

A Comparative Study on Intonation between Korean, French and English: a ToBI approach*

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ABSTRACT

Intonation is very difficult to describe and it is furthermore difficult to compare intonation between different languages because of their differences of intonation systems. This paper aims to compare some intonation phenomena between Korean, French and English. In this paper I will refer to ToBI (the Tone and Break Indices) which is a prosodic transcription model proposed originally by Pierrehumbert (1980) as a description tool. In the first part, I will summarize different ToBI systems, namely, K-ToBI (Korean ToBI), F-ToBI (French ToBI) and ToBI itself (English ToBI) in order to compare the differences of three languages within prosody. In the second part, I will analyze some tokens registered by Korean, French and American in different languages to show the difficulties of learning other languages and to find the prosodic cues to pronounce correctly other languages.

The point of comparison in this study is the Accentual Phrase (AP) in Korean and in French and the intermediate phrase (ip) in English, which I will call "subject phrase" in this study for convenience.

Keywords: Intonation, ToBI, K-ToBI, F-ToBI, AP, ip

1. Introduction

The problem of representation is crucial to the study of intonation. A theory of intonation will need to include at least the following subcomponents (Hirst 1983):

- a *phonological component* specifying the structures and categories of underlying representations
- a *phonetic component* defining the relationship between the underlying representation and the acoustic parameters (i.e. segmental duration, fundamental frequency and intensity as functions of time)
- an *interpretative component* relating the underlying representation to

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syntactic, semantic and pragmatic aspects of meaning.

It is notoriously difficult to compare intonation between languages because of its nature. Intonation is closely related to different components of the grammar such as phonetics, phonology, syntax and semantics. Furthermore a comparative study on intonation between languages is difficult because of the difference of language types. Korean and French are considered as syllable-timed languages but English is a stress-timed language. That is to say that Korean and French do not have lexical stress but English has lexical stress which influences the intonation curve.

In this study, I will focus the analysis on the subject part to discover the intonation patterns of three languages and to describe how other language speakers pronounce them with the interference of their native languages. And finally we will summarize the difficulties of the speakers in producing foreign languages in order to discover the cue points of learning these three languages' intonation patterns properly.

The study is based on the fundamental frequency (F₀) track analyzed through PitchWorks with 10 simple declarative sentences. Firstly, I summarized the comparison tool for this study, namely ToBI (the Tone and Break Indices). Within the ToBI system, I will describe these languages' intonation in order to point out their differences in prosodic system.

2. ToBI (the Tone and Break Indices)

In this section, I will summarize the characteristics of intonation in general and within this basic knowledge, I will also summarize the ToBI system which proposes a prosodic transcription for different languages focussed on Korean, French and English.

2.1 Intonation and ToBI

Pitch variations in discourse constitute what is called the intonation of sentences and they play a very important linguistic role, especially in foreign language studies. Intonation is one of the suprasegmental properties of speech and it typically has effects that are expressed beyond segmental boundaries. Intonation is not easy to define because of its complexity but one thing that we can agree on is that intonation refers to a narrower range of phenomena of prosody, generally the patterns of pitch rises and falls and the patterns of stress in a given language. In this sense, I choose the ToBI system from among others to describe intonation of Korean, French and English which will give us a unified model of comparison.

ToBI which is summarized in this study, is based on the former works of

Pierrehumbert (1980), Pierrehumbert and Beckman (1986), Jun and Beckman (1994), Jun (1999), Jun and Fougeron (1995, 1999) among others. According to these authors, ToBI is a prosodic transcription convention and assumes intonational phonology with a close relationship to a hierarchical model of prosodic constituents. As the basis of the ToBI is assumed equally for all languages, I will mention here the principles of the description of the ToBI system to help the idea of intonational phonology from Pierrehumbert's work.

Pierrehumbert (1980) has proposed a model of English intonation in her dissertation. The main purpose of Pierrehumbert's thesis is to develop an abstract representation for English intonation and to investigate the rules which map these phonological representations into phonetic representations. This is to seek the simplest possible underlying representation by determining what properties of the surface representation can be explained by realization rules, instead of being marked in the underlying form.

There are three components of the phonology of intonation. Firstly, there is a grammar of allowable tunes which generates sequences of Low (L) and High (H) tones. Secondly, referring to the metrical grid in Liberman (1975) and Liberman & Prince (1977), there is a metrical representation of the text in which the grid tells us which syllables are stressed or unstressed, and the relationships in strength among the stressed syllables. And finally, there are rules for lining up the tune with the text. That is to say that the complete phonological representation for intonation is a metrical representation of the text with tones lined up in accordance with the rules.

As for the phonetic representation of intonation, ToBI adopted the Fo contour which has also three components. Firstly, the Fo of metrically strong syllables are pitch accents which are described by H and L with or without starred tone. They can be single tone or bitonal accents. Secondly, the Fo contour at the end of a phrase, after the last pitch accent determines a phrase accent & boundary tone. These tones do not line up with metrically strong syllables but align with the phrase boundary (Liberman 1975). L- and H- note phrasal accents and L% and H% are boundary tones. The phrasal accent is positioned near the end of the word with the nuclear stress and the boundary tone is positioned at the end of a phrase. Finally, the Fo contour in between the tones is drawn as a direct line between two adjacent tones, namely, H and L or L and L, but Fo dips down between two H tones, namely, H* and H*, but not between L* and L*.

I will summarize the English ToBI first because it has the basic principles of all other ToBI systems.

2.2 English ToBI (ToBI)

ToBI, basically proposed by Pierrehumbert in 1980, was revised by Pierrehumbert and Beckman in 1986, and recently revised by the same authors and colleagues in 1993. According to the authors, the ToBI is a standard model for labeling English prosody in

which they give guiding principles as follows: Categorical aspects of prosody are of two types: prosodic structure (grouping of words into prosodic constituents) and the intonation pattern. In this sense, ToBI is designed to distinguish all of the categorically distinct intonation patterns and prosodic units, but it does not transcribe aspects of prosody which are more amenable to quantitative measures than to the categorical divisions and also does not transcribe predictable categorical aspects of prosody, such as stressed vs. unstressed syllables.

