

Australian English Sequences of Semivowel /w/ + Back
Vowel /ɜ:/, /ɔ:/ or /ɒ/ Perception
by Korean and Japanese Learners of English

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ABSTRACT

This paper aimed at examining the influence of L1 (native language) phonology when speakers of L1 perceive L2 (foreign language) sounds. Korean and Japanese learners of English took a perception test of Australian English words 'work', 'walk' and 'wok'. Based on Korean and Japanese phonology, it was predicted that Korean subjects would face more difficulties than Japanese subjects. The results of the experiment substantiated the influence of L1 phonology in L2 learners' L2 sound perception.

**Keywords : perception, Australian English vowels, Korean vowels,
Japanese vowels**

1. Introduction - Phonetic and phonological comparisons

It is frequently observed that Japanese and, in particular, Korean learners of English face difficulty in distinguishing the Australian English words 'work, walk, wok' and we can consider why this is so.

The composition of the vowel sequence of these three words is semivowel /w/ plus one of three monophthongs /ɜ:, ɔ:, ɒ/. The phonological treatment of the sequence of semivowel /w/ + a monophthong differs in the three languages (AE, Korean, Japanese). In AE, the sequence of semivowel /w/ + a monophthong is by no means a diphthong (a single vowel, but one in which

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two targets or components can be discerned (Clark & Yallop, 1990: 108))¹⁾.

Korean phonology accepts the sequence of semivowel /w/ or /j/ + a monophthong as a diphthong. The instances are as follows: /je/ '계', /jɛ/ '계', /wa/ '와', /wɛ/ '왜', /we/ '외'²⁾, /we/ '웨', /wi/ '위', /wɛ/ '위'³⁾ (Lee, H-B., 1989: 5). In Japanese, there is only one diphthong, which contains the semivowel /w/ + a monophthong /a/, namely /wa/ 'わ'.

Narrowing our focus to the words 'work', 'walk', and 'wok', let's compare the treatment of the sequence of semivowel /w/ + a monophthong for these three words in the three languages in question. In AE, the sequence of semivowel /w/ plus a monophthong, such as /ɜ:/ or /ɔ:/ or /ɒ/, does not count as a diphthong. Hence, Australian listeners will hear three different vowels preceded by the feature of lip-rounding, which is the main attribute of the semivowel /w/, when they face the vowel sequences of these three words. This means that the Australian listeners will not find any differences of the main vowel in both normal (C)V and WV sequences.

Korean listeners of AE would, however, face quite a different situation when listening to the three words in question. In the Korean vowel system, there is one diphthongal vowel '위' /wɛ/ which can match all three vowel sequences of the three English words in question. As accounted for above, Korean native speakers treat diphthongs as one sound. Thus, if they identify the vowels included in English words 'work', 'walk' and 'wok' as a Korean diphthong '위' /wɛ/, they will not discover any phonological points to distinguish the vowels in the three English words.

In contrast, the Japanese vowel system does not possess any matching diphthongal vowel against the three sequences of semivowel /w/ + one of three monophthongs /ɜ:/, /ɔ:/ and /ɒ/ in the words 'work', 'walk' and 'wok'⁴⁾.

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- 1) In AE, on the contrary, the sequence of a monophthong target + offset (semi) vowel is regarded as a diphthong. The examples are as follows: /aj/ hide, /ej/ hay, /ɔy/ (fronting and rising); /aw/ how, /ow/ hoe (backing and rising); /iə/ here /Uə/ tour /eə/ hare (centering).
 - 2) The Korean vowel '외' used to be a monophthong which possessed a quality of /ø/. However, at the present time, most of the Korean speakers (middle or young aged) pronounce this vowel as a diphthong /we/.
 - 3) Some scholars count the diphthongs '외' /we/ and '위' /wi/ as monophthongs /ø/ and /y/, respectively (Kim Y-S., 1981; Lee, K-M., 1972).
 - 4) These three AE sequences seem not to be located in quality areas overlapping with that of the only Japanese diphthong /wa/. Thus Japanese listeners might not be influenced by their L1 diphthong /wa/ when they listen to the three AE sequences /wɜ:/, /wɔ:/ and /wɒ/.

Thus, Japanese listeners will not face any negative L1 interference. This situation might allow Japanese listeners to discern the semivowel /w/ and the following monophthong separately. As a result of this, as in the cases of sequence of (C)V, Japanese listeners will hear two different phones in the vowel sequences (/w/ followed by a monophthong /ɜ:/ or /ɔ:/ or /ɒ/) belonging to the words in question.

2. Prediction

In this section, predictions of perception and production of the AE /w/ + a monophthong sequences by Korean and Japanese speakers of English are introduced based on three different models, that is, the traditional view, Flege's model, and Best's model.

2.1. Traditional view

Tarone (1987:71) tabulated a simplified Contrastive Analysis pattern between the L1 and the L2 as shown in Table 1.

