

A comparative study between French schwa
and Korean [i]
-An experimental phonetic and phonological perspective-

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ABSTRACT

The aim of this paper is to investigate the acoustic characteristics of the French vowel [ə] and Korean [i] and to seek a way of understanding them from a phonological point of view. These two vowels have similar distributional properties, i.e. they alternate with zero in some contexts. Therefore, in both languages, they are not found when immediately followed by a nucleus with phonetic content and in word-final positions. We firstly compare the two vowels by measuring the actual frequencies of the formants, pitch and energy using CSL. We also consider whether the realisation of the two vowels is affected by the speed of speech sounds. In order to show that realisation of the two vowels in both languages is not arbitrary, rather predicted, we will introduce the notion of proper government, proposed and developed by Kaye (1987, 1990) and Charette (1991).

Keywords: acoustic characteristics, vowel/zero alternation, proper government

1. INTRODUCTION

Unlike other vowels in the vocalic inventory, the French vowel [ə] and Korean [i] alternate with zero in some contexts. For instance, they are not found before another vowel and word-finally. Therefore, it has been studied by many phoneticians and phonologists in both languages. However, as pointed out by Lee (1999), there has not been much work which approaches these vowels by comprising both phonetic and phonological viewpoints. This has resulted in the phonetic reality lying apart from the phonological theory. Moreover, there is a strong tendency that most native Korean speakers replace the French schwa to the Korean [i] when they learn French. Therefore, in this paper, we try to investigate the acoustic characteristics and the phonological behaviour of the two vowels.

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In section 2, on the basis of spectrographic analysis, we present the acoustic characteristics of the two vowels. In section 3, we consider the realisation of the two vowels from a phonological viewpoint. We show that they are neither of insertion nor of deletion, and that they are controlled by the principles, as we shall see shortly. Summaries and conclusions are given in the final section.

2. AN EXPERIMENTAL PHONETIC POINT OF VIEW

2.1 Methods

As mentioned already, this experiment is conducted in order to compare the acoustic characteristics of the French schwa and Korea [i]. The data is recorded from a native French speaker (34 year old male) and a standard Korean speaker (40 year old male) and analysed using CSL 4300B (Kay Elemetrics Co.) at the phonetics laboratory of Kyungpook national university. The two vowels are analysed both in isolation, and in short utterances to investigate the actual vowel qualities and to grasp the relationship between the speed of speech sounds and their realisation.

2.2 Results

Figure (1) below shows a spectrogram of the isolated vowels (i.e. without a consonant), [ə] in French and [i] in Korean.

(1) A spectrogram of the French vowel [ə] and Korean [i]

The first window displays the wave form of the speech sounds in order to capture acoustic data. The window below indicates the spectrogram of the corresponding data in the wide-band. The sound spectrograph translates a sound into a visual representation of its component frequencies. The horizontal axis represents time (msec), and the vertical axis represents fundamental frequency (Hz). The formants show up as dark horizontal bars.

The measured frequencies of the formants (F_1 & F_2), pitch and energy of the two vowels are given in (2) below:

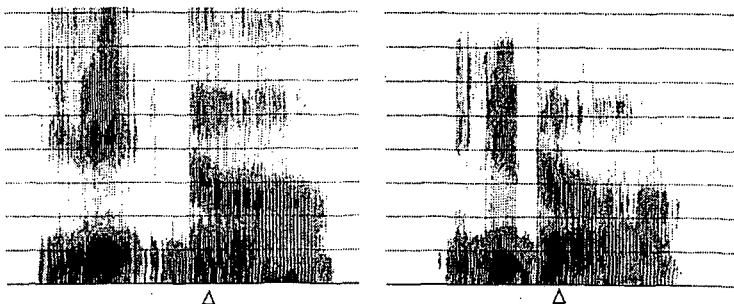
(2) The acoustic quality of the two vowels