With these basic principles of ToBI, we should now consider briefly the notations for ToBI in order to describe other languages within its system.

The authors propose four parallel tiers, 1 to 4, with time aligned to describe prosody within ToBI:

- Tier 1 : tone tier
- Tier 2 : word tier or orthographic tier
- Tier 3 : break index tier
- Tier 4 : miscellaneous tier.

Tier 1 is a Tone tier which transcribes the tune and a two-level prosodic phrase structure. ToBI (version 1993) allows five pitch accents in this tier. Pitch accents (peaks or valleys) are placed somewhere within the accented syllable, preferably within the interval that can be identified with the syllable's vowel. '<' is used for delayed tonal target and '>' is used for early tonal target. Phrasal tones are noted in Tier 1 too: intermediate phrase (ip: L- or H-) and intonational phrase (IP: L% or H%). H% is at the end of a phrase and %H, at the beginning of a phrase. We can have four combinations of a full intonational phrase (L-L%, L-H%, H-L%, H-H%). It is a convention to write phrase accents and boundary tones together at or just before the right edge of the word, also before the related break-index mark. As for an intonation-phrase-medial phrase accent, it is convention to put the phrase tone at the right end of the phrase final word.

Tier 2 is an Orthographic tier in which we can write a word so that the last segment of the word comes on the right edge of a speech signal.

Tier 3 is a Break-index tier where we transcribe the strength of association (coherence or disjuncture) between adjacent words. We can write a number from 0 to 4 at or just after the right edge of the word. This numbering captures the hierarchical nature of the prosodic groupings. '0' for clear phonetic marks of clitic groups. '1' for most phrase-medial word boundary. '2' for a mismatch between tone and juncture. '3' for intermediate phrase boundary. '4' for intonation phrase boundary.

Tier 4 is a Miscellaneous tier to note any comments or markings (e.g. silence, audible breaths, laughter, false start, hesitation, disfluencies, and other spontaneous speech

effects.). When events have a duration, it is convention to mark the starting point with '<' and the ending point with '>'.

There are also notations for uncertainty or underspecification as follows. '*' means underspecified pitch accent: the started pitch is accented, but the tonal value has yet to be assigned. '-' means underspecified phrase accent. '%' means underspecified boundary tone. '*?' means the uncertainty of accentedness. 'X*?' means the uncertainty of accent type. 'x' means underspecified break index. '#-' means break is uncertain between two levels (ex. 2- means not sure of 1 or 2). #p means a disfluency after this level of juncture (ex. 1p for abrupt cutoffs).

All these notations are used to describe English prosody and we can summarize that English intonation is determined by three things: pitch accent types, pitch accent locations, and phrasing. With these parameters, we can assume that there are mainly three different tones in English, namely Pitch accents, Intermediate phrase tones and Intonation phrase tones. That is to say, at the phrasal level, there are two types of phrasal tones which are associated with the edge of a phrase. Firstly, the Phrase accent, either H- or L- belongs to an intermediate phrase (ip). Phrase accent is realized on syllables after the nuclear pitch accented word till the intermediate phrase edge. This 'ip' is the domain of nuclear pitch accent, focus, and downstep. Secondly, the Boundary tone, either L% or H% belongs to an 'Intonation phrase' which is larger than the intermediate phrase. This boundary tone is realized on the last syllable of the Intonation Phrase (IP). It can be upstepped after H- phrasal accent. The IP is also marked by a lengthening of the phrase final syllable, and is often, but not necessarily, followed by pause.

In this study, I will deal only with the ip of the utterance initial position to analyze English intonation curves pronounced by Korean or French speakers to experiment with a foreign language accent and to observe where the cue point is of an exact pronunciation.

2.3 Korean ToBI (K-ToBI)

The summary of K-ToBI is mainly based on Sun-Ah Jun's works (1990, 1993, 1996) on Seoul Korean intonation and it is a prosodic transcription convention for Seoul Korean. It is based on the design principles of the original English ToBI. The first version of K-ToBI was developed by Mary Beckman and Sun-Ah Jun in 1994. The current version that I will summarize in this study is the one which was revised by Sun-Ah Jun in 1999 and elaborated by herself in 2000. According to Jun, like the other ToBI systems, K-ToBI assumes intonational phonology with a close relationship to a hierarchical model of prosodic constituents as proposed by Pierrehumbert and her colleagues (Jun 2000).

The main idea of Jun on the intonational structure of Seoul Korean is as follows. Jun

has proposed in her works (Jun 1990, 1993, 1996, 1998; Jun & Oh 1996) that Korean intonation has a hierarchical structure, such as, Intonation Phrase (IP), Accentual Phrase (AP) and Word. Within this framework, the author claims that an IP final syllable has a boundary tone and a final lengthening. This boundary tone is varying from a single tone (ex. H% or L%) to a combined tone (ex. HL%, HLH%, etc.) and it is only realized at the end of IP but not at the beginning. AP is a smaller phrase within an IP, which is defined by tones. AP can include more than one Word and the tonal pattern of AP is either LHLH or HHLH. The initial tone is determined by the AP initial segment. That means if the initial segment is aspirated or tense, the AP has a HHLH pattern, and otherwise a LHLH pattern. Jun also gives the guidelines for the realization of the underlying AP tones, namely LHLH or HHLH.

The initial tone (L or H) is realized on the first syllable of an AP. The final two tones, LH, are realized on the last two syllables of an AP: L in penultimate and H in final syllable. The second tone, initial H, is realized on the second of an AP when the AP is longer than 3 syllables. According to her research, when the phrase is shorter than 4 syllables, four possible surface forms are found: L(H)LH, LH(L)H/HH(L)H, L(HL)H/H(HL)H, (L/H)HLH. And when an AP is short, and followed by a High tone, AP final H can be realized as L. If not, AP final H stays and the following AP initial H becomes L. Furthermore, AP final tone (H) is overridden by the IP final boundary tone when AP is final to IP.

