alternated with [ɒ] in *profit*. and *promise*. It is also alternated with [æ] in *planet*. Thus we see that [ʌ] is alternated with [ɒ] and [æ]. The C–V combination in the syllabification system is <ccvc-vc>, and it is the same among the words here. We now assume that these three vowels in variant words are all placed in the same phonemic territory in our subjects with the phonological features of [+central] and

[−(tongue) high]. Here is another example *con- tam-i- nate* [kəntǽmineit] (<cvc-cvc-v-cvč>) where [æ] in this word is alternated with [ı] in *continent* [kɒ́ntınənt] (<cvc-cv-cvcc>) and [e] in *content* [kɒntént] (<cvc-cvcc>) All these three vowels in the variant words share the same phonological features [+ (tongue) front] and [+tense] although the number of syllable is different from each other. The target word is four syllabled although the variants are two and three syllabled.

The difference of the number of syllables is suggestive for us to claim which variant is closer to the target word. Hypothetically, the smaller the gap of the number of syllables in a variant word is, the closer it is to the target word. We also assume here that the placement of tongue plays an important role in the process of alternation of vowels.

Significantly, we have the target word *prev-a- lent* [prévələnt] with the syllable structure (< ccvc-v-cvcc>) where [e] is alternated with the long vowel [ɜ:] in its variant word *permanent* [pɜ́:mənənt] (<cv̄-cv-cvcc>), with the single vowel [ɒ] in *problem* [prɒ́bləm] (<ccvc-cvc>), with [æ] or [ɑ:] in *plant* [plænt] or [plɑ:nt] (<ccvcc> or <ccv̄cc>), and with the long vowel [u:] in *prove* [pru:v] (<ccv̄c>) and [æ] in *plan* [plæn] (<ccvc>). The number of syllables is varied between the target word and its variant words. In the target word and *plant* or *plan*, the confusion of [l] with [r] takes place and [ɜ:] in *permanent* where [r] is not acknowledged probably undergoes the strong influence of the same final part of [ənt].

Here is another example. The target word is *a-bode* [əbóʊd] (<v-cv̌c>) where the diphthong [oʊ] is alternated with the long vowel [ɔ:] in *aboard* [əbɔ́:d] (<v-cv̄c>), with the diphthong [ɔɪ] in *avoid* [əvɔ́ɪd] (<v-cv̌c>), and also with the diphthong [aʊ] in *about* [əbáʊt] (<v-cv̌c>). The diphthong [oʊ] is also alternated with the monophthong [ʌ] in *above* [əbʌ́v] (<v-cvc>). First, [o] in [oʊ] and [ɔ] in [ɔ:] were perceived similar by the subjects. That is, [o] and [ɔ] are not distinguished from each other in their cognitive and phonologically perceptual process of [o] and [ɔ] sounds. Second, in *about*, it is not rare for a learner of English to confuse the two consonants [d] and [t] in so far as they are both [+explosive] and [+alveolar] consonants. And we also assume that [o] in [oʊ] is alternated with [a] in [aʊ] in terms of the bridging vowel of [ɔ]. As for the syllable structure, it is almost the same, namely <vcvc>, among the target word and its variant answered words.

4. 0 Data Analysis

4. 1 Research Procedures and Methodology

The data presented in this research was obtained from the research conducted by Toya (1993) in terms of the experiment of learning foreign language vocabulary through listening to the modified texts. In this research, 109 Japanese learners of English at university level were asked to listen carefully to two texts which included 24 target items with different types of vocabulary explanation. After listening to each text, the subjects were requested to put down the Japanese meaning of the target items. The items to be answered were given orally and immediately. Since this experimental procedure was repeated three times, the subjects wrote down their answers three times. The responses obtained were scored up based upon the prepared guidelines by three raters and more than 90 per cent of inter-rater reliability in percentage agreement was reported.

During the task of scoring, an interesting phenomenon was observed, that is, quite a number of answers which were considered at first to be wild guesses appeared repeatedly among their answers. Later, however, the English translation of those responses revealed the fact that their linguistic forms were of great similarity in their correct answers. This has been discussed in Toya

(1993 : 100), claiming that "most errors resulted from the Ss' phonological incompetence in the perceptual task of listening. They often failed to discriminate the sounds and to acknowledge the words as what they already knew."

Further analysis takes place in this paper. The data has turned out to be invaluable for the investigation of decoding mistakes in that its data-collection method did not target at measuring adequately the cognitive or perceptual ability to comprehend a set of sounds such as minimal pairs. Rather, it requested the subjects to grasp appropriately the meaning of words. In other words, they were asked to listen carefully to the lexical items in order to comprehend what they meant. Thus the subjects had a tendency to draw their attention to the given words as a whole, not to each segmental phoneme. This has served to make an analysis of decoding errors in the similar experimental environment.

The tendency for low proficiency learners to be attracted to the form rather than to the content or the meaning of words is reported in Haastrap (1989). In her introspective research to determine the process of inferring the meaning of unknown words in a context, she claimed that the subjects take advantage of the strategies which were holistic and/or analytic, and bottom-up and/or top-down oriented. Investigating two levels of proficiency, high and low, she found out that low level learners mainly take advantage of the holistic approach. That is, they tended to understand the word as a whole. They were less capable, compared with their high proficiency counterparts, of smooth interaction between different strategies and of selecting appropriate strategies. Thus a number of decoding mistakes occurred due to the formal or phonological similarities rather than the semantic ones.

What we acknowledge in the present research is that the subjects produced decoding mistakes in the course of employing the holistic approach. One significant question remains : how can we measure the degree of similarity to identify an acceptable sound as it is ? As a matter of fact, little is known to what extent two words are considered to be similar in their phonological perception. Our attempt, therefore, is to investigate the decoding errors and to offer some explanation in terms of the cognitive or perceptual similarity or closeness of segmental sounds in phonological form.