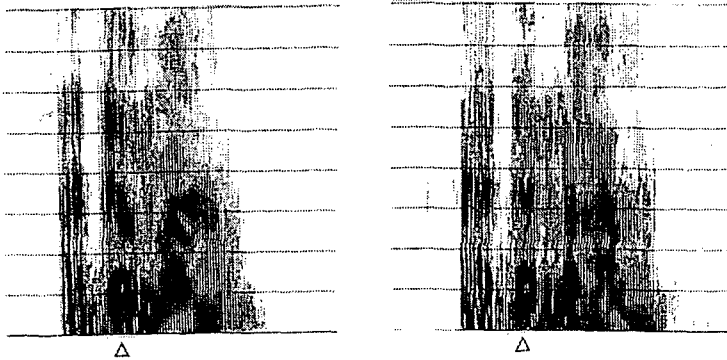
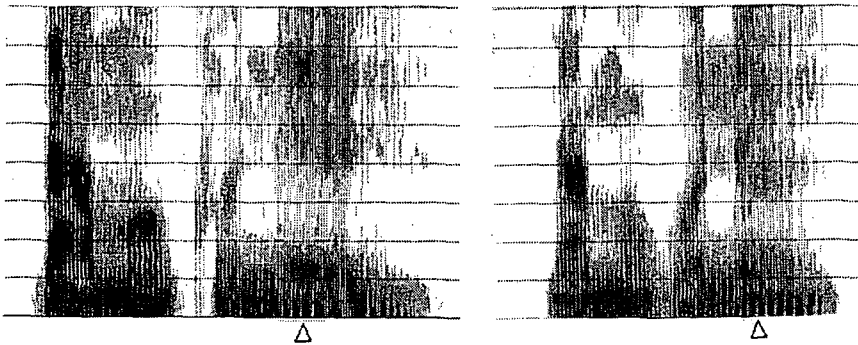
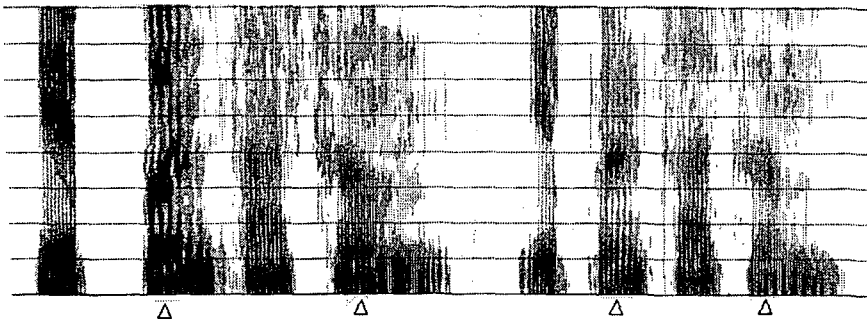
	French [ə]	Korean [i]
F_1 (Hz)	423	425
F_2 (Hz)	1260	1617
pitch(Hz)	101	217
energy(dB)	71	72

Note that the F_1 of the two vowels is not much different. It means that the two vowels are pronounced in the similar height, since the first formant (F_1) is inversely related to vowel height. Note also that they differ in F_2 and pitch.

Let us now consider whether the two vowels are omitted in fast speech. The figures in the left column show a spectrogram of the normal speed of each utterance and the fast speed is shown in the right column. (Δ indicates the zone where the vowel in question is realised.)