Let's now review Jun's K-ToBI labelling conventions (2000). In accordance with general design principles of ToBI, K-ToBI expands a tone tier into two tiers, a phonological tone tier and a phonetic tone tier, in order to describe surface tonal patterns which are not predictable from the underlying tones. Therefore, different from the original ToBI, for the notation of K-ToBI, the author proposes five parallel tiers (Jun 2000):

- Tier 1 : a word tier
- Tier 2 : a phonological tone tier
- Tier 3 : a phonetic tone tier
- Tier 4 : a break-index tier
- Tier 5 : a miscellaneous tier

Jun mentioned that the expansion of the tone tier was devised to label the surface tonal pattern of an Accentual Phrase (AP) separately from the underlying tones marking the AP boundary. According to the author, this point is different from the earlier versions of K-ToBI which had four tiers as in the original ToBI, and this was motivated by the following reasons. First, unlike English, in Korean, distinctive pitch events do not come

from an individual phrasal tone but as a set of tones forming an AP. Furthermore, though the most common tone pattern of an AP is LHLH or HHLH, the surface realization of the AP tone has various patterns and these variations are neither distinctive nor predictable. Therefore, by labelling surface tonal patterns, the authors try to investigate if there is any meaning difference among these patterns. Second, it is to separate the AP-like boundary tone as 'La' on the phonetic tone tier from the other AP tones. Third, it is to differentiate H tones, those from underlying forms and those of surface realizations, and then to describe their Fo values properly. Therefore, the authors propose to label the AP and IP boundaries at a phonological tone tier and the individual AP tones at a phonetic tone tier aligned with the corresponding surface Fo event. Fourth, the authors claim that by separating a tone tier into phonological and phonetic tone tiers, we can easily accommodate tonal transcriptions of other dialects.

Using these two tone tiers, the notation of K-ToBI labelling conventions of each tiers is similar to the original ToBI. It can be summarized as below (Jun 2000).

Tier 1 is a word tier which corresponds to the orthographic tier in English.

Tier 2 is a phonological tone tier which is used to mark the boundary tone of an Intonation Phrase (IP) and the boundary tone of an IP-medial Accentual Phrase (AP). There are two types of boundary tones, namely LHa and T%. 'LHa' marks the end of an IP-medial AP, aligned with the end of an AP final segment determined from the waveform. The LHa tone should be placed at or just before the corresponding break index marker regardless of the actual location of the peak. 'T%' marks the end of an IP, aligned with the end of an IP final segment determined from the waveform. 'T' is used as a variable of the IP tones. A T% tone at a phonological tone tier should be placed at or just before the corresponding break index marker regardless of the actual location of the peak. When a word is final to an AP and final to an IP, only the IP boundary tone is written at the end of the word.

Tier 3 is a phonetic tone tier which is used to mark the surface realization of AP tones and IP tones. As for AP tones, we will have three initial tones (L, H, and +H) and three final tones (La, Ha, and L+). According to the author the description of the realizations and locations of three AP final tones and three AP initial tones is as below.

AP final tones:

Ha: This is the most common AP final tone of an IP-medial AP. It can be either the end of a rising tone or a high flat tone. This label is placed aligned with an actual Fo peak on the AP final syllable.

La: This is a less common AP final tone, sometimes seen when the following AP begins with a H tone. This label is placed aligned with an actual Fo valley on the AP final syllable.

L+: This tone is not for the final syllable of an AP, but to label the low toned penultimate syllable of an AP, either before the AP final H tone or before the IP final H boundary tone. This tone is not labeled if it is predictable from adjacent tone labels.

AP initial tones:

L: This tone marks an L tone on the first syllable of an AP. This label should be placed aligned with the Fo valley on the first syllable of an AP.

H: This tone marks a H tone on the first syllable of an AP. This label should be placed aligned with the Fo peak on the first syllable of an AP (but avoid the first pitch point at the beginning of a vowel which is most likely due to the segmental perturbation).

+H: This tone marks the H tone on the second syllable (or sometimes the third syllable when the AP is long or uttered fast or produced under focus) of an AP. This label should be placed aligned with the Fo peak on the second syllable. When the peak continues over following syllable, this label is placed aligned with the last Fo peak of the phrase initial peak.

For the IP boundary tones, the whole tone is placed toward the end of the IP final syllable aligned with the Fo maximum for H ending boundary tones and the Fo minimum for L ending tones. As this study does not concern itself with the IP tones, I will not go into details for the description of realization rules of these tones. There are also notations for a case of uncertain or underspecified events, for both AP and IP, and we can use some labels in a phonetic tone tier. These labels are very similar to ToBI's labels.

Tier 4 is the break-index tier in which break indices, from 0 to 3, represent the degree of juncture perceived between each pair of words and between the final word and the silence at the end of the utterance. '0', for cases of clear phonetic marks of "clitic" groups. '1', for phrase-internal "word" boundaries. '2', for cases of a minimal phrasal disjuncture which is typically associated with the tonal pattern at the right edge of the Accentual Phrase. '3', for cases of a strong phrasal disjuncture which is typically associated with the tonal pattern at the right edge of an Intonation Phrase. Furthermore, in cases of mismatch, these break indices are flagged with the diacritic 'm' which indicates the mismatch between the tonal pattern and the boundaries. There are also some break index labels, such as x, #-, and #p which have a similar function as in English.

Tier 5 is a miscellaneous tier in which any comments and markings are transcribed as in the original ToBI.

From all of these descriptions, we can agree that Korean intonation is determined by two things: AP and IP, with assumption that AP's underlying tonal patterns are either

LHLH or HHLH following its initial segment at the initial position of an utterance. And also, according to the author's claim, we have assumed that an AP final tone is always a rising tone (LH). We will examine this fact later through the speech registered from English and French speakers.