4. 2   Results and Discussion

The data we observe here is not as simple as those of minimal pairs such as *bat* and *bet*, *bat* and *pat*, or *bat* and *bad*, where the subjects are requested to draw their careful attention to the difference between the phonemes concerned. In our research, the target word *investigate* had variant words such as *investment, invade, invite, industry*. The given four-syllable word *in-ves-ti-gate* was heard by some subjects as the three-syllable word *in-dus-try* and the two-syllable words *in-vade* and *in-vite*. As we saw in the last section, the four-syllable word *con-tam-i-nate* is alternated with the three-syllable word *con-ti-nent* or the two-syllable word *con-tent*. Furthermore, the given three-syllable word *pre-ve-lent* was alternated with the three-syllable word *per-ma-nent*, and with the two-syllable word *prob-lem* or one-syllable words such as *plant, prove*, and *plan*. Here we see the degree of similarity between the sound of a target word and its individual variant error sound in terms of the gap of the number of syllables between the two. Thus we assume that the variant word *permanent* sounds much similar to the target word *prevalent* than the individual variants of *plant, prove*, and *plan* because of the smaller gap in the number of syllables.

Even among the errors of individual variant words of one syllable, the three words concerned here show us slightly different degree of phonological similarity to the target word. *Plant* is closer to the target word *prevalent* than another variant word *plan* because of the existence of the

terminating consonant [t]. *Prove* seems closer to the target word than *plan* and *plant* in that the subjects correctly grasp the second consonant [r] as it is rather than [l]. However, the second vowel in the target word is the monophthong [ə]. Then we assume the monophthong [æ] is relatively closer to [ə] than the diphthong [uː] in *prove*, and the single vowels [æ] and [ə] are both [+syllabic], [−high], [−round], and [−tense] in their phonological features. What is important is the phonological process of syllabification which is primarily supported by a vowel in terms of syllabification. Hence we assume *plant* is closer to the target word than *prove*. Thus we assume that, as for the degree of phonological similarity of a variant word to the target word, the number of syllables comes first, and whether a given individual variant vowel is monophthong or diph/triphthong comes second. And thirdly, among the variety of phonological features, the feature [+vocalic] namely [+syllabic] is most important in the process of syllabification. Thus whether or not a vowel concerned is [+syllabic] or [+vocalic] functions in testing the similarity or the closeness of a variant word to its target word.

Since the subjects misheard the words as those which they already knew quite well, the analysis of each error from the target word shows us a great amount of irregular omissions, insertions, and alternations of segmental elements of sound. Therefore, we would like to focus on the conspicuous cases in our data and to offer some adequate explanation based on our findings in our phonological aspect of interlanguage between English and Japanese.

4. 2. 1. Syllables

As we mentioned earlier, the subjects' L1, i.e. Japanese, is considerably different from their L2, i.e. English in the syllabification system. Since Japanese is an open-syllable language, some evidence of negative transfer was found in the perceptual and cognitive process of decoding. The transfer includes : 1) the perception of the target word ending with a vowel, and 2) the omission or insertion of a consonant in the [CC] clusters at the word-initial, middle, and final positions.

The following is the examples where the consonants at the word-final position were not perceived correctly. The subjects misheard the words as those ending with an open-syllable [CV]. Two patterns were mainly observed : the examples (5)-(9) show the omission of an explosive [t], while both examples (10) and (11) demonstrate the omission of a liquid [l] at the word-final position.

(5) Target word :   crammed [kræmd]   <ccvcc>
     Variant :   *cry* [kraɪ]   <ccv̌>

(6) Target word :   discard [dɪskɑːd]   <cvc-cv̄c>
     Variant :   *discover* [dɪskʌvə]   <cvc-cv-cv>

(7) Target word :   deposit [dɪpɒzɪt]   <cv-cvc-vc>
     Variant :   *deny* [dɪnaɪ]   <cv-cv̌>

(8) Target word :   contaminate [kəntæmɪneɪt]   <cvc-cvc-v-cv̌c>
     Variant :   *continue* [kəntɪnjuː]   <cvc-cvc-cv̄>

(9) Target word :   anticipate [æntɪsɪpeɪt]   <vc-cvc-v-cv̌c>
     Variant :   *empathy* [émpəθi]   <vc-cv-cv>

(10) Target word :   reveal [rɪvíːl]   <cv-cv̄c>
     Variant :   *review* [rɪvjúː]   <cv-cv̄>

(11) Target word : nickel [níkəl]   <cvc-vc>
      Variant :   *echo* [ékoʊ]   <v-cv̌>

Notice that, in the variant word in (5), the [CC] cluster [md] in the target word was omitted. In cases of (6)-(8), the word-final syllable pattern [CVC] has been perceived as [CV] syllable system. In (10), the subjects did not grasp [l] sound after the long vowel [juː]. Instead, they misheard the syllable as open-ended with the incorrect long vowel [uː]. (11) is the example where [l] was alternated with [ʊ] sound which was perceived as a part of the diphthong [oʊ].

4. 2. 2. Consonant Clusters ([CC])
4. 2. 2. 1. Omission
It was observed that there was a tendency for the subjects to have difficulties in comprehending words with the initial consonant cluster of [l] or [r]. In (12), the first voiced velar stop [g] was omitted and only the following liquid retained though it was misheard as [r] for [l].

(12) Target word : glide [glaɪd]   <ccv̌c>
      Variant :   *ride* [raɪd]   <cv̌c>

The combination of the [CC] cluster and a vowel was perceived in (13) and (14).