(3) *Il est dehors.*



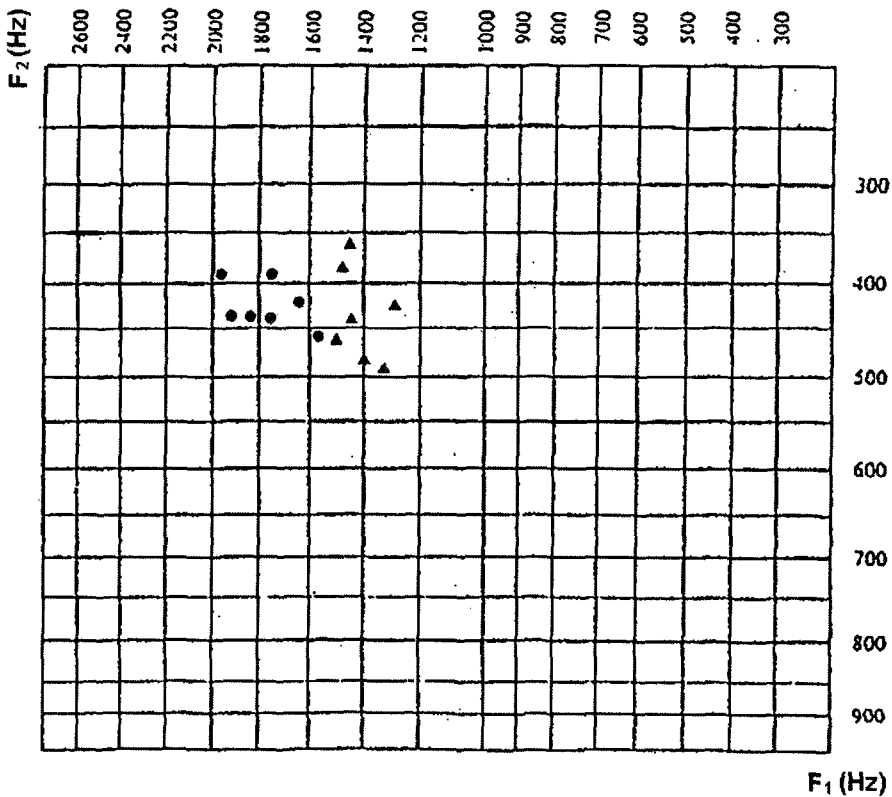
(4) *A demain!*(5) *namu kinil*(6) *yep'in sasim*

As can be seen in the spectrograms above and pointed out by Lee (1999), both French schwas and Korean [i]s are not omitted in fast speech. In other words, there is no clear correlation between speech speed and the presence or absence of the two vowels. The two vowels always appear when they are expected to be there. According to Lee's (1999) analysis about French [ə], F_1 lies within 300-500 Hz and F_2 within 1300-1600 Hz. In the case of Korean [i], however, it appears that F_1 varies

within 400-460 and F_2 within 1,600-1,900 according to the experiment carried out, i.e. the variation zone of F_1 is narrow. It implies that the Korean [i] is less affected than the French [ə] by the position and the environment where it appears.

The formant frequencies are plotted in Figure (7). The chart reflects the difference between the French [ə] and Korean [i], showing F_1 plotted against F_2 . (Signs \blacktriangle and \bullet indicate French and Korean, respectively.)

(7) A formant chart of the French vowel [ə] and Korean [i]



Summarizing what we have said about acoustic quality of [ə] in French and [i] in Korean, they have almost the same quality, but differ in that the Korean [i] is said on a higher pitch than the French [ə]. Neither of them is omitted in the fast speed of speech sounds. Let us now go into the discussion of how vowel/zero alternation is explained in phonology.

3. A PHONOLOGICAL POINT OF VIEW

3.1 An overview of the theory of GP

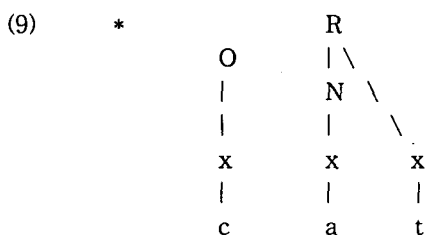
Government Phonology (henceforth, GP; Kaye, Lowenstamm & Vergnaud (KLV; 1985, 1990), Charette & Kaye (1994) aims to look for 'Universal Grammar' in phonology and to provide non-arbitrary accounts for various phonological phenomena. In doing so, GP is based on the notion of principles and parameters. As one of the principles, GP claims that all phonological domain must end in a nucleus. This follows from the Coda Licensing Principle, which is presented below:

(8) Coda Licensing Principle (Kaye, 1990: 311)

Post-nuclear rhymal positions must be licensed by a following onset.

The principle above illustrates that the preceding consonant must be associated to the rhymal position under government by the following consonant. In accordance with this licensing principle, an apparent domain-final consonant cannot be syllabified into a rhyme, but must be syllabified into an onset followed by a domain-final empty nucleus. Therefore, a phonological domain must end in a nucleus.