2.4 French ToBI (F-ToBI)

French intonation has been a research target for many years and researches have been made by many authors like Delattre (1939), Mertens (1987), Rossi (1985), among others. Also, several phonological models on French intonation were proposed (Hirst & Di Cristo 1984, 1996; Post 1993; Jun & Fougeron 1995; among others). These authors all agree that a tone is associated with a stressed syllable and a stress is rhythmic or postlexical. They also agree with the fact that an utterance is hierarchically organized into different prosodic levels, though not by the same terminology. But they do not agree with the levels of phrasing and their tonal representation, neither for the notion of accent in French and the degree of abstractness in the tonal representation. Therefore, to conform to the other languages for the description of intonation, in this study, I will refer to Jun & Fougeron's model (1995, 1997, 1998) based on Pierrehumbert & Beckman framework on ToBI to describe French intonation.

Assuming that an intonational tune is composed of a sequence of underlying H and L tones, and that each tone is linked to a syllable which is either metrically strong or marks the boundary of a prosodic unit, Jun & Fougeron (1995, 1997, 1998) propose two intonational units in French: Intonation Phrase and Accentual Phrase. And these units are determined in a hierarchical structure as in the other ToBI systems. An IP can contain one or more APs. An Intonation Phrase (IP) final syllable has a boundary tone and has a strong final lengthening, and optionally followed by a pause.

An Accentual Phrase (AP) is a smaller phrase within an IP, and larger than a Word. AP is the domain of primary and secondary stress. The authors propose the underlying tonal pattern of an AP as LHLH* in which H* is a demarcative pitch accent associated with the primary stressed syllable of an AP. AP also has a final lengthening, but it is weaker than an IP final lengthening. Furthermore, LHLH* can be realized as LHiLH* when this AP has a secondary stress. The 'Hi' which is a phrasal initial H tone is realized on the initial stressed syllable of the first lexical word within an AP. Assuming this, the authors propose the description of the location of underlying AP tones: AP-initial L, AP-final H (H*), AP-initial H (Hi), and AP-penult L. The location of each tone is described below.

AP-initial L:

This tone is associated with the syllable(s) before Hi as a low plateau if

there are two or more syllables. When Hi is on the first syllable of an AP, the L is not always realized.

AP-final H (H*):

This tone is realized on the phrase final full vowel, and it has a demarcative function. This is traditionally known as “accent primaire” (= primary accent) or “accent final” (= final accent). ‘*’ is used to show that the tone is associated with a stressed syllable. Every word final full vowel can be the target of the primary accent, though not always realized in surface, i.e. phrasal stress. After having conducted some experiments, the authors assumed that Hi is not a pitch accent for two reasons: First, it is not always realized on a stressed syllable with a full vowel. Second, the Hi-toned syllable is not always significantly longer than non-AP-final syllables.

AP initial H (Hi):

The occurrence of Hi is influenced by several factors, mostly rhythm, style, and speaker. The location of the Hi is also variable and optional. It is often realized on the initial stressed syllable of the first lexical word within an AP. It is generally noted to fall on one of the first two syllables of the first lexical word within a phrase.

AP-penult L:

It tends to be realized on the syllable preceding the H*-toned syllable, thus on the penultimate syllable if the phrase final syllable contains a full vowel. However, as the number of syllables in an AP decreases, the L tends to occur in the final syllable, i.e., the same syllable as the H*-toned syllable.

By assuming the underlying four tones associated with certain syllables within an AP, we can have following realization of an AP underlying tone as follows. There are five types of surface realizations of AP (/LHiLH*/) when not all four underlying tones are realized. The tone(s) in a parentheses refers to the tone(s) not realized due to undershoot: /LHiLH*/ can be realized as [L(HiL)H*], [L(Hi)LH*], [LHi(L)H*], [(L)HiLH*] and [LHi(L)L*]. The last realization pattern by L* is the most common pattern when an AP is final in an Intonation Phrase whose boundary tone is L%.

As I have mentioned earlier, in this study we will only examine events focussed on an AP unit. Therefore, for F-ToBI description, I only summarized the characteristics of French AP and I will not go into details for other units of intonation.

3. Method for the Comparison between Languages

Until now we have just summarized how the ToBI system can describe intonation for each of three languages: Korean, French and English.

In Korean, the stress is not lexical, but postlexical, if exists at all. At a phrasal level, there is no need to know the meaning of a word. Phrasal stress is sensitive to the boundary of a word, and the position of syllables within an Accentual Phrase. Two intonational units define Korean intonation: Accentual Phrase and Intonation Phrase. The underlying tonal pattern of an AP is /LHiLH/. An AP final syllable is not always lengthened. Hi is associated with the second syllable. Its realization is sensitive to length, style, etc. An IP has a boundary tone and a lengthening. An IP final % tone overrides an AP final H tone.

In French, the stress is not lexical, but postlexical as in Korean. But at the phrasal level, we need to know the meaning of a word: what syllable is stressable (reduced or full vowel). Only a lexical word can get a phrasal stress. As in Korean, two intonational units determine French intonation: Accentual Phrase and Intonation Phrase. The underlying pattern of an AP is /LHiLH*/. Different from Korean, a French AP final syllable is always lengthened. Hi falls on the 1st to 3rd syllable of an AP and its realization is also sensitive to length, style, etc. As for an IP boundary tone and lengthening, it is the same as in a Korean IP. Also, an IP final % tone overrides an AP final H* tone which is the same as in Korean.

In English, the stress is lexical which is different from Korean and French. Therefore, at the phrasal level, we need to know the meaning of a word: which syllable is stressed. Only a full vowel can be stressed. Different from Korean and French, English intonation structure is determined by three intonational units: Pitch Accent, intermediate phrase and Intonation Phrase. Pitch accents are determined by the Fo contour of metrically strong syllables. English has downstep which is triggered by the preceding bitone and is blocked by the intermediate phrase boundary. The ip is the domain of focus. At the phrasal level, phrasal stress follows the lexical stress pattern.

As the English intonational units differ from Korean and French, it is not easy to compare intonation patterns between languages. However, in this study I will compare the utterance initial ip part of English with Korean and French AP. For convenience, we will just call the comparison part, "subject".

3.1 Hypotheses

As mentioned earlier, this study aims to observe whether foreign speakers can realize intonation patterns of other languages: Korean speakers learning French and English, French speakers learning Korean and English, English speakers learning Korean and

French. With the assumptions summarized in section 2, I propose some hypotheses for this experiment as below.