(13) Target word : plummet [plʌ́mɪt]   <ccvc-vc>
      Variants :   a. *permit* [pɜ́ːmɪt]   <cv̄-cvc>
                     b. *purpose* [pɜ́ːpəs]   <cv̄-cvc>

(14) Target word : prevalent [prévələnt]   <ccvc-v-cvcc>
      Variant :   *permanent* [pɜ́ːmənənt]   <cv̄-cv-cvcc>

Furthermore, [s] before the velar voiceless stop [k] was omitted in the word-middle position. Notice the following :

(15) Target word : discard [dɪskɑ́ːd]   <cvc-cv̄c>
      Variants :   a. *decrease* [dɪkríːs]   <cv-ccv̄c>
                     b. *depart* [dɪpɑ́ːt]   <cv-cv̄c>
                     c. *deceive* [dɪsíːv]   <cv-cv̄c>
                     d. *coward* [káʊəd]   <cv̌-vc>

In the variant word of (15a), the sound [s] between [ɪ] and [k] in the target word was omitted, yet the other segmental sounds are survived. In the variant (15b), not only the omission of [s] occurred but also it affected the following sound [k]. The velar stop was alternated with the explosive [p]. The fricative consonant [s] appears in both the target word and its variant consonant although it becomes a part of the second syllable in this variant word. This variant is rather ambiguous, for it may be possible to explain that the sound [k] was omitted, not [s]. Still, we would like to take this as a case of [s] omission, considering that the first syllable in the target [CVC] was perceived as [CV] in (15c). The variant (15d) shows rather peculiar case among the four variants. because the word-middle consonant cluster [sk] seems to have transferred itself into the vowel [ʊ] which is a part of the diphthong [aʊ] in the first syllable. Another explanation may be possible. The subjects may have failed to correctly perceive the first syllable [dɪs] of the target word *discard*. Thus the second syllable [kɑːd] was misheard as [káʊəd], where the consonant [s] has been omitted.

In examples (16) and (17), the nasal [n] was omitted in the variants. The [(C)V + [n]] syllable

was perceived as the [(C)V] syllable there :

(16) Target word : anticipate [æntísɪpeɪt]   <vc-cvc-v-cv̌c>
     Variant :   *patient* [péɪʃənt]   <cv̌-cvcc>

(17) Target word : convey [kənvéɪ]   <cvc-cv̌>
     Variant :   *obey* [əbéɪ] [oʊbéɪ]   <v-cv̌>

In Japanese, the nasal [N] which covers English [n], [m], and [ŋ], can take the terminating place, and can construct a [CVC] syllable. In this respect, the subjects omitted this consonant unexpectedly in the above examples. A possible explanation may be that, since Japanese is often referred to as a mora language, the consonant [N] functions as one mora which is as long as one unit of syllable such as [do] and [mɯ] (cf. the Japanese pronunciation [sɯ-pɯ-ri-N-gɯ] for the English word *spring* shown in Table 1). As for (16), a Japanese would expect that the target word *anticipate* could be pronounced as being close to [a-N-ti-ʃi-pe-i-to]. In contrast, the first target syllable [æn] in English is just one syllable. It is therefore possible to assume that the omission of [n] took place due to the different features between [N] in Japanese and [n] in English.

Nasals offer different interesting examples as we observe the variants in examples (18)-(20) where the syllable structure of [(C)CVCC] was perceived as that of [(C)(C)VC] :

(18) Target word : prevalent [prévələnt]   <ccvc-v-cvcc>
     Variants :   a. *problem* [prɒbləm]   <ccvc-cvc>
                    b. *plan* [plæn]   <ccvc>

(19) Target word : crammed [kræmd]   <cvcc>
     Variants :   a. *crayon* [kréɪɒn]   <cv̌-vc>
                    b. *claim* [kleɪm]   <ccv̌c>
                    c. *cream* [kriːm]   <ccv̄c>

(20) Target word : plunge [plʌndʒ]   <ccvcc>
     Variants :   a. *plum* [plʌm]   <ccvc>
                    b. *plan* [plæn]   <ccvc>

Significantly, the word-final consonant omission occurred in all the variant words immediately after the nasals of [n] and [m]. The distinction between the syllable ending with a combination of vowel and [+nasal] consonant and the syllable with a single vowel is not difficult to perceive in so far as Japanese offers a clear distinction between *ma* [ma] (pause, room) and *man* [maN] (ten thousand). In fact, the examples indicate that the subjects successfully grasped the sounds right after the last vowels of the target words. Still, the final [CC] clusters were simplified into one consonant and the survived ones were all nasals. One should notice, therefore, that, if the omitted word-final consonants were to be correctly perceived, they would request that a vowel can be inserted at the very end of the target words. For example, a Japanese listener would expect the word *prevalent* to be pronounced as [pɯ-re-ba-re-N-to], just as the English word *land* is often pronounced as [ra-N-do]. Thus we claim that the gap between the native speaker's pronunciation and the non-native speaker's listening expectancy results in this type of mistake.

4. 2. 2. 2. Insertion

Here is an example of the phonological confusion between [pɜː] and [pre] at the word-initial position :

(21) Target word :   purchase [pɜ́ːtʃəs]   <cv̄-cvc>
      Variant :   *precious* [préʃəs]   <ccv-cvc>

This is an opposite case of example (14) and the liquid [r] is inserted here instead of being omitted. The sound [ɜː] is regarded as a vowel and [r] as a consonant, and we have categorized this case under phonemic insertion for consonant clusters. However, the liquid [r] has the features of a vowel such as [+vocalic], [+continuant], and [+voiced], and is similar to [ɜː]. Therefore, this type of mishearing should be considered as a confusion of the two and thus work in two ways.

As for examples (22)-(27) below, an extra consonant was added to the word-middle position when the target words were perceived. Examples (22) and (23) can be regarded as the reverse cases of example (15). They all indicate that the subjects did not successfully discriminate the stops such as [p], [t], [k] from the [[s]+C[+stop]] clusters when listening for the content meaning.

(22) Target word :   deposit [dɪpɒ́zɪt]   <cv-cvc-vc>
      Variant :   *despite* [dɪspáɪt]   <cv-ccv̌c>

(23) Target word :   undertake [ʌ́ndəteɪk]   <vc-cv-cv̌c>
      Variant :   *understand* [ʌndəstǽnd]   <vc-cv-ccvcc>

There are two ways in interpreting example (24). Observing the degree of similarities among the target consonants and the replacing or inserted ones, we assume that the consonant [m] in the target word was alternated with another nasal [n] and that the glottal stop [g] was inserted between [ʌ] and [n]. Another possible explanation remains. Note that the second syllable in the target word is the [VC] pattern while that of the variant is a [CVC] pattern. Both target and variant words have the first syllable ending with [-VC]. This may indicate that the consonant [n] which occurs at the beginning position of the first syllable has been omitted. If this is the case, the inserted consonant could be [n], not [g].