For instance, let us consider the syllable structure of the English word 'cat'. Without the Coda Licensing Principle, it would be possible to represent its syllable structure as shown in (9) below:



The Coda Licensing Principle presented in (8), however, rules this out. The coda position occupied by the 't' in (9) above is not licensed, since there is no following onset. Therefore, the syllable structure in (9) is ill-formed. The well-formed alternative to (9) is shown in (10) below:

(10)	O	R	O	R
		N		N
	x	x	x	x
	c	a	t	

The occurrence of word-final consonants depends on whether a language licenses domain-final empty nuclear positions. As for the licensing of word-final empty nucleus as well as of a word-internal empty nucleus, GP supplies the ECP and proper government, which are presented in (11) and (12) below:

(11) Empty Category Principle;

- i. The phonological ECP (Kaye, 1993: 94)
A p-licensed (empty) category receives no phonetic interpretation.
- ii. P-licensing
 - (a) Domain-final (empty) nuclei are p-licensed (parameterised).
 - (b) Properly governed (empty) nuclei are p-licensed.

(12) Proper Government (Kaye, 1993: 94)

- α properly governs β if
- i. α and β are adjacent on the relevant projection,
 - ii. α is not itself licensed, and
 - iii. No governing domain separates α and β.

Firstly, as can be seen in (11), the licensing of word-final empty nucleus is parametric. The language of the world can be divided into two groups depending on whether they license such positions or not. On the one hand, languages which do not license word-final empty nuclei would obligatorily give phonetic content to those nuclei (e.g. Japanese, Brazilian Portuguese). On the other hand, in languages which license word-final empty nuclei, words may appear to end in consonants (e.g. English, German). Secondly, what determines whether or not a word-internal empty nucleus may be left without phonetic manifestation is whether or not it is properly governed. According to proper government, a word-internal empty nucleus may not be phonetically realised when it is adjacent to another nucleus which itself is not licensed. If proper government fails to apply, the word-internal empty nucleus must be

phonetically manifested.¹⁾

We claim that the vowel [ə] and [i] in French and Korean, respectively, are the manifestation of empty nuclei, following Charette (1991), Heo (1994) and Kim (1996). It means that they are always present in lexical representations, and their phonetic interpretation is determined by the ECP and proper government, as explained above. Let us first consider how the vowel [ə] behaves in French.

3.2 The Case of French

In this section, we present the properties of schwa found in French along with some relevant data which lead to the conclusion that schwa is the manifestation of empty nuclei. Although it is assumed to be true that schwa is the interpretation of empty nuclei, it appears in quite different types of environment. When schwa occurs in word-final position, it is never pronounced regardless of the number of consonants that precede it, as shown in (13) below:

(13) a. after one consonant

sale	[sal]	'dirty'	malade	[malad]	'sick'
lente	[lɑ̃t]	'slow'	cantique	[kɑ̃tik]	'song'
rage	[raʒ]	'rabies'	chère	[ʃɛr]	'dear'
grande	[grɑ̃d]	'tall'	suave	[syav]	'sweet'

b. after two consonants

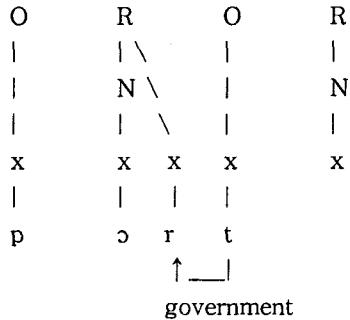
porte	[port]	'door'	livre	[livr]	'book'
ferme	[fɛrm]	'farm'	bible	[bibl]	'bible'
verge	[vɛrʒ]	'yard'	montre	[mɔ̃tr]	'watch'
barbe	[barb]	'beard'	tendre	[tɑ̃dr]	'tender'

As noted from the data in (13a,b), schwa in word-final position can be empty and realized as zero. Therefore, unlike in Japanese and Italian, French words ending in a consonant are abundant, and no words end in [ə].

The following configuration is the case where an empty nucleus is preceded by two consonants. Since the final consonant can only be syllabified within an onset, a nucleus must follow this onset to satisfy the governing constraints. The derivation of *porte* is illustrated in (14) below:

1) In many languages, unlicensed empty nuclei are realised as a vowel. What distinguishes one language from another is the nature of the segment which alternates with zero. The vowel [u] alternates with zero in Tangale, [i] in Moroccan Arabic, [a] in Khalkha Mongolian. These are accounted for in terms of the same set of principles and parameters.