Hypothesis 1: The Korean AP underlying pattern is LHLH but when an AP begins with an aspirated or tense segment, it realizes as HHLH. As both in French and English, the segmental properties do not affect the initial tone, French and English speakers will have difficulties in realizing the difference between LHLH and HHLH of an AP tonal pattern in Korean.

Hypothesis 2: French AP final gets a lengthening. This means that the final syllable of a French AP is also stressed. A stressed syllable in French is at least twice as long as an unstressed syllable (Lee 1997). Korean does not have this effect. Therefore, Korean speakers learning French will have difficulties in lengthening the final syllable of a French AP. However, even though English does not have an AP level, since English is a stress-timed language, English speakers learning French will realize this lengthening easily. English speakers learning French should try not to associate any accent on the unstressed syllables.

Hypothesis 3: In Korean, AP final is not always lengthened, but French speakers learning Korean will lengthen the last syllable of an AP in Korean.

Hypothesis 4: Korean and French know H tones at the end of an AP. But English does not know phrase final H tones. An English ip final is associated with a L tone. Thus, Korean and French speakers learning English will have difficulties in realizing an English ip final L tone.

3.2 Subjects

We had difficulties in finding subjects who spoke at the same level in three languages. Thus, we examined our designed sentences registered by the students of the linguistic department at UCLA and the students of the French department at PUF. For baseline data, two Korean male speakers and three Korean female speakers participated in this study; for the French data, two French male speakers and one female French speaker; for the English data, two English male speakers and one female speaker participated in this study. For the experiment of Korean as foreign language, one French male speaker and one English female speaker participated. For the French as a second language data, three Korean male speakers, two Korean female speakers, two English male speakers and two English female speakers participated. Finally, for the English data as a second language, two Korean male speakers, three Korean female speakers and two French male speakers participated¹⁾.

1) In this study, we could not consider the difference of the age of speakers nor their

3.3. Procedures

In order to examine the above hypotheses, we designed ten declarative sentences with the person's name at the initial of the sentence which contained from two to six syllables for each language. Speakers were asked to read the sentences naturally three times. They were given no further instructions. These registered sentences were analysed through PitchWorks. The initial APs of Korean and French were measured, and the initial ip of English was measured. We measured the pitch of each syllable's peak and valley, and the duration of the last syllable within an AP and an ip, in order to observe whether the intonational pattern corresponds with the described ToBI systems and whether the speech patterns match our hypotheses.

4. Results and Discussion

In this section, we will describe the results of the experiments with the above hypotheses and discuss the problem of Intonation in foreign language acquisition. We examined 960 sentences of Korean, French and English(among them, K-K = 150, F-F = 90; E-E = 150; E-K = 30; F-K = 60; K-F = 150; E-F = 120; K-E = 150; F-E = 60)²⁾, and selected only a few examples which are significant for the comparison.

4.1 Experiment of Hypothesis 1: Korean AP underlying pattern

Table 1 shows the measurement of some realizations of a Korean AP underlying pattern, /LHLH/ into [LHLH] or [HHLH]. When the initial segment of an AP was aspirated or tense, all Korean speakers pronounced H at the initial of the AP.

Table 1. An example of a Korean AP underlying pattern realized in 3 syllabled AP experimented with French and English speakers: /nunaga/ vs. /c^hanmiga/.

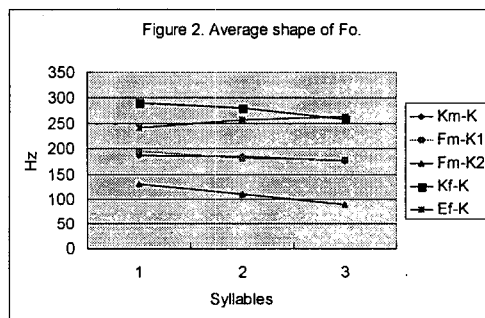
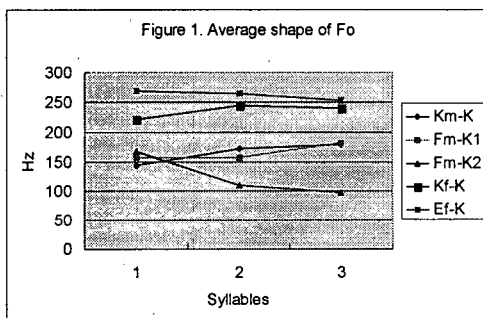
Hz speaker-lg	1 [nu]	2 [na]	3 [ga]	1 [c ^h an]	2 [mi]	3 [ga]
Km-K	144: L	172: H	179: H	187: H	185: H	176: H
Fm-K1	157: L	158: L	182: H	195: H	181: H	179: H
Fm-K2	168: H	111: L	98: L	131: H	111: L	90: L
Kf-K	221: L	244: H	241: L	291: H	281: H	258: H
Ef-K	269: H	265: H	253: L	241: L	257: H	263: H

(Km = Korean male speaker; Fm = French male speaker; Kf = Korean female speaker; Ef = English female speaker; K1 = first speaker; K2 = second speaker)

foreign language levels because of the difficulty in finding subjects.

2) i.e. K-K means Korean native speaker for Korean data.

In Figure 1, the measurements show that Km-K produces [nunaga] with the [LHH] pattern, and [c^haŋmiga], with the [HHH] pattern as we have mentioned in the hypothesis. We assume that the second L tone was undershot in both cases. But, Kf-K produced [nunaga] with the [LHL] pattern which means that Korean AP final does not always end with H tone. Fm-K1 produced [nunaga] with [LLH] which is a little different from Km-K, but produced [c^haŋmiga] with [HHH], the same as Km-K. Fm-K2 also produced both patterns different from the basic pattern of an AP Korean; instead of [LHH] and [HHH], Fm-K2 produced them both as [HLL]. Furthermore, Ff-K produced [nunaga] with [HHL] and [c^haŋmiga] with [LHH] in which we can notice that AP initial tone is reversed. As a result, we can conclude that both French and English speakers do not differentiate between the Korean AP underlying patterns /LHLH/ and /HHLH/. Thus, we do have this difference of an AP initial pattern but this is not a crucial element in learning Korean, because it does not give any difference in meaning; it merely sounds like a foreigner's pronunciation.