(24) Target word :   plummet [plʌ́mɪt]   <ccvc-vc>
      Variant :   *magnet* [mǽgnɪt]   <cvc-cvc>

We have shown the example of the liquid insertion in (21) at the word-initial position. The same kind of insertion is observed in examples (25), (26), and (27) at the word-middle position. Note that the insertion occurred at the beginning of the stressed syllables.

(25) Target word :   abode [əboʊd]   <v-cv̌c>
      Variant :   *abroad* [əbrɔ́ːd] [əbrɒ́ːd]   <v-ccv̄c>

(26) Target word :   discard [dɪskáːd]   <cvc-cv̄c>
      Variant :   *decrease* [dɪkríːs]   <cv-ccv̄c>

(27) Target word :   contaminate [kəntǽmɪneɪt]   <cvc-cv-cv-cv̌c>
      Variant :   *complain* [kəmpléɪn]   <cvc-ccv̌c>

There was a case of insertion with the nasal [n] as the following examples (28)-(30) show.

(28) Target word :   glide [glaɪd]   <ccv̌c>
      Variants :   a. *grind* [graɪnd]   <ccv̌cc>
                       b. *grand* [grænd]   <ccvcc>

(29) Target word :   undertake [ʌ́ndəteɪk]   <vc-cv-cv̌c>
      Variants :   *understand* [ʌndəstǽnd]   <vc-cv-ccvcc>

(30)   Target word :   anticipate [æntˈsɪpeɪt]   <vc-cvc-v-cv̌c>
      Variant :   *patient* [péɪʃənt]   <cv̌-cvcc>

In these examples, [n] was inserted between the diphthongs [ɑɪ] or [eɪ] and the stops [d], [k], or [t]. As for example (28), both [n] and [d] are articulated at the alveolar position and voiced, though the former is a nasal and the other a stop. These variants indicate that, at the word-final, to distinguish a single consonant [C] from the consonant cluster [CC] immediately after the diphthong was difficult. Earlier in examples (18)-(20), we have argued that the Japanese subjects were confused with English nasals and Japanese [N] in terms of syllabification. The cavitary movement, in producing [aɪd], starts from [a], gets narrower to produce [ɪ], and the tongue would end up touching the alveolar position when producing [d]. Between [ɪ] and [d], the Japanese subjects may have perceived as if they had heard the nasal [n]. The same explanation can be made for examples (29) and (30).

The omission and insertion of nasals and liquids, at least the confusion between the syllables with and without these consonants, may be related to the phenomenon of epenthesis among Japanese learners of English. Nasals and liquids are rather close to vowels ; therefore, the insertion of these can be regarded as a similar phenomenon as epenthesis. The fact that the subjects were confused in this respect indicates that their ability to decode the target words was insufficient. It should be noted that the subjects did not always simplify the clusters by omission but also created unnecessarily complex representation and misheard the individual consonants as the [CC] clusters.

Here is the final example of the consonant insertion. In (31), the subjects perceived the final liquid [l] as if it had been the cluster [ld]. This example gives us a good contrast with example (10) and (11) in which the word-final [l] was omitted. Examples (10), (11), and (31) indicate that it is difficult for Japanese to correctly perceive the liquid [l] at the word-final position.

(31)   Target word :   reveal [rɪvíːl]   <cv-cv̄c>
      Variant :   *rebuild* [riːbɪld]   <cv̄-cvcc>

The decoding errors which we observed so far are related to the notion of syllabification. They may attribute to the fact that "Japanese is one of the many languages that allow very few consonants to occur at the end of a word" (Odlin 1989 : 122). Still, if we were to depend only on L1 transfer, we would expect to find the other type of errors, i. e. epenthesis. It has been reported by Odlin (1989 : 122) that when Japanese speakers with little experience in English try to pronounce words with the [CVC] syllables, they often have "a vowel added to create a second syllable as in [pigə]" for the word *pig*. This type of errors, however, did not appear in our data except that we have argued that the nasal and liquid insertion could be regarded as a similar pattern to epenthesis.

The mishearing of the [(C)VC] syllable as [(C)V] by the L2 learners of English may be regarded as evidence of the interference from L1 ; however, some researchers have attributed this kind of interlanguage phonology to the language universals to some extent. Eckman (1981a, 1981b) found that "the native speakers of Cantonese and Spanish devoiced word-final stops in English although such a rule does not exist in either at the native or target languages" Odlin (1989 : 121). He concluded that the explanation for the devoicing rule lay in the universal phonological similarities, not in their native languages. Tarone (1980) indicated the universal preference for the open syllable of the [CV] tier. In the case of Japanese, to nail down the source for the devoicing rule is difficult because the [CV] tier is a characteristic of the Japanese language as well as common in many languages in the world. Therefore, it is most reasonable to conclude that the devoicing rules by Japanese are due to the interaction of both as studies like Sato (1984) demonstrated (for

review, see Odlin 1989).

4. 2. 3. Alternation of Vowels

Regarding the decoding mistakes caused by the mishearing of vowels, we would like to limit our scope to the issue of short vowels only. Taking into consideration the fact that Japanese has less number of vowels than English (cf. Table 3), we would like to propose that Japanese with insufficient amount of experience in English could have difficulties in accurately discriminating English vowels. The investigation by Scholes (1968, cited in Odlin 1989) supports this idea as he concluded that "non-native speakers are likely to categorize foreign language sounds largely in terms of the phonemic inventory of the native language (Odlin 1989 : 114)." A recent study by Bohn and Fledge (1990) shows that this is basically true for those who have not had much exposure to the target language. They demonstrated that the English vowel [æ] falls somewhere between [ɛ] ([ɛː]~[e]) and [a] sounds ; therefore, it is a "new" vowel for German speakers. They tested English-experienced and inexperienced adult German subjects as well as English native speakers on their perception of the vowel [æ], contrasting it with [ɛ] in the [bVt] environment. They created a number of words of this phonological environment recorded with a vowel in a continuum and had the groups of subjects discriminate the phonological boundary of the two vowels. The results showed that English native speakers were accurate in discriminating the two vowels, whereas inexperienced German speakers failed to tell the boundary. The pattern obtained by the experienced German speakers fell between those of the native speaker group and inexperienced group, indicating that the experienced group was capable of perceiving the phonemic difference, though their ability was less than the native speakers'.