(1) is a case of 'positive transfer' where both the native language and the target language have the phoneme /t/, so the learner will have no difficulty in acquiring this sound from the target language. (2) might be called a 'convergent negative transfer' where the L1 retains two phonemes /f/ and /v/, yet these two sounds are considered allophones of a single phoneme /f/ in the L2. In this case, few, if any, problems for the learners are predicted since either the learner does not have to learn to make any new distinctions or hear any distinction in the L2. However, in example (3), a case of 'divergent negative transfer' where the L1 retains only one phoneme /l/ and the L2 two, /l/ and /r/, the L2 learners will face most difficulty. The two sounds in the target language will be perceived and uttered by the L2 learners as minor variants or the identical sound of the native language phoneme /l/, so that the learner would be predicted to have great difficulty in discriminating /l/ from /r/ (Tarone 1987:71-72).

Turning our attention to our topic, the three vowel sequences of /wɜ:/, /wɔ:/ and /wɒ/, to Korean listeners these vowel sequences would belong to case (3), since Korean listeners will perceive and produce the three English vowel sequences as minor variants of a Korean diphthong /wʌ/ 'ㅜㅓ'. Thus, Korean listeners will face great difficulty in discriminating amongst the three

different vowel sequences (see Table 2).

Table 1. Three different relationships between L1 and L2 phones

	Native Language		Target Language
(1)	/t/		/t/
(2)	/f/ /v/]	/f/ —
(3)	/l/ —		[/l/ /r/

Table 2. The relationship between Korean /wΛ/ and AE /w3:/, /wɔ:/ & /wɒ/

Korean		English
{ /wΛ/ 'ㅌ' }	/	{ /w3:/ 'work' }
	—	{ /wɔ:/ 'walk' }
	\	{ /wɒ/ 'wok' }

To the Japanese, these three vowels sequences would be perceived quite differently. Since Japanese does not possess any /w/ + /3:/ or /ɔ:/ or /ɒ/ sequence as a diphthong in its vowel system⁵⁾, the three English vowel sequences would be treated like other normal CV sequences. That is to say, the /w/ sound would be heard as a consonant or a consonant-like sound as in the other normal CV sequences (for instance, /sa/, /ko/, /te/, /nu/, /ri/) which are common in Japanese phonology. Therefore, the perception and production of Japanese learners with respect to the three AE vowel sequences can not but be predicted on the same basis of prediction on monophthongal vowels /3:/, /ɔ:/, and /ɒ/ (see Table 3).

5) Even though there is one diphthong 'わ' /wa/ in Japanese, this diphthong will not be identified as one of the three English vowel sequences in question due to the great difference of vowel quality between the Japanese diphthong and the three AE vowel sequences.

Table 3. Prediction on Japanese learners' acquisition of AE /wɜ:/, /wɔ:/ & /wɒ/

/wɜ:/	'work'	difficult
/wɔ:/	'walk'	easy
/wɒ/	'wok'	difficult

The vowels /ɜ:/ and /ɒ/ in AE are the ones that do not have a counterpart in Japanese phonology. Hence, when Japanese learners listen to 'work' and 'wok', they will have some difficulty in identifying these two words. On the other hand, the Japanese vowel system possesses a counterpart /o/ to the AE vowel /ɔ:/ so that Japanese listeners would perceive the English word 'walk' with ease.

2.2. Flege's model

Table 4. Prediction based on Flege's model: prediction of the classification of the /wɜ:/, /wɔ:/ & /wɒ/ vowels by L2 learners

	/wɜ:/	/wɔ:/	/wɒ/
Korean	similar	similar	similar
Japanese	new	similar	new

In terms of Flege's model (see Table 4), three vowel sequences /wɜ:/, /wɔ:/, and /wɒ/ in AE have only one counterpart /wʌ/ 'ㅏ' in the Korean vowel system (Flege, 1984, 1987). Thus, beginning Korean learners would classify the three AE sequences as 'similar' sounds, perceiving them as a Korean diphthong /wʌ/ 'ㅏ'. This situation might greatly confuse Korean listeners in their perception of these three vowel sequences and, in addition, they will ultimately be unable to produce these sequences authentically, since the process of Equivalence Classification will prevent the learners from establishing a phonetic category for 'similar' sounds.

Japanese learners, however, will receive these three sequences in a different way. Since the counterparts of 'AE /ɜ:/ and /ɒ/ do not exist in the Japanese vowel system, the sequences /wɜ:/ and /wɒ/ will be 'new' sounds to Japanese learners. This means that, even though the listeners will have some difficulty with 'new' sounds in the beginning, after lengthy experience in the L2 speaking environment they will ultimately establish new categories for 'new'

sounds and perceive and produce them well without the hindrance of Equivalence Classification. The sequence /wɔ:/ in AE will be categorised as a 'similar' sound to Japanese listeners since a counterpart /o/ for AE /ɔ:/ exists in Japanese phonology. Thus it would be hard to achieve the accurate production of this vowel sequence in the long run.

2.3. Best's model

For predicting the acquisition of the three AE vowel sequences on the basis of Best's Perceptual Assimilation model (Best, 1994, 1995), three pairs of /wɜ:/-/wɔ:/, /wɔ:-wɒ/, and /wɜ:/-/wɒ/ were formed (see Table 5).