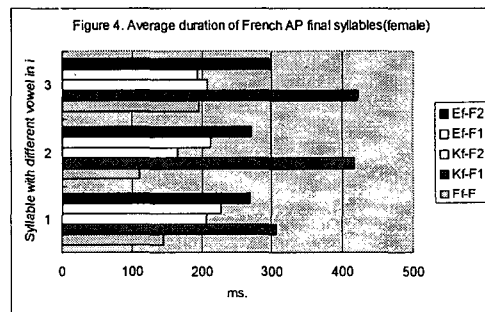
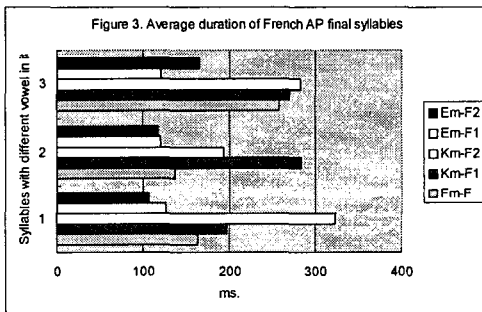


4.2 Experiment of Hypothesis 2: French AP final syllable lengthening

It is true that a French AP final syllable is longer than other syllables but it is also known that the lengthened syllable's length varies throughout the vowel quality and the segment numbers of the final syllable. Table 2 shows the measurement of AP final syllables pronounced by Korean and English speakers compared with the native French speakers.

Table 2. French AP final syllable durations in ms.: /-no/ vs /-ri/ vs /-nav/.
(1 = 1st speaker; 2 = second speaker)

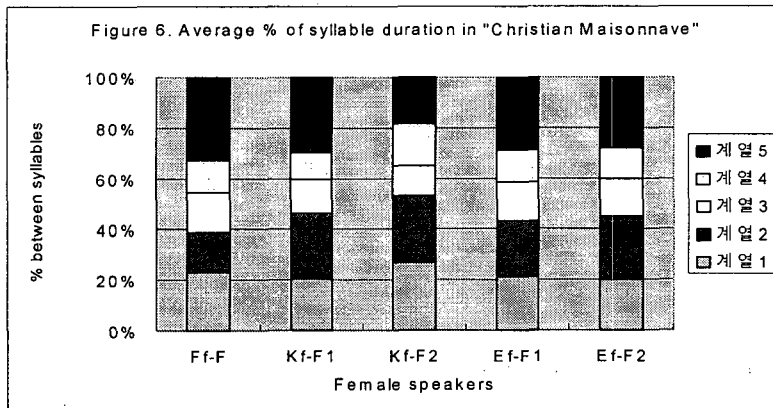
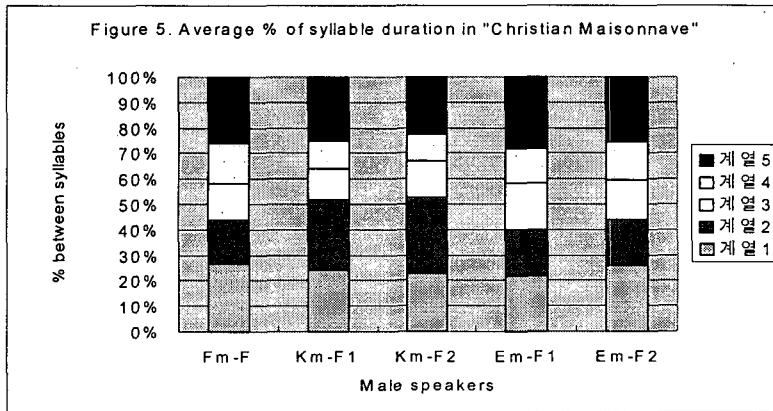
ms speaker-language	1 [-no]	2 [-ri]	3 [-nav]
Fm-F	164	137	258
Km-F1	198	283	270
Km-F2	323	194	282
Em-F1	126	120	120
Em-F2	107	118	166
Ff-F	145	111	196
Kf-F1	307	416	422
Kf-F2	206	165	207
Ef-F1	226	212	193
Ef-F2	269	271	299



Figures 3 and 4 illustrate an average duration of French final syllables with different vowels. Figure 3 shows the measurements for the male speakers and Figure 4, for the female speakers. Fm-F and Ff-F served as the basis of comparison. We can notice that [-ri] is the shortest and [nav] is the longest syllable both in Fm-F and Ff-F measurements. But Korean and English speakers do not have this difference of vowel quality. Koreans tend to pronounce the final syllable of a French AP rather long (i.e. Km-F1, Km-F2, Kf-F1). Nevertheless, Kf-F2, who is well trained in English, shows the same tendency as English speakers. English speakers tend to pronounce all syllables almost equally and do not seem to recognize the different length of segments nor the difference of the vowel quality. To compare these data with the other unstressed syllables, we have measured [kris-tjā-mε-zo-nav] and Table 3 shows the results.

Table 3. An average measurement of a French AP: [kris-tjä-mε-zɔ-nav].

syllables: ms. speaker(m/f)-lg.	1 [kris]	2 [tjä]	3 [mε]	4 [zɔ]	5 [nav]
Fm-F	232	151	128	138	224
Km-F1	294	338	153	134	305
Km-F2	286	375	180	128	282
Em-F1	256	211	212	158	329
Em-F2	264	186	162	152	260
Ff-F	270	186	183	150	381
Kf-F1	314	389	201	159	451
Kf-F2	300	292	128	184	204
Ef-F1	227	229	160	135	305
Ef-F2	262	329	191	159	367



Figures 5 and 6 show the % comparison of duration between syllables per speaker. The initial syllable, [kris] is pronounced rather long due to its combination of segments (i.e. CCVC). In both figures, we can see that French native speakers pronounce the second, third and fourth syllables shorter than the final syllable, [nav]. In comparison,

Korean speakers (both male and female) have a tendency to pronounce “Christian Maisonnave” into two APs, “Christian” and “Maisonnave”. That is why the second syllable of AP, [tjã] is longer or almost the same length as the final accented syllable, [nav]. Furthermore, we could also observe that there is a break between these two APs at the PitchWorks analysis window. In the case of English speakers, male speakers pronounced “Christian Maisonnave” in one AP and had a slight final lengthening, but female speakers pronounced it in two APs, much like Koreans do. As a result, we can conclude that Korean and French speakers learning French do produce the final lengthening but not enough to sound like native French speakers. I think it is a matter of the fluency of the French language.