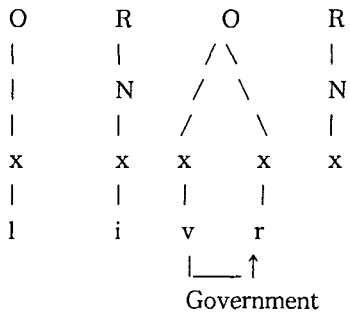
(14) *porte* [pɔrt] 'door'



Structure (14) is the lexical representation of *porte*. Like in words ending in a single consonant, words ending phonetically with a consonant cluster have a final nucleus in their representation. Even though this final empty nucleus has no phonetic content, the position is nevertheless underlyingly present. The final empty nucleus is licensed by virtue of its position and licenses the preceding onset. The liquid 'r' in the rhymal position is governed by the following onset 't'. Because they establish the relationship of interconstituent government, the right member is the governor.²⁾ Therefore, the structure above is well-formed and the final empty nucleus does not get phonetic interpretation, yielding [pɔrt], not *[pɔrtə].

Another type of consonant cluster found in word-final position is given in the right column of the example (13b). In other words, unlike in the examples in the left column where the order of the consonant cluster is reversed. While in the left column of (13b) the sequence of liquid-obstruent is found, in the right column the sequence of obstruent-liquid is attested. Consider the derivation of *livre*.

(15) *livre* [livr] 'book'



2) There are two different types of government established between two consonants. One is the interconstituent government which is the relationship between the consonant in the following onset and the consonant in the preceding rhymal position(head-final, e.g. rt, rv, rd). The other is the constituent government which is established in branching onsets(head-initial, e.g. br, pl, tr).

In the structure above, the final empty nucleus is licensed to be realised as zero and licenses the preceding onset, as expected. The consonant cluster preceding the final empty nucleus is the sequence of obstruent-liquid. However, unlike in (14), they establish the relationship of constituent government, which means that the left member governs the right one (i.e. 'v' governs 'r'). Therefore, the structure in (15) is well-formed and the final nucleus is not interpreted. As a result, we hear [livr], not *[livrə].

Word-internally the situation is different. Schwa is realised as zero when preceded by one consonant and as schwa when two consonants precede it. Consider the examples:

(16) a. after one consonant

lentement	[lãtmã]	'slowly'
souvenir	[suvnir]	'to remember'
prévenir	[prevnir]	'to advise'
sagement	[saʒmã]	'sensibly'
riverain	[rivrẽ]	'waterside'
galerie	[galri]	'gallery'

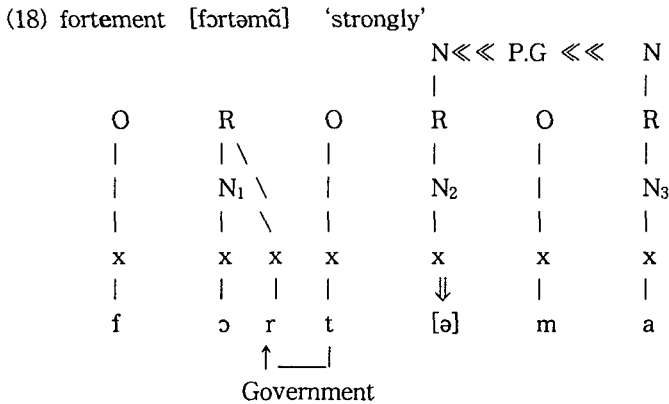
b. after two consonants

fortement	[förtəmã]	'strongly'
parvenir	[parvə'nir]	'to achieve'
forgeron	[fɔʒərɔ̃]	'blacksmith'
appartement	[apartəmã]	'apartment'
librement	[librəmã]	'freely'
advenir	[advə'nir]	'to happen'

The derivation processes of *lentement* and *fortement* are given in (17) and (18) respectively:

(17) *lentement* [lãtmã] 'slowly'

			N <<<P.G <<<		N
O	R	O	R	O	R
	N ₁		N ₂		N ₃
x	x	x	x	x	x
l	a	t		m	a



Note in (17) that the empty nucleus is followed by a nucleus with phonetic content. Therefore, it is properly governed by the following filled nucleus N₃. As a result, it is not interpreted, yielding [lãtmã]. However, in (18), although the empty nucleus N₂ is followed by a nucleus with phonetic content, it is phonetically interpreted. What is of importance is that the empty nucleus is preceded by an obstruent which governs the preceding liquid. In this case, the onset before the empty nucleus is a governor which governs a preceding rhyml complement. What distinguishes with the example (17) is that the empty nucleus is preceded by a consonant which does not govern a complement. A properly governable empty nucleus N₂ fails to be properly governed because the preceding consonant must govern the complement, liquid 'r'. Therefore, N₂ must be phonetically realised.³⁾