Table 5. Prediction based on Best's model⁶⁾

	/wɜ:-wɔ:/	/wɔ:-wɒ/	/wɜ:-wɒ/
Korean	SC	SC	SC
Japanese	cross-cat.	cross-cat.	UNC

To Korean listeners, all the three sequences in AE belong to one diphthong. Therefore, all three pairs will fall in the SC contrast. This categorization predicts that all three pairs will be poorly discriminated by Korean learners of English⁷⁾.

6) In Best (1995), she slightly changed the term of two assimilation types. The Cross-Category type was renamed as the Uncategorized versus Categorized type (UC Type). Also the Uncategorizable (UNC) type was renamed as the Both Uncategorizable type (UU Type).

7) As discussed in Section 1., Korean phonology accepts several diphthongs. 'ㅜ' /wʌ/ is one of them. Also this vowel's range spans AE /wɜ:/, /wɔ:/ and /wɒ/. Thus Korean people whose mother tongue is Korean will perceive the three AE vowel sequences /wɜ:/, /wɔ:/ and /wɒ/ as Korean 'ㅜ' /wʌ/. Based on this analysis, all the three pairs /wɜ:/-/wɔ:/, /wɔ:/-/wɒ/ and /wɜ:/-/wɒ/ should be classified as the SC Type in Best's model. Since the purpose of this paper is to measure the influence of L2 learners' L1 phonology, the above prediction must be selected for our experiment. For the purpose of reference only, if we consider the prediction of perception of monophthongal vowels in Park (1997), the pair /wɜ:/-/wɔ:/ will be the TC Type and the /wɜ:/-/wɒ/ and /wɔ:/-/wɒ/ pairs the Cross-category Type. Because the /ɜ:/ and /ɔ:/ vowels in AE belong to different Korean vowel categories, while AE /ɒ/ falls outside one of Korean vowel categories, namely in uncommitted phonetic space.

To Japanese listeners, the AE vowel /ɔ:/ is only a sound falling within their native phonetic category while the other two AE vowels /ɜ:/ and /ɒ/ fall in uncommitted phonetic space. According to this classification, both the pairs /wɜ:-wɔ:/ and /wɔ:-wɒ/ will belong to cross-category contrast. For the cross-category contrast, the discrimination of L2 learners should be quite good (for more detailed discussion see Park (1997)). On the other hand, the pair /wɜ:-wɒ/ will be categorised as Uncategorizable (UNC) since both /ɜ:/ and /ɒ/ vowels fall within uncommitted phonetic space. This contrast will be discriminated only to a poor to moderate degree. Consequently, amongst the three pairs, Japanese listeners would have the most difficulty discriminating the /wɜ:-wɒ/ pair.

2.4. Prediction in terms of length and quality (Japanese learners)

To Korean listeners, the three AE vowel sequences will pertain to only one Korean monophthong /wɜ/ 'ㄱㅓ'. However, to Japanese listeners, the vowel sequences will be perceived as semivowel /w/ + one of three different monophthongs /ɜ:/, /ɔ:/, or /ɒ/. Also, as shown in Park (1997), Japanese listeners can distinguish length of vowels phonologically. Thus, in the cases of Japanese listeners, we may predict different performance depending upon the difference of superiority between length and quality of respective monophthongs. The detailed prediction is as follows.

The three AE vowels /ɜ:/, /ɔ:/, /ɒ/ included respectively in English words 'work', 'walk', and 'wok' differ in vowel quality and length. /ɜ:/ and /ɔ:/ are long while /ɒ/ is short. Should the length factor be the superior one, /ɒ/ would be easy for Japanese listeners to identify since this vowel is distinctive (short length) from the other two vowels (long length).

While the vowel /ɔ:/ in AE has a counterpart /o/ in the Japanese vowel inventory, the two other AE vowels, /ɜ:/ and /ɒ/, are pronounced at places in the vowel quadrilateral where no matched vowel occurs in the Japanese vowel system. If the quality feature is superior, /ɔ:/, which has a counterpart in the Japanese vowel system, it would be easier for Japanese listeners to identify than the other two vowels /ɜ:/ and /ɒ/. In turn, considering the result of Perception Test in Park (1997), the vowel /ɒ/, which arises at the low-back area with the lip-rounding feature, would be the more difficult vowel to identify between /ɜ:/ and /ɒ/⁸⁾.

8) In Park (1997 : 96), the Japanese subjects perceived /ɜ:/ correctly 37 out of 40 while they gave the correct answer for /ɒ/ just 21 out of 40.

3. Experiment

3.1. The aims of experiment

In the previous sections, the prediction of the acquisition of AE /w/ + monophthong sequences by Korean and Japanese learners of English in terms of the four different models was presented. To test each theory's prediction, an experiment is conducted to gauge perception of the sequences by Korean and Japanese listeners.

The experiment is designed to ascertain Korean and Japanese learners' ability to identify one of the three different sequences by listening to 'work, walk, wok' test words and thus to verify the predictions of the models.