With the kind of data collection method employed in Bohn and Fledge (1990), non-native speakers of English, as they get more experienced with L2, may learn to listen to a new vowel and not to perceive it as a similar sound in L1. However, as Miyawaki et al. (1975 ; cited in Leather and James 1991 : 313) found out, even nonnative speakers with experience in L2 may not be too successful in perceiving a sound in context, i.e., when the sounds need to be discriminated in a larger context. The decoding mistakes in our data support the findings in Miyawaki et al. (1975) in that the alternation of vowels did not always follow the Japanese-English inventory correspondence.

As is shown in the table below, the vowel was misheard in four different ways :

[Table 4]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ʌ]	[æ]	(a)	plunge [plʌndʒ]	plant [plænt]	plan [plæn]
		(b)	plummet [plʌmɪt]	planet [plæˈnɪt]	plant [plænt]
	[ɑː]	(c)	bulk [bʌlk]	bark [bɑːk] [baːrk]	- -
	[ɜː]	(d)	plummet [plʌmɪt]	permit [pɜ́ːmɪt]	purpose [pɜ́ːpəs]
	[ɒ]	(e)	bulk [bʌlk]	box [bɒks]	involve [ɪnvɒ́lv]
		(f)	plummet [plʌmɪt]	profit [prɒ́fɪt]	promise [prɒ́mɪs]

In Japanese, there is no distinction between [ʌ] and [æ]; therefore, both sounds would be perceived as Japanese [a]. Examples (a) and (b) in Table 4 occurred because of this L1 interference. Variant 2 in example (c), *bark*, has a long vowel [ɑː] and it replaced the target sound [ʌ] in *bulk*. The subjects must have misheard [ʌ] as [a] there. This example further shows that the discrimination was unsuccessful between the short vowel [a] and the long vowel [ɑː] though the distinction should have been fairly easy. The difference between short and long vowels is meaningful in their L1, as [kado] (corner) and [kaːdo] (card) make a minimal pair in Japanese. It may be the case that the [l] sound after the vowel [ʌ] in the target word was perceived as another liquid [r], thus it was alternated with [ar], then [ɑː]. As for example (d) in Table 4, the transfer process seems more complicated, the vowel [ɜː] being alternated with [ʌ]. The long vowel [ɜː] is often transferred into [ɑː] in the Japanese phonographic system written in *katakana*, as the word *work* [wɜːk] is pronounced as [wɑːkɯ] in the Japanese borrowed word. This example, as well as example (c), indicates that the listener did not discriminate the length of the vowels. While the English vowels all can be categorized as relating to Japanese sounds, [ɒ] in example (e) and (f) is generally regarded as being closer to [o] rather than to [a]. For example, the variant 1 in (e), the word *box* is usually pronounced as [boʔk(ɯ)s(ɯ)] in Japanese; note that [ɒ] is alternated with [o]. Still, English [ɒ] gives a contrast with Japanese [o] in that it does not have much of [+round] feature. The general alternation of [ɒ] with [o] in Japanese borrowed words such as *box* has influence from the spelling letter "o", for the Japanese romanized writing system (*romaji*) offers this letter to be pronounced as the Japanese [o]. Therefore, it should not be surprising that, aurally, the distinction between [ʌ] and [ɒ] to Japanese ears is not as clear as that between Japanese [a] and [o].

Table 5 is an opposite case of Table 4 and shows which variant vowels were perceived as [ʌ]. There were only two example cases. The example in (a) is the reverse of example (c) in Table 4. The subjects again failed to hear the length of the vowel correctly and confused between [ɑː] and [ʌ]. In (b) of Table 5, the short low central vowel [ʌ] replaced the diphthong [oʊ]. This is one of the examples which, if presented in a minimal pair situation, would never confuse Japanese listeners.

[Table 5]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ɑː]	[ʌ]	(a)	**discard** [dɪskɑːd]	*discuss* [dɪskʌs]	*discover* [dɪskʌvə]
[oʊ]		(b)	**abode** [əbóʊd]	*above* [əbʌv]	- -

The results regarding the mishearing of the vowel [ɒ] appear in Tables 6 and 7. All the examples indicate that the sound [ɒ] is perceived as that having [+front] feature rather than [+back] which contributes to the Japanese [o].

Notice that, in (a) of Table 6, the length of the vowel in the target word and the variant was problematic. The variants in (b) show that the short vowel was perceived as the diphthong [aɪ] whose first half was [a]. The vowel [ʌ] was perceived as [ɒ] in example (a) in Table 7. This is another indication that [ɒ] represented the Japanese sound [a] rather than [o]. Example (b) in Table 7 gives an opposite case of example (c) in Table 6. The difference between the vowels [ɒ] and [e] is featured by the tongue position [+high] and [+low]. That is, [e] is articulated more to the front and at the higher position in the cavity compared with [ɒ]. This mishearing pattern was less

[Table 6]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ɒ]	[ɑː]	(a)	deposit [dɪpɒzɪt]	depart [dɪpɑːt]	-
	[aɪ]	(b)	deposit [dɪpɒzɪt]	despite [dɪspaɪt]	deny [dɪnaɪ]
	[e]	(c)	predominantly [prɪdɒmɪnəntli]	pretend [prɪténd]	-
	[iː]	(d)	deposit [dɪpɒzɪt]	decrease [dɪkríːs]	-

[Table 7]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ʌ]	[ɒ]	(a)	plummet [plʌmɪt]	profit [prɒfɪt]	promise [prɒmɪs]
[e]		(b)	prevalent [prévələnt]	problem [prɒbləm]	-

expected than examples such as (a) and (b) in Table 6 or (a) in Table 7. Still a less expected case is shown in example (d) in Table 6, where the short low central vowel [ɒ] was perceived as the long high front vowel [iː]. A possible explanation to this is to see the influence from other vowel(s) in the same word. In this example, the target word *deposit* has a high front vowel [ɪ] in the third syllable and this fact may have affected the way the vowel in the second syllable was perceived.