We have so far considered that French schwa is the manifestation of empty nuclei. Based on the discussion so far, the generalization is that schwa is never realised phonetically when schwa is preceded by only one consonant, both word-finally and word-internally.⁴⁾ However, the behaviour of schwa is neither accidental nor is it specific to French. This analysis can be extended to Korean. In what follows, we discuss the case of Korean.

3) Charette proposes the notion of 'Government-licensing' to provide an explanation for the examples where a properly governable empty nucleus fails to be properly governed when it is preceded by a consonant which governs a complement. For a detailed discussion, refer to Charette (1991).

4) It is almost always the case that a schwa in the initial syllable of a bisyllabic word and precede by a single consonant is not phonetically realised. However, when the onset is branching, schwa is manifested. However, the realisation in the initial position is not dealt with in this paper. For a discussion about this, refer to Charette (1991).

3.3 The case of Korean

The properties of [i] found in Korean follow from the same principles of the theory. Words in Korean may end in either a consonant (e.g. [pap] 'rice') or a vowel (e.g. [napi] 'butterfly'). What is important is that words ending in [i] are really rare.⁵⁾ If this vowel had the same properties as other vowels, we would expect it to have the same distribution.

However, the process of [i]-zero alternation in Korean is different from French in many respects. For example, the alternation can only be observed between stem and suffix. In other words, there are no cases in which the vowel [i] in the stem undergoes elision when a vowel-initial suffix is added. For instance, when the nominative suffix '-i' is added to *kasim* 'breast', it is realized as [kasimi], not *[kasmi]. This shows a different behaviour of alternating vowels from that found in other languages: the latter are sometimes present and sometimes absent, according to the contexts that follow, as seen in the French data discussed above.

Despite the above facts, which appear to show that [i] in Korean differs little from the non-alternating vowels of this language, there is good evidence to claim that this vowel has a special status in Korean phonology. That is, as we shall see below, Korean [i] does not behave arbitrarily, but appears and disappears systematically. In addition, as mentioned already, the vowel does alternate with zero in some contexts. This process may be accounted for by the claim that a nucleus that dominates a vowel which regularly undergoes elision may be underlyingly empty, and is interpreted either as zero or a vowel, according to conditions of government.

The properties of [i] in Korean are the same as those of alternating the vowel in French, as mentioned above. In other words, we can predict the behaviour of this vowel both in morphologically simplex words as well as in morphologically complex words. The alternation of [i] with zero is systematic. The presence or absence of this vowel relates to the presence or absence of the following vowel.⁶⁾

Like in French, the notion of proper government provides a good explanation why penultimate empty nuclei get no phonetic interpretation, when the final nucleus is filled. Relevant examples are given in (19) below:

5) To our knowledge, only three words end in this vowel: [ki] 'he', [əni] 'an interrogative pronoun' and [yəni] 'other (person)'. On the realisation of [i] in this final position, refer to Heo (1994).

6) The presence and absence of the vowel [i] is not only controlled by the presence or absence of the following vowel, but also by the quality of the flanking consonants. However, for the purpose of simplification, this type of examples are not dealt with in this paper. For a detailed discussion, see Heo (1994), Kim (1996).

(19)	togømu	[togmu]	'friend'
	s'ərømɛ	[s'əlme]	'sleigh'
	t'arøki	[t'alki]	'strawberry'
	karøpi	[kalpi]	'spareribs'
	canøc ^{hi}	[canc ^{hi}]	'feast'
	cagøk'i	[caŋk'i]	'cock-pheasant'

It is seen that penultimate empty nuclei are not interpreted when the following nucleus is filled. In this case, unlicensed nuclei play a role as proper governor. Take the form *togømu* as an instance. The derivation is given in (20) below:

(20)	<i>togømu</i>	[togmu]	'friend'		
				N	««P.G
				««	N
	O	R	O	R	O
		N ₁		N ₂	
	x	x	x	x	x
	t	o	ŋ	m	u

It is seen that the penultimate nucleus N₂ is empty and is followed by a filled nucleus. Thus, N₂ is p-licensed by proper government, hence inaudible. Note that the notion of proper government predicts the impossibility of forms like *[togimu], *[s'ərime] which is correct.