3.2. Experiment

3.2.1. Materials

The purpose of the Perception Test was to check the influence of the semivowel /w/ arising right before a monophthong, such as /ɜ:/ or /ɔ:/ or /ɒ/, in Australian English to Korean and Japanese listeners when they listen to the sequence of /w/ + one of the three monophthongs /ɜ:/, /ɔ:/, /ɒ/. For accommodating the sequences in question, three English words, 'work', 'walk', and 'wok', that have identical environment '-k', were selected. Also, to compare the influence of the semivowel /w/ directly, three other English words 'hurt, hort, hot', that do not possess the semivowel /w/ but contain the identical monophthongs /ɜ:/, /ɔ:/, /ɒ/ respectively, were also selected⁹⁾.

Two Australians recorded the six test words. The recorded test words by the two Australians were later used to prepare a test tape and to carry out the acoustic measurement of the test words (work, walk, wok).

The two Australians read aloud each test word three times in a sound-attenuated booth. A portable cassette recorder (Marantz model CP230) and a high condenser microphone (Sony model ECM-30) were used to record the two Australian native speakers' voices. The recorded test items were digitized and saved as sound files. When the test tape of the Perception Test was made, the sound files which contained each test item were retrieved and

9) 'hort' is a meaningless word made for this experiment. However, to the subjects, this word was provided with the explanation that 'hort' was an abbreviated form of the word 'horticulture'.

recorded onto a cassette audio tape.

The Perception Test tape contained a total of 36 items (6 words X 2 speakers X 3 repetitions). The three repetitions were determined by the consideration of the total item number of the test and the number of compared vowels in the Test. The order of test words was randomly determined. Each word was repeated twice in the test. The inter-stimulus interval was 3s, and the inter-item interval 5s.

3.2.2. Procedure

The test was conducted in a lab where the subjects listened to each item through headphones. The sound level was adjusted by the subjects for the most appropriate level.

The subjects were asked to circle an appropriate word out of three example words ('work, walk, wok' set or 'hurt, hort, hot' set) provided on the answer sheet for one item after listening to each test word. However, no presentation of the native speaker's actual pronunciation for the test words was given to the subjects in advance before the test commenced, since all /w/-containing words were frequently used in normal conversation and were counted as familiar words to the subjects.

3.2.3. The subjects and analysis

Twenty subjects took part in this test. The subjects belonged to one of the four different groups (Korean Experienced, Korean Inexperienced, Japanese Experienced, Japanese Inexperienced) that have respectively five members. The answer sheets of the subjects were marked by the author and the data were typed into computer for statistical analysis. A statistical program, S-PlusTM, was used for statistical analysis.

3.2.4. Results

The results of the subjects' performances in the test were analysed and presented in the form of matrix. It was possible to check the subjects' replying range on each AE /w/ + monophthongal vowel sequence by making matrix tables. In a matrix, three vowel (sequence)s belonging to rows represent the target vowels which must be identified by the subjects and three vowel (sequence)s in columns present the actual vowels which were replied by the subjects. Thus the correct answers must be on the diagonal line in the matrix.

● Korean subjects

Table 6. Confusion matrices of Korean subjects
(a sum of two groups (KE, KI)' results)

	w3:	wɔ:	wɒ	(R)		3:	ɔ:	ɒ	(R)
(T) w3:	49	10	1		(T) 3:	57	3		KE=30
wɔ:	7	44	9		ɔ:		56	4	KI=30
wɒ	16	10	34		ɒ	1	3	56	

The combined confusion matrices of Korean subjects are shown in Table 6. As has been predicted, Korean subjects did not make clear distinction on /w3:/ (49/60), /wɔ:/ (44/60), and /wɒ/ (34/60). However, they did make clear distinction on the /h/-initiating words ('hurt': 57/60, 'hort': 56/60, 'hot': 56/60). This shows the importance of the L1 phonological system. That is to say, the fact that one diphthong /wʌ/ in Korean phonology corresponds to all the three AE vowel sequences /w3:/, /wɔ:/, /wɒ/ led the Korean listeners' low accuracy in their perception of the /w/-initiating words.

● Japanese subjects

Table 7. Confusion matrices of Japanese subjects
(a sum of two groups (JE, JI)' results)

	w3:	wɔ:	wɒ	(R)		3:	ɔ:	ɒ	(R)
(T) w3:	60				(T) 3:	58	2		JE=30
wɔ:	2	58			ɔ:		59	1	JI=30
wɒ	8	9	43		ɒ	2	2	56	

The combined confusion matrices of the Japanese subjects are shown in Table 7. Unlike the Korean subjects, the Japanese subjects did make clear distinction on /w3:/ and /wɔ:/ sequences. However, they did not perceive the /wɒ/ sequence clearly (43/60). With respect to the /h/-initiating words, the Japanese subjects made accurate identification on the three different words 'hurt, hort, hot'.

The difficulty of perception of /wɒ/ should be accounted for from the point that AE /ɒ/ is intrinsically difficult to perceive and produce as shown in Park

(1997, Ch.4) as well as the negative influence of /w/, which is preceding /ɒ/ vowel, for perceiving the vowel /ɒ/. One might question as to the high accuracy of perception on AE /ɒ/ in 'hot'. However, the high accuracy of /ɒ/ in 'hot' was made under the three vowel (/ɜ:/, /ɔ:/, /ɒ/) choice situation. If the AE vowel /a/ in 'hut' had been included as a test word in the test, the situation might have differed as shown in Park (1997)¹⁰.