4.3. Experiment of Hypothesis 3: Korean AP final syllable lengthening

We measured only two French male speakers for Korean data. Thus, we compared the data with the measurement of syllable durations of two Korean male speakers and two Korean female speakers. Table 4 shows an example of a Korean AP final measurement in duration between Korean native speakers and two French male speakers learning Korean. This experiment should be conducted with more subjects later on, and also with English speakers learning Korean.

Table 4. An average measurement of a Korean AP between syllables: [nu-na-ga].

syllables/ms. speaker-language	1 [nu]	2 [na]	3 [ga]
Km-K1	83	122	97
Km-K2	107	186	115
Fm-K1	64	151	272
Fm-K2	284	172	353
Kf-K1	100	181	97
Kf-K2	92	188	176

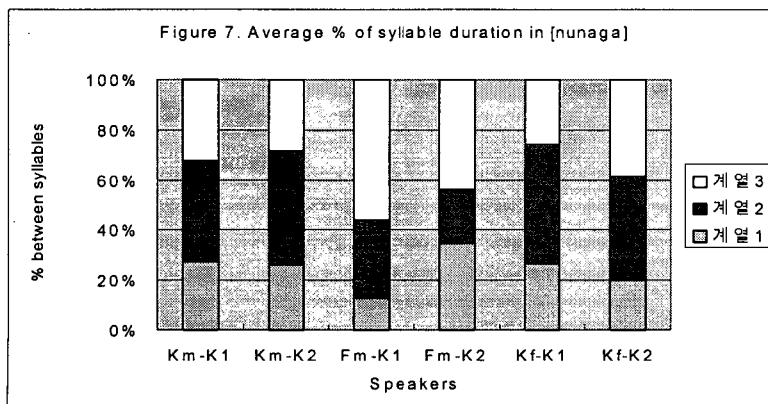


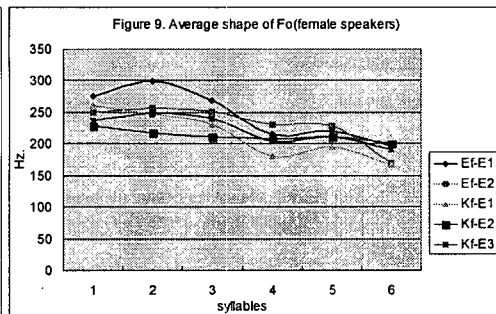
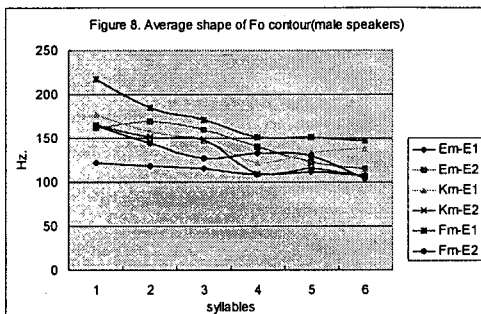
Figure 7 illustrates this measurement in % duration between syllables. We can see that the final syllable does not lengthen in Korean AP, and also the second syllable, which is the accented one with Hi tone, is the longest in this case. But French speakers do lengthen the final syllable due to interference from their native language. To conclude this part of experiment, we can mention that the Hi tone acquisition is needed when learning Korean as a foreign language.

4.4. Experiment of Hypothesis 4: realization of an English ip final L tone

Table 5 shows the measurement of an English ip final L tone experimented with Korean and French speakers. We compared the pitch contour data between English native speakers and Korean and French speakers learning English. The measurement data indicate that an English ip final L tone does not seem to be problematic for the subjects who participated in this experiment. They all pronounced [k^him-bɔ-li-le-ven-bɔrg] with a falling tone and the final syllable's pitch is definitely produced with a L tone.

Table 5. English ip final L tone realized by Korean and French speakers in 6 syllabled ip: [k^him-bɔ-li-le-ven-bɔrg]

speakers-ig.	Hz	1 [k ^h im]	2 [bɔ]	3 [li]	4 [le]	5 [ven]	6 [bɔrg]
Em-E1		122	118	115	109	112	108
Em-E2		162	169	160	140	123	115
Km-E1		177	158	147	122	134	138
Km-E2		165	151	148	110	115	107
Fm-E1		217	185	171	151	151	147
Fm-E2		164	144	127	133	130	104
Ef-E1		275	299	268	215	221	196
Ef-E2		250	257	251	231	229	170
Kf-E1		260	247	231	180	195	167
Kf-E2		229	218	211	209	211	200
Kf-E3		237	248	240	204	211	191



Figures 8 and 9 illustrate the average shape of F0 contour. The contour shape of each

speaker is realized differently but we can observe that the final syllable is definitely lower than other syllables. Thus, we can conclude that either these foreign speakers are good in English or an English ip final L tone is not particularly difficult to acquire.

