

## Voicing and Tone Correlation in L2 English\*

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### ABSTRACT

The underlying premise of this study was that L1 production is easily transferred into L2 production. In neutral intonation, there is a consonant-tone correlation in Korean: High tone patterns are correlated with voiceless aspirated and tense consonants and Low-High tone patterns are correlated with lax or other voiced consonants. The purpose of this study was to see whether the correlation in Korean (L1) is transferred into English (L2) production and whether the degree of transfer differs depending on the degree of proficiency. Eight Korean speakers and two American speakers participated in the experiment. F0 contours of words and sentences were collected and analyzed. The results of the present study showed that there is a strong correlation between voicing and tone in L2 utterances. When utterance-initial consonant types were voiceless, the word or the sentence began with the H pattern; otherwise it had the LH pattern. The degree of interference differed depending on the degree of proficiency: less proficient speakers showed a stronger correlation in terms of the magnitude (Hz) and size (ms) of the effects on F0. The results indicate that the consonant-tone correlation in L1 is strongly transferred into L2 production and the correlation transfer can be one of the actual aspects that cause L2 speakers to produce deviant L2 accents and intonation.

**Keywords:** transfer, deviant accents, voicing, tone, F0