● Statistical comparison

In the summary ANOVA table (Table 8) of Korean and Japanese subjects' perception of the AE /w/ + monophthong (/ɜ:, ɔ:, ɒ/) sequences and the pure monophthongs (/ɜ:, ɔ:, ɒ/), the difference of perception of /wɜ:/ and /wɔ:/ was significant (/wɜ:/: p=0.014, /wɔ:/: p=0.044).

This statistical result strongly supports the claim that the Japanese subjects can distinguish /wɜ:/ and /wɔ:/ without the hinderance of L1 phonological constraints (as can be seen from the Korean subjects) regardless of the semivowel /w/'s existence right before /ɜ:/ and /ɔ:/. Also, this result provides a sound support for the author's prediction.

● Each Korean group

Respective Korean groups' result matrices are provided in Table 9 and The ANOVAs and t-tests as post-hoc analyses of the Korean and Japanese groups on the basis of different L1 backgrounds and L2 experience are presented in Table 11.

10) Amongst 19 incorrect answers of the Japanese subjects for the target /ɒ/ in the perception test cited in footnote (8), 17 answers were /a/.

Table 8. Summary ANOVAS

(Vowel identification concerning different L1 background)

Independent Variables	Dependent Variables	Degrees of Freedom	Sum of Sq.	Mean Sq.	F Value	Pr.	Comparisons
La (Kor, Jap)	Total Errors	1	72.2	72.2	4.18	0.055	Jap>Kor
Residuals		18	310.8	17.27			
La (Kor, Jap)	Errors on /wɜ:/	1	6.05	6.05	7.31	0.014	Jap>Kor
Residuals		18	14.9	0.83			
La (Kor, Jap)	Errors on /wɔ:/	1	9.8	9.8	4.64	0.044	Jap>Kor
Residuals		18	38	2.11			
La (Kor, Jap)	Errors on /wɒ/	1	4.05	4.05	1.57	0.226	
Residuals		18	46.5	2.58			
La (Kor, Jap)	Errors on /ɜ:/	1	0.05	0.05	0.16	0.695	
Residuals		18	5.7	0.32			
La (Kor, Jap)	Errors on /ɔ:/	1	0.45	0.45	0.87	0.363	
Residuals		18	9.3	0.52			
La (Kor, Jap)	Errors on /ɒ/	1	0	0	0	1	
Residuals		18	8.8	0.49			

● Korean Inexperienced (KI) group

The subjects of the KI group made mistakes over all six words selected in this test: work (22/30), walk (16/30), wok (14/30), hurt (27/30), hort (26/30), hot (26/30). However, between the /w/-initiating set and the /h/-initiating set, there was a remarkable difference of performance of the KI group members. On /w/-initiating words, the listeners scored from around 73 % (work) to less than 50 % (46.7 % for wok). On the other hand, the listeners marked around 90 % (hurt: 90 %, hort: 86.7 %, hot: 86.7 %) on /h/-initiating words.

The some 10 % of KI subjects' misperception in terms of the /h/-initiating words seems to reflect the failure of absolute identification of the three AE central/back vowels /ɜ:/, /ɔ:/, and /ɒ/ (pure phonetic reason) as shown in Park (1997). On the contrary, the great augmentation of misperception of the /w/-initiating words may only be accounted for by the fact that the Korean vowel system keeps only one diphthong 'ㅜ' /wɜ/ which can contain all the three vowel sequences /wɜ:/, /wɔ:/ and /wɒ/ in Australian English (phonological reason). Thus, it can be claimed that our prediction was correct

with regard to the performance of the KI listeners.

Table 9. Confusion matrices of respective Korean groups

Inexperienced n=5

	wɜ:	wɔ:	wɒ	(R)		ɜ:	ɔ:	ɒ	(R)
(T) wɜ:	22	7	1		(T) ɜ:	27	3		
wɔ:	5	16	9		ɔ:		26	4	
wɒ	10	6	14		ɒ	1	3	26	

Experienced n=5

	wɜ:	wɔ:	wɒ	(R)		ɜ:	ɔ:	ɒ	(R)
(T) wɜ:	27	3			(T) ɜ:	30			
wɔ:	2	28			ɔ:		30		
wɒ	6	4	20		ɒ			30	

● Korean Experienced (KE) group

The comparison of this group's performance with that of the KI group clearly demonstrated that there had been a great improvement of perception for the three AE vowels /ɜ:/, /ɔ:/, and /ɒ/ in both /w/-initiating set and /h/-initiating set. The listeners belonging to this group did not make any wrong reply for the three /h/-initiating words. Also all but one subject did not misperceive the words 'work' and 'walk'. However, the word 'wok' caused a great difficulty to the listeners (10 cases of misperception out of 30).