Table 8 shows how the target vowel [æ] was misheard. There were four variants : [aɪ], [e], [eɪ], and [ɪ]. The English [æ] is different from the Japanese [a] as it has [+front] feature. Therefore, [æ] is often explained as the vowel between the Japanese [a] and [e]. It is predictable that this target vowel should aurally be categorized by either the Japanese [a] or [e]. Therefore, it was rather surprising that we did not obtain any example of confusing [æ] with [ʌ] or [ɑː] in our data. The variant with the quality of Japanese [a] was only seen in example (a) in Table 8, where the target vowel was perceived as the diphthong [aɪ] which started with the sound [a]. The examples (b), (c), and (d) show that the [+front] feature of the target sound [æ] was perceived more strongly than [+ low]. Thus in these examples, the variants include the mid front vowel [e]. It should also be noted that the variants in (a) and (d) are diphthongs [aɪ] and [eɪ], and that both include the high front vowel [ɪ]. Thus we are able to observe even among the diphthong variants that the [+low] feature of the target vowel has been lost. The most obvious case to this is example (e) in Table 8 where the target vowel [æ] is alternated with the short high front vowel [ɪ]. Still, one caution should be made in interpreting the variants 1 and 2 in (e) of Table 8, for the number of syllables in the variants is smaller than that of the target word. It is possible that the subjects dropped the whole syllable [tæ] with the vowel [æ] in question. If this is the case, the vowel [ɪ] in the variants is not the alternative to [æ], but the influence of [mɪ].

The alternation of [ʌ] with [æ], both of which would be perceived as Japanese [a], is shown in examples (a) and (b) of Table 9. Note that this alternation was not found in Table 8 which is the reverse case. It should be noticed that, according to Tables 4, 5, 8, and 9, the subjects perceived the vowel [æ] as being closer to Japanese [a] than the sound [ʌ]. That is, despite the fact that the

[Table 8]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[æ]	[aɪ]	(a)	**crammed** [kræmd]	*cry* [kraɪ]	- -
	[e]	(b)	**contaminate** [kəntǽmɪneɪt]	*content* [kəntént]	- -
		(c)	**anticipate** [æntísɪpeɪt]	*empathy* [émpəθi]	- -
	[eɪ]	(d)	**contaminate** [kəntǽmɪneɪt]	*complain* [kəmpléɪn]	- -
	[ɪ]	(e)	**contaminate** [kəntǽmɪneɪt]	*continent* [kɔ́ntɪnənt]	*continue* [kəntínjuː]

English vowel [æ] is articulated more to the front and tensed than the Japanese equivalent vowel [a], Japanese speakers more often perceive [æ] as [a] than they do to [ʌ]. This could be because that, based on the Japanese romanized system, the letter "a" is associated with the Japanese vowel [a] while the letter "u" is pronounced [ɯ]. Therefore, Japanese speakers generally are less troubled when they find that the sound which they perceived as [a] is spelled "a" compared with the occasion where the sound is spelled "u". The other examples in Table 9, i.e. the vowel [æ] replacing the short mid front vowel [e] and the front diphthongs [aɪ] and [eɪ], can be explained in the same way as we discussed earlier for Table 8.

[Table 9]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ʌ]		(a)	**plunge** [plʌndʒ]	*plant* [plænt]	*plan* [plæn]
		(b)	**plummet** [plʌ́mɪt]	*planet* [plǽnɪt]	*plant* [plænt]
[aɪ]	[æ]	(c)	**glide** [glaɪd]	*grand* [grænd]	- -
[e]		(d)	**prevalent** [prévələnt]	*plant* [plænt]	plan [plæn]
[eɪ]		(e)	**undertake** [ʌndətéɪk]	*understand* [ʌndəstǽnd]	- -

The examples (a) and (b) of Table 10 show that the [+front] feature of the target vowel [e] was perceived correctly. As for example (c), we have mentioned about the difficulty of decoding the [ɒ] sound in Table 6. We have observed the example of the vowel [ɒ] perceived as [e]. If we apply this to the current example (c), we can conclude that this is another mishearing example in which the [+front] feature survived. In example (d), the target vowel was misheard as the long vowel [ɜː]. The [+front] feature is again preserved here. This is an interesting example because the syllable [pre] was perceived as [pɜː]. That is, the word-initial [C+[r]+[e]]] syllable is perceived as [C+[ɜː]]. This is sensible, for [r], [e] and [ɜː] are articulated at the positions close to one another. We have observed a reverse example where additional [r] had been inserted between the initial consonant and the immediately following vowel (see examples such as (13), (14), and (21)). As for example (e)

in Table 10, in which the subjects heard *prevalent* as *prove*, the difference between the target vowel [e] and the variant [uː] is significant. The vowel [uː] is a long vowel, with the features of [+round] [+high] [+back]. In contrast, the short target vowel [e] offers the features of [−round] [+mid] [+front]. The sounds close to Japanese [ɯ] are nonexistent in the target word *prevalent*, therefore, we need to regard this as a clear example of unexpected decoding mistakes.

[Table 10]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[e]	[æ]	(a)	prevalent [prévələnt]	*plant* [plænt]	*plan* [plæn]
	[aɪ]	(b)	prevalent [prévələnt]	*pride* [praɪd]	-
	[ɒ]	(c)	prevalent [prévələnt]	*problem* [prɒbləm]	-
	[ɜː]	(d)	prevalent [prévələnt]	*permanent* [pɜːmənənt]	-
	[uː]	(e)	prevalent [prévələnt]	*prove* [pruːv]	-

The patterns of vowel alternation in Table 10 are supported by the examples in Table 11. Examples (a) and (b) show the case in which the target sound [æ] was misheard as [e]. This is a reverse pattern of (a) in Table 10. Both examples (c) in Table 10 and (c) in Table 11 indicate the confusion between [ɒ] and [e]. The above mentioned variant examples, i.e. (a)-(c) in Table 11, have earned [+low] feature which does not characterize the target vowel. The unstable positions in articulation in terms of incorrect perception go to the opposite direction as far as examples (d) and (f) are concerned. In these examples, the variants [eɪ] and [ɪ] include the high vowel [ɪ]. Example (f) has been touched upon when we analyzed example (21). An explanation has been offered earlier in the discussion regarding (d) in Table 10. Example (f) here indicates that this pattern works two ways.