Penultimate empty nuclei are phonetically realised, when the final nucleus is empty, as seen in the data below:

(21)	sasømo	[sasim]	'deer'
	kasømo	[kasøm]	'breast'
	katøkø	[katøk]	'full'
	yørømo	[yørømø]	'summer'
	kusørø	[kusil]	'pearl'
	metøpø	[mɛtip]	'knot'

The interpretation of the penultimate empty nuclei is accounted for as follows. The final empty nucleus is p-licensed, therefore, it cannot p-license the preceding nucleus, which must be realised. The word *sasømo* 'deer' is taken as an example to illustrate this fact:

(22) *sasømə* [sasim] 'deer'

			N // P.G	<<<	N
O	R	O	R	O	R
	N ₁		N ₂		N ₃
x	x	x	x	x	x
			↓		
s	a	s	[i]	m	

Note that there are two successive empty nuclei. The empty nucleus N₃ is p-licensed by virtue of its domain-final position. N₂ is not domain-final and thus cannot be p-licensed in the same way as N₃. However, the potential proper governor of N₂, i.e. N₃ is itself licensed, which means that the conditions for proper government are not satisfied. Therefore, N₂ is not p-licensed and must receive phonetic interpretation according to the ECP. As a result, the unlicensed empty nucleus N₂ is realised as [i].

However, in Korean although word-final empty nuclei are licensed, the empty nucleus after a consonant cluster behaves in a different way. As we saw in the previous section, while words like *porte* [pɔrt] 'door', *livre* [livr] 'book', *ferme* [fɛrm] 'farm', *verge* [vɛrʒ] 'yard' are well-formed in French, in Korean, a word-final empty nucleus can only be manifested as zero after a single consonant. When the final empty nucleus is preceded by a consonant cluster, one of them must always be deleted, as seen in (27) below:⁷⁾

(27)	<i>tarøkø</i>	[tak]	'chicken'
	<i>sa:rømə</i>	[sa:m]	'life'
	<i>yətərøpø</i>	[yətəl]	'eight'
	<i>c^hirøkø</i>	[c ^h ik]	'arrowroot'
	<i>a:rømə</i>	[a:m]	'knowledge'

As already mentioned earlier, word-final empty nuclei are licensed in both languages. However, the licensed empty nuclei in Korean do not have the same status as in French. In other words, the licensed empty nuclei in French are able to serve as proper governors of the preceding onsets, whereas they are not in Korean. As a result, while consonant clusters preceding word-final empty nuclei are realised as they are in French, in Korean one of the two consonants is deleted.

We have so far seen that proper government is a mechanism which controls the

7) Heo claims that consonant clusters found in Korean are not genuine sequences, but are separated by an intervening empty nucleus. For a detailed discussion about consonant cluster simplification, see Heo (1994).

interpretation of empty nuclei, and that [ɨ] in Korean should be the phonetic interpretation of an ungoverned empty nucleus. In addition, [ɨ] is subject to exactly to the same principles that govern the distribution of the French schwa.

4. CONCLUSION

The French vowel [ə] and Korean [ɨ] have the similar acoustic characteristics in terms of the frequency of the first formant, but they differ in the second formant and pitch. They both are not omitted in the fast speech sounds. However, interestingly, the first formant of the Korean vowel [ɨ] varies in a narrower zone compared with that of the French schwa. It may be the reason that the vowel [ɨ] in the stem does not undergo elision when a vowel-initial suffix is added. In other words, the Korean [ɨ] is less affected by the environment where it occurs, i.e. it is stable. Actually, in Korean, as long as [ɨ] appears in orthography, it is pronounced, unlike in French. That is, the system of orthography and pronunciation are equal.

However, the French vowel [ə] and Korean [ɨ] have the same distributional properties, e.g. they are not phonetically interpreted when immediately followed by a nucleus with phonetic content. The presence or absence of the two vowels in both languages are explained by the notion of proper government within the theory of GP.

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