The perfect scores of the KE listeners for /h/-initiating words might be interpreted as that they could identify the AE vowels /ɜ:/, /ɔ:/, and /ɒ/ quite authentically. Also, massive improvement of perception of the listeners over the AE vowels in 'work' and 'walk' seems to have indicated that the perceptual problems of L2 learners over the L2 vowels having counterparts in the L1¹¹⁾, derived from phonological discrepancy between the L1 and the L2 phonological systems, can be resolved after considerable experience in L2 speaking environment. In other words, the semivowel /w/, possessing lip-rounding

11) The AE vowels /ɜ:/ and /ɔ:/ can be matched to the Korean vowels /ʌ/ 'ㅏ' and /o/ 'ㅓ', respectively.

feature, does not continue to play a role along with the accumulation of L2 experience of the L2 learners.

However, the case of another /w/-initiating word 'wok' made quite different perceptual performance (10 cases of misperception out of 30) of the KE subjects. As accounted for in Park (1997), /ɒ/ in AE is a novel vowel and the most problematic vowel for the KE listeners to perceive. Hence, it can be claimed that /ɒ/ vowel in AE caused perceptual problem to the Koreans unlike the other AE vowels /ɔ:/ and /ɜ:/. The poor performance of the KE group members against the AE vowel /ɒ/ might be interpreted as meaning that the perceptual problem derived from lack of a counterpart over the most problematic AE vowel /ɒ/ could not be improved even after lengthy exposure to L2 speaking environment. Also, the semivowel /w/ possessing the lip-rounding feature right before /ɒ/ in word 'wok' seemed to add extra difficulty for the KE subjects to identify the AE vowel /ɒ/.

● Each Japanese group

Respective Japanese groups' result matrices are provided in Table 10 and The ANOVAs and t-tests as post-hoc analyses of the Korean and Japanese groups on the basis of different L1 backgrounds and L2 experience are presented in Table 11.

Table 10. Confusion matrices of respective Japanese groups

		<u>Inexperienced</u> n=5					
		wɜ:	wɔ:	wɒ (R)			
(T) wɜ:		30			(T) ɜ:	29	1
	wɔ:	2	28			29	1
	wɒ	8	4	18	ɒ	2	28

		<u>Experienced</u> n=5					
		wɜ:	wɔ:	wɒ (R)			
(T) wɜ:		30			(T) ɜ:	29	1
	wɔ:		30			30	
	wɒ		5	25	ɒ	2	28

● Japanese Inexperienced (JI) group

The members of the JI group did perform fairly well on five words 'work' (30/30), 'walk' (28/30), 'hurt' (29/30), 'hort' (29/30), 'hot' (28/30). However, as in the case of the KE group, their performance on the word 'wok' (18/30) was not good.

The JI listeners did not face any difficulty in distinguishing 'work' from 'walk'. This might be interpreted as meaning that the existence of the semivowel /w/ possessing the lip-rounding feature just before /ɜ:/ or /ɔ:/ did not cause any extra-difficulty to the Japanese inexperienced listeners. This result seems to indicate that, unlike the KI subjects, the JI listeners could separate the semivowel /w/ from the monophthongs /ɜ:/ and /ɔ:/ in the sequences without the negative influence of their L1 phonological system.

The poor identification of /ɒ/ in the word 'wok' appears to demonstrate that /ɒ/ vowel is problematic for the JI listeners to perceive as the cases of the Korean groups. Also, the comparison of the performance of this group over 'wok' and 'hot' seems to indicate that the lip-rounding feature of the semivowel /w/ arising right before the vowel /ɒ/ in 'wok' added more difficulty for the JI subjects to identify the vowel in question.

● Japanese Experienced (JE) group

The aspect of the perceptual performance of the JE group was almost identical to that of the JI subjects. Except the word 'wok' (25/30), the JI listeners identified the other 5 words accurately ('work' (30/30), 'walk' (30/30), 'hurt' (29/30), 'hort' (30/30), 'hot' (28/30)). Five misperceptions of 'wok' by the JE subjects seem to say that the perception of the AE vowel /ɒ/ is still difficult to the Japanese listeners who have abundant experience (more than 5 years) in English speaking situation.

One difference of this group from the JI group in the outcome is that the accuracy of the JE group in perceiving the AE vowels was higher than that of the JI group. This is likely to be interpreted as meaning that the experience factor was influential in improving the ability of perceiving L2 vowels.

● Statistical comparison

In the summary ANOVA table (Table 11) of the four different groups' perception of the AE /w/ + a monophthong (/ɜ:/, ɔ:/, ʊ/) sequences and pure monophthongs (/ɜ:/, ɔ:/, ʊ/), the differences of total errors and of the perception of /wɜ:/ and /wɔ:/ sequences amongst groups were significant (Total errors $p < 0.01$; /wɜ:/ $p < 0.05$; /wɔ:/ $p < 0.01$). It can be analysed that the significant result of the total error difference is attributable to the significant difference of the /wɜ:/ and /wɔ:/ sequence perception amongst the four groups.

As to the /wɔ:/ sequence, all Japanese groups and the Korean experienced (KE) group made highly accurate perception while the KI subjects perceived less accurately. This outcome seems to show that along with the accumulation of L2 experience, Korean experienced subjects could improve their perception of the /wɔ:/ sequence to the level of the Japanese groups regardless of the existence of semivowel /w/ possessing lip-rounding feature in the sequence and that Japanese groups' performances, regardless of the degree of their L2 (English) exposure, were better than that of the KI group.