5. Concluding Remarks

In this study, we have conducted experiments which compare the intonational systems of Korean, French and English. To summarize, we have examined a Korean AP initial tone realization, a French AP final syllable lengthening, a Korean AP final syllable lengthening and an English ip final L tone realization. The results are as follows. First, French and English speakers do not differentiate between [LHLH] and [HHLH] patterns of a Korean AP. Though it appears this difference is not crucial in the comprehension of Korean, this point needs more elaborate research to determine whether the difference does, in fact, affect specific meaning comprehension. Second, Korean and English speakers seem to have difficulties in defining boundaries of a French AP. Therefore, in French intonation learning, rhythmic pattern acquisition must precede the stress pattern. Third, French speakers tend to lengthen the final syllable of a Korean AP, presumably due to their native language habit. Thus, in order to more closely approximate native Korean pronunciation, French speakers should consciously attempt to not lengthen the final syllable of a Korean AP. Fourth, the English ip final L tone is not problematic for foreigners to acquire. The present study highlights the importance of discrimination of intonational difference between languages, and the comparison should be considered in foreign language studies. Finally, further research in this area that includes more subjects at different language levels is needed to provide a wider comparison of intonation between languages.

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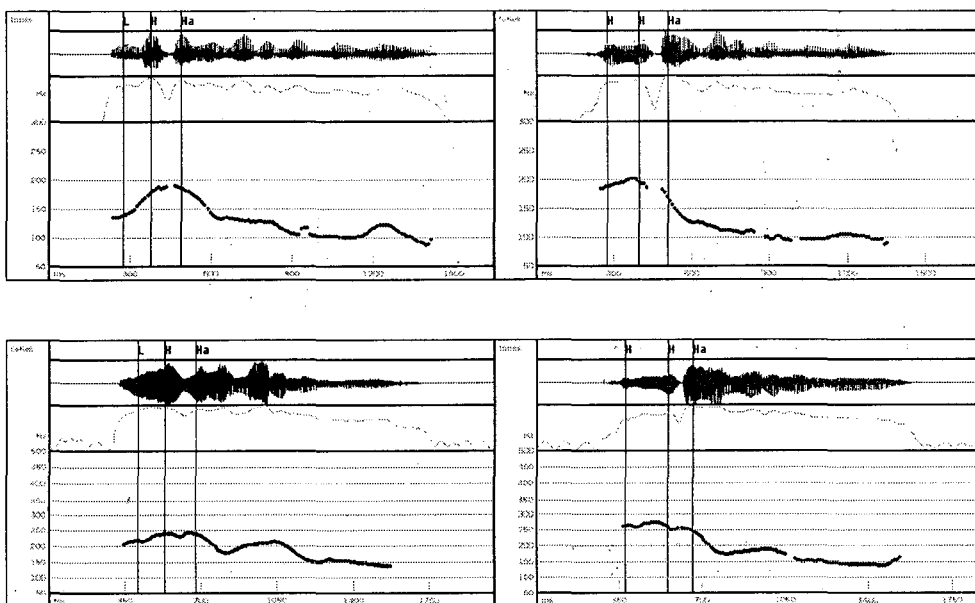
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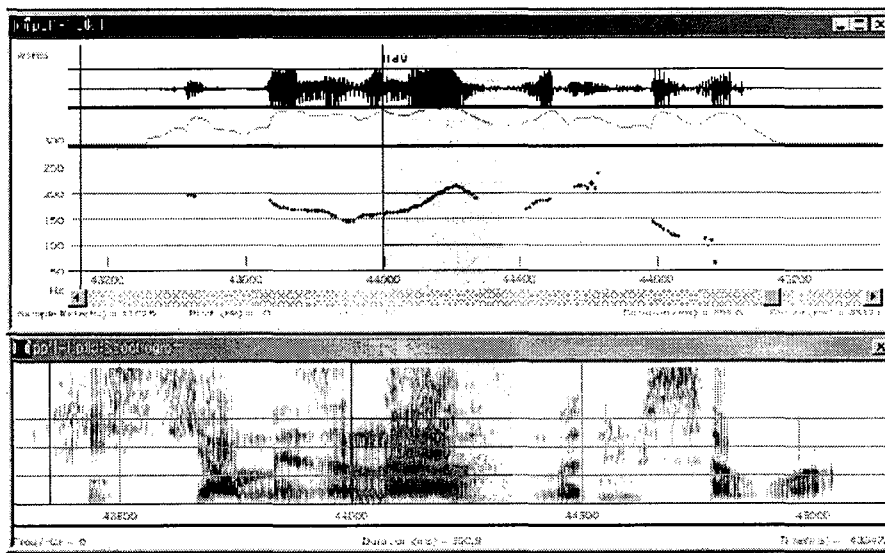
Appendix

Some examples of the PitchWorks analyses which illustrate this study.

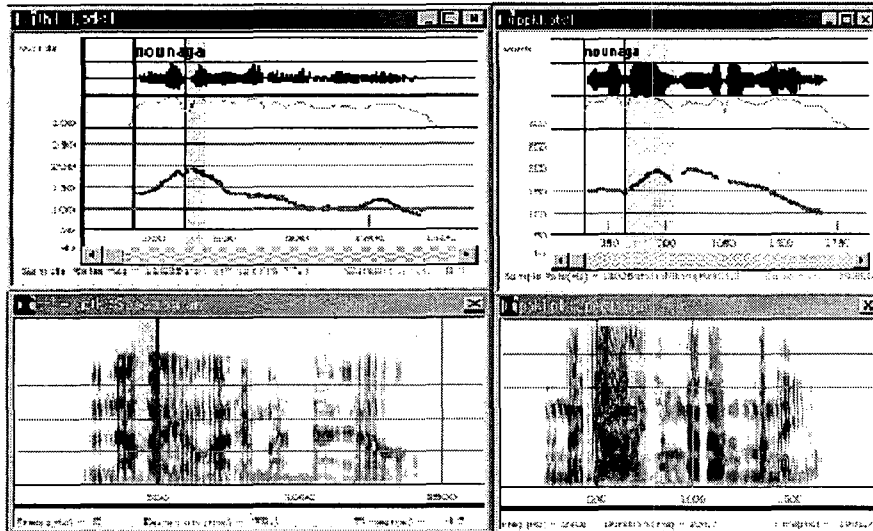
A. Korean AP patterns realized by Korean speakers: [LH(L)H] vs. [HH(L)H]



B. A French AP final lengthening : [kristjãmezɔnav]



C. A Korean AP final realized by Korean and French speakers in [nunaga...]



D. An illustration of an English ip: [k^him-bə-li-le-ven-bərg]