[Table 11]

Target vowel	Variant vowel		Target word	Variant
[æ]		(a)	contaminate [kəntǽmɪneɪt]	*content* [kəntént]
		(b)	anticipate [æntísɪpeɪt]	*empathy* [émpəθi]
[ɒ]	[e]	(c)	predominantly [prɪdɒ́mɪnəntli]	*pretend* [prɪténd]
[ɪ]		(d)	nickel [níkəl]	*echo* [ékəʊ] [ékoʊ]
[eɪ]		(e)	obtainable [əbtéɪnəbl]	*object* [əbdʒékt]
[ɜː]		(f)	purchase [pɜ́ːtʃəs]	*precious* [préʃəs]

Tables 12 and 13 show the mishearing examples concerning the high front vowel [ɪ]. The two patterns in Table 12 are predictable. Although Japanese vowels include the short-long contrast, they do not discriminate the feature of [+tense] or [+lax]. Therefore, there should be no wonder to find the mishearing pattern such as example (a). The variant vowel of (b) in Table 12, [e], is a short mid front vowel. The difference between the target and variant vowels is the height of the tongue position. Otherwise, both sounds are similar enough to be a variant of each other. Regarding the example in Table 13, there is a possibility that the syllable [tæ] was omitted on the course of perception. Therefore, we would like to present this example as it is.

[Table 12]

Target vowel	Variant vowel		Target word	Variant
[ɪ]	[iː]	(a)	nickel [níkəl]	negro [níːɡrəʊ][níːɡroʊ]
	[e]	(b)	nickel [níkəl]	echo [ékəʊ] [ékoʊ]

[Table 13]

Target vowel	Variant vowel	Target word	Variant 1	Variant 2
[æ]	[ɪ]	contaminate [kəntǽmɪneɪt]	continent [kóntɪnənt]	continue [kəntínjː]

Table 14 deals with how the English schwa [ə] has been misheard. The schwa appears in unstressed syllables and generally caused by reduction of the vowel. This is a difficult phonological aspect of English to acquire for Japanese speakers, for the Japanese vowel system requires all the vowels to be categorized and consequently perceived as one of the five basic vowels. The romanized system fosters this problem, unconsciously imposing the sound-spelling correspondence of "a" as [a], "i" as [ɪ], "u" as [ɯ], "e" as [e], "o" as [o]. Following these, the target word in example (a) of Table 14 would be pronounced [niʔkerɯ] in Japanese. In more optimistic cases, Japanese pronunciation of *nickel* would be either [nɪkerɯ] or [nɪkoː]. The former has more influence from the written form, while the latter is a more accurate representation of English pronunciation. To aurally decode the liquid [l] at the word-final position is a difficult task for Japanese speakers. The liquid [l] sounds close to Japanese [ɯ], both of which are articulated with lips narrowly-open and only narrow space in the oral cavity. With the explanation above, the example (a) should not be remarkable. Still, note that, in our interpretation, we have taken more seriously the fact that the target vowel [ə] was alternated with the diphthong [əʊ] and the word-final liquid [l] was omitted than the possibility that the string [əl] was alternated with the diphthong [əʊ]. Example (b) indicates that the first syllable [pɜː], although it was stressed, was not perceived at all. The subjects only heard [tʃəs] and thought that it was [tʃeɪs]. Since both [ə] and [e] are articulated at the mid tongue position, this mistake is sensible. The confusion between the short vowel [ə] and the diphthong [eɪ] is also predictable, for diphthongs only take as much length as short vowels in English while the Japanese vowel combination of [ei] is longer than a single vowel [e] or [ɪ].

[Table 14]

Target vowel	Variant vowel		Target word	Variant 1	Variant 2
[ə]	[əʊ] [oʊ]	(a)	nickel [níkəl]	echo [ékəʊ] [ékoʊ]	negro [ní:grəʊ] [ní:groʊ]
	[eɪ]	(b)	purchase [pɔ́:tʃəs]	chase [tʃeɪs]	- -

4. 2. 4.　Alternation of Consonants

Consonant alternation in the data saw three patterns : voiced/voiceless confusion, typical L1 transfer, and the others.

4. 2. 4. 1　Voiced/Voiceless alternation

In Table 15, the voiceless velar stop [k] is alternated with its voiced counterpart [g] at the word-middle position.

[Table 15 : [k] vs. [g]]

Target word		Variant word	
discard	[dɪskɑ́:d]	*disguard	*[dɪsgɑ́:d]
nickel	[níkəl]	negro	[ní:grəʊ] [ní:groʊ]

The mishearing due to the confusion between voiced/voiceless stop is also observed in the variants of the following Table 16. In Table 16, the voiced alveolar stop [d] is alternated with its voiceless counterpart [t] at the word-middle and word-final positions. One example of the voiceless stop [t] replaced with the voiced [d] is found at the word-final position. The difficulty in distinguishing the voiced and voiceless stops at the word-final position should attribute to the fact that the closed syllable [—VC] generally never occurs in Japanese.

[Table 16 : [t] vs. [d]]

Target word		Variant word	
predominantly	[prɪdɑ́mɪnəntli]	pretend	[prɪténd]
abode	[əbóʊd]	about	[əbáʊt]
crammed	[kræmd]	client	[klárˌənt]
discard	[dɪskɑ́:d]	depart	[dɪpɑ́:t]
prevalent	[prévələnt]	pride	[praɪd]

4. 2. 4. 2　L1 transfer

We have raised the issue of some English consonants which are nonexistent in Japanese phonological system (Cf. Table 2). We have found that a fair number of decoding mistakes fall into this criteria. Three patterns were observed : [v] vs. [b], [l] vs. [r], [m] vs. [n]. The examples in Table 17 show that the subjects did not discriminate the labiodental fricative [v] and the bilabial stop [b]. All the mistakes occurred at the word-middle position (the target items *lay bare* and *in bulk* are regarded as consisting of a series of the sounds each).