With regard to the /wɜ:/ sequence, the two Japanese groups performed significantly better than the KI group. Different national (Korean and Japanese) groups' significantly different perceptual performances seem to result from whether or not there was a negative influence of their L1 phonology.

However, as to perception of the /wʊ/ sequence, in which the /ʊ/ vowel was the most problematic in perception to both Korean and Japanese subjects, and to the monophthongal vowels (/ɜ:/, /ɔ:/, /ʊ/), there was no statistical significance amongst the four different groups. For the three monophthongal vowels, all of the four groups perceived them accurately. On the other hand, for the /wʊ/ sequence, all of the four groups perceived it unsatisfactorily.

Table 11. Summary ANOVAS (Vowel identification concerning different L1 background and L2 experience)

Independent Variables	Dependent Variables	Degrees of Freedom	Sum of Sq.	Mean Sq.	F Value	Pr.
Gr (KE, KI, JE, JI)	Total Errors	3	197.8	65.93	5.7	0.007
Residuals		16	185.2	11.58		
Comparisons (t-test) KE > KI (t=-2.54, df=8, p=0.0345) JE > KI (t=-3.29, df=8, p=0.011) JI > KI (t=-2.34, df=8, p=0.0472)						
Gr (KE, KI, JE, JI)	Errors on /wɜ:/	3	8.55	2.85	3.68	0.034
Residuals		16	12.4	0.78		
Comparisons (t-test) JE > KI (t=-3.14, df=8, p=0.0138) JI > KI (t=-3.14, df=8, p=0.0138)						
Gr (KE, KI, JE, JI)	Errors on /wɔ:/	3	24.6	8.2	5.66	0.007
Residuals		16	23.2	1.45		
Comparisons (t-test) KE > KI (t=-2.4, df=8, p=0.0432) JE > KI (t=-3.06, df=8, p=0.0157) JI > KI (t=-2.4, df=8, p=0.0432)						
Gr (KE, KI, JE, JI)	Errors on /wɒ/	3	12.55	4.18	1.76	0.194
Residuals		16	38	2.38		
Gr (KE, KI, JE, JI)	Errors on /ɜ:/	3	0.95	0.32	1.06	0.395
Residuals		16	4.8	0.3		
Gr (KE, KI, JE, JI)	Errors on /ɔ:/	3	2.15	0.72	1.51	0.25
Residuals		16	7.6	0.48		
Gr (KE, KI, JE, JI)	Errors on /ɒ/	3	1.6	0.53	1.19	0.346
Residuals		16	7.2	0.45		

4. Discussion and Conclusions

The result of the test broadly demonstrated that the quality feature is a more influential factor than the length feature since the AE vowel /ɒ/ was the most difficult one to Japanese listeners. This outcome parallels that of Ingram and Park (1997). This seems repeatedly to indicate that the quality feature is a main factor and the length feature is a complementary one¹²⁾.

However, the fact that the AE vowel /ɜ:/, which is a novel vowel to

12) The superiority of lip-rounding is also discussed in Flege & Hillenbrand (1984) and Polka & Werker (1994).

Japanese listeners, along with the vowel /ɔ:/ in AE which has a counterpart in the Japanese vowel system, did not cause any perceptual problem to Japanese listeners has not yet been resolved. Following the prediction based on the quality feature, both AE vowels /ɜ:/ and /ɒ/ should have been equally difficult to Japanese listeners since both vowels were novel vowels to Japanese listeners. This outcome also poses a question for Best's Perceptual Assimilation model. In the previous section, Best's model defined the AE vowels /ɜ:/ and /ɒ/ as the sounds which fall in uncommitted phonetic space in Japanese. On the basis of this definition, the AE pairs /ɜ:-ɔ:/, /a-ɒ/, /ɔ:-ɒ/ and /ɜ:-a:/ were classified as cross-category comparison to Japanese listeners. In terms of Best's model, all cross-category comparison pairs must be well discriminated by L2 listeners. However, the /a-ɒ/ pair was not discriminated by Japanese listeners. If the discrepancy of easiness is discovered between the two AE vowels /ɜ:/ and /ɒ/ falling in uncommitted phonetic space for Japanese listeners, Best's model might be evaluated as is not being correct in its prediction of the L2 vowel perception of L2 learners.

The discrepancy of easiness between the AE vowels /ɜ:/ and /ɒ/ causes some problem not only to Best's model but also to the traditional view. In the previous paragraph, it was predicted that both AE vowels /ɜ:/ and /ɒ/ would be equally difficult to Japanese listeners since both vowels were novel vowels to them. This prediction, also, can not make any reasonable account for the greater difficulty of the AE vowel /ɒ/ than /ɜ:/.

At this point, we might tentatively pick up a couple of points for why the AE vowel /ɒ/ was more difficult than /ɜ:/. Firstly, the difference of the arising areas of the two vowels in the vowel quadrilateral can be pointed out with the consideration of lip-rounding. The AE vowel /ɜ:/ arises at the centre of the vowel quadrilateral. This location seems not to present a strong difficulty to L2 learners, since the central area is the closest area to the relaxed (natural) state of the tongue. This fact is well supported by the existence of 'schwa' /ə/, which is a pair vowel of /ɜ:/ in AE and arises for substituting for decoloured vowels in English. On the contrary, the arising area of the vowel /ɒ/ is low-back in the vowel quadrilateral (Clark & Yallop, 1990:69) and this vowel possesses lip-rounding. If listeners are perceiving vowels in terms of their gestural properties (Best's model), then there may be some basis for difficulty of perceiving /ɒ/. Also, Maddieson's (1984) report that only 5 out of 318 languages possess this vowel in their vowel inventories supports the fact that

/ɒ/ is a language-universally difficult vowel. Secondly, while /ɜ:/ vowel possesses long length, which will provide abundant time for L2 listeners to catch crucial cues to identify this vowel, /ɒ/ is pronounced with fairly short length. This short length of /ɒ/ is unlikely to give plenty of cues to L2 listeners for identifying this vowel. The short length of this vowel might have deceived Korean and Japanese listeners to perceive it as /a/ in Ingram and Park (1997).

As a conclusion, these two points might provide clear evidence that /ɒ/ in AE is language-universally more difficult than other AE vowels, which are also novel vowels to Korean and Japanese listeners¹³).

In this paper, the prediction on perception of Korean and Japanese listeners in terms of CA analysis over English words 'work', 'walk', and 'wok' was made under the consideration of the phonological factors of the three languages, that is the treatment of the sequence of semivowel /w/ + a monophthong as just semivowel /w/ + a monophthong or a diphthong depending upon different languages.

The outcome clearly demonstrated that the prediction was correct for the KI subjects. Hence, it can be pointed out that the prediction derived from phonological consideration is working well for inexperienced L2 learners. However, the great improvement of the KE subjects for the items 'work', 'walk' seems to demonstrate that the pure phonologically-oriented confusion can be recovered along with the accumulation of L2 experience of L2 learners. This part of the outcome was not able to be predicted. Therefore, this part can be included as a part of the whole prediction to the prediction based on phonological consideration of the L1 and the L2.

The outcome of Japanese listeners did not follow the prediction based on the CA theory. Unlike the prediction, the sequence /wɜ:/ was not difficult at all to Japanese listeners. This point is a weak point of the prediction based on the CA theory. The resolution for this wrong prediction is likely to be found from the language-universal factors suggested in the previous paragraphs.

Flege's model has a couple of incorrect prediction points with regard to

13) Should we consider the better perception of /ɒ/ than that of /wɒ/ of Korean and Japanese subjects, the addition of /w/ to /ɒ/ might have caused more difficulty to the subjects. However, small number of misperception for /ɒ/ by the subjects might have resulted from the merely 3-vowel-choice (/ɜ:/, ɔ:/, ɒ/) situation in the test (cf. footnote (8) and (10), Park 1997, Ch. 4).

Japanese listeners' performance. Firstly, the /wɜ:/ sequence as a 'new' sound did not make any perceptual problem to Japanese listeners (both to JE and JI) unlike the prediction of the model. Secondly, the /wɒ/ sequence (another 'new' sound) even caused perceptual difficulty to the JE listeners (5 cases of misperception out of 30) to the contrary. This result is also discrepant from the prediction of 'new' sound by this model. Once again, why the incorrect prediction by Flege's model arose should be found out from the language-universal factors suggested above.

In the previous paragraph, we discussed a weak point of Best's model, that the model could not provide any reasonable account of why there existed the discrepancy of ease of perception between the two AE sounds /ɜ:/ and /ɒ/, both of which were falling in uncommitted phonetic space in Japanese. Here, the focus of discussion with regard to Best's model will be shifted to the pairs rather than each sound.

Both pairs of /wɜ:-wɔ:/ and /wɔ:-wɒ/ were categorized 'cross-category' comparison by Best's model to Japanese listeners. Thus, two pairs should have been discriminated well by the listeners. The outcome of the two pairs demonstrated that the pair /wɜ:-wɔ:/ supported the prediction satisfactorily, however, the other pair /wɔ:-wɒ/ proved that the prediction was incorrect by showing many misperceptions of /wɒ/ as /wɔ:/ by Japanese listeners (four times out of 30: JI, five times out of 30: JE). This outcome seems to reveal that Best's model possesses some vulnerable points in predicting L2 learners' perceptual behaviour.

Overall, all three models (CA theory, Flege's model, and Best's) failed to provide any reasonable account to explain the discrepancy of easiness (or difficulty) between the two AE vowels /ɜ:/ and /ɒ/ to Japanese listeners (and the KE listeners) and this fact successively forced all three models to make an incorrect prediction with regard to these two sounds in relation to Japanese listeners' performance. This result is predictable since all three models are basically based upon the relative comparison of the sounds in the L1 and the L2. In order to resolve this crucial weakness of all the three models, the consideration of language-universal factors discussed earlier seems unavoidable.

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