[Table 17 : [v] vs. [b]]

Target word		Variant word	
abode	[əbóʊd]	*avoid*	[əvóɪd]
lay bare	[leɪ bér] [leɪ béə]	*level*	[lévəl]
in bulk	[ɪn bʌ́lk]	*involve*	[ɪnvólv]
convey	[kənvéɪ]	*obey*	[əbéɪ][oʊbéɪ]
reveal	[ɹɪvíːl]	*rebuild*	[riːbíld]
prevalent	[prévələnt]	*problem*	[próbləm]

The biggest number of variants were obtained relating to the well-known distinction between [l] and. [r]. They are summarized in Table 18. Note that most of the [l] vs. [r] errors took place in the [CC] cluster at the word-initial position. The high rate of mistakes seems partly due to the fact that the liquids consisted of the [CC] clusters that were uncommon in Japanese. The two examples in which the [l] vs. [r] distinction needed to be made at the word-final position must have been also problematic for Japanese learners. Both examples indicate that discrimination of the two liquids is even more difficult when they appear at the very end of the syllable, making the [(C)VC] tier.

[Table 18 : [l] vs. [r]]

Target word		Variant word	
glide	[glaɪd]	*grade*	[greɪd]
		grind	[graɪnd]
		grand	[grænd]
		ride	[raɪd]
crammed	[kræmd]	*claim*	[kleɪm]
		client	[kláɪ̯ənt]
plummet	[plʌ́mɪt]	*promise*	[prómɪs]
		profit	[prófɪt]
prevalent	[prévələnt]	*plant*	[plænt]
		plan	[plæn]
nickel	[níkəl]	*negro*	[níːgrəʊ] [níːgroʊ]
lay bare	[leɪ bér] [leɪ béə]	*label*	[léɪbəl]
		level	[lévəl]

We have argued that English nasals [n], [m], and [ŋ], as they stand alone, are allophones in Japanese and all are perceived as [N]. The mishearing errors in Table 19 support this argument, showing that the subjects could not discriminate [m] vs. [n]. In the first five variants in Table 19, the mishearing occurred at the word-middle position. As for the target words *crammed*, *prevalent*, and *plunge*, the difficulty was in the [CC] cluster at the word-final position. Except for the variant *client*, the other variants for the three target words have a simplified ending, i.e. one nasal. The errors show that the subjects not only misheard [m] vs. [n], but failed to grasp correctly the last consonant in the word-final syllable [V([m]/[n])C].

4. 2. 5. Others

We obtained a number of consonant alternation examples that did not fit into the above categories. For example, there are cases of not contrasting stops vs. continuants. They are [s] vs.

[Table 19 : [m] vs. [n]]

Target word		Variant word	
contaminate	[kəntǽmmeɪt]	*complain*	[kəmpléɪn]
anticipate	[æntísɪpeɪt]	*empathy*	[émpəθi]
plummet	[plʌ́mɪt]	*planet*	[plǽnɪt]
		plant	[plǽnt]
		magnet	[mǽgnɪt]
crammed	[krǽmd]	*crayon*	[kréɪɒn]
		client	[klɑ́ɪˌənt]
prevalent	[prévələnt]	*problem*	[prɒbləm]
plunge	[plʌndʒ]	*plum*	[plʌm]

[t] (both alveolar), [s] vs. [p] (alveolar vs. bilabial), [d] vs. [v] (alveolar vs. labiodental), [k] vs. [v] (velar vs. labiodental), [t] vs. [ʒ] (alveolar vs. palatal), [t] vs. [θ] (alveolar vs. interdental), [p] vs. [m] (both bilabial, stop vs. nasal), [k] vs. [l] (velar stop vs. alveolar liquid), [b] [p] vs. [n] (bilabial stops vs. alveolar nasal), and [t] vs. [n] (both alveolar, stop vs. nasal).

The confusion among stops are found as well in [k] vs. [d], [p] vs. [k] and [t]. The last sets of the example errors occurred due to the confusion among continuants : [f] vs. [tʃ] (both [+strident], labiodental vs. palatal), [f] vs. [m] (labiodental constrictive vs. bilabial nasal), [ʃ] vs. [tʃ] (both palatal, [+strident]), and [n] vs. [l] (both alveolar, nasal vs. liquid).

5. 0 Conclusion

We have thus far discussed some important phonological aspects of syllabification in terms of the negative evidence in the process of second language acquisition. Japanese learners of English tend to make a number of linguistic errors in the course of their acquisition of the second language, English. Phonological errors of vowel or consonant alternation, omission, or insertion are ubiquitous. And also, there should be some reason why the errors are so common and more or less systematic especially in the phonological errors of vowels or consonants. An adequate explanation of this reason is a matter of linguistics rather than a matter of motivation or psychology.

In **2.0**, we discussed the syllabification system in terms of [CV] tier in the cluster of phonological and sequential segments both in the phonological source language (L1) of Japanese and in the target language (L2) of English. In so far as syllabification is the key term to explain adequately the pronunciation gap between a target word and its variant word, our position in the acquisition of second language is that the syllabification system between the source language and the target language works to a great extent.

In **3.0**, we made a phonological analysis on the process of intervention from the source language to the target language in terms of phonological alternation of vowels and consonants, particularly focusing upon the overgeneralization of vowels. Vowels are [+vocalic] and also [+syllabic] and they play the role of the nucleus in a syllable. A vowel in a target word is transferred into a number of variant vowels in variant words under the phonological influence of the source language. Our research suggested the number of vowels and therefore the number of syllables and the shared phonological features between the target word and its variant words play an important role to explain adequately the processes of phonological alternation, omission, and insertion of vowels from the target words.

In **4.0**, we made a rather detailed data analysis of vowels in variant words in contrast to vowels in their target word. We proposed the hypothetical notion of the similarity and closeness of vowels in variant words to the target word. In order to support this hypothesis, we first made a comparative analysis of the number of syllables between the target word and its variants. We secondly drew our attention to monophthongs in Japanese compared with monophthongs, diphthongs and triphthongs in English. Finally, we dicussed whether or not the number of phonological features shared between a vowel in a target vowel and its variant vowels in a target word are equal, and we also discussed the phonological reason why a vowel in a target word is tranferred into a number of variant vowels in its variant words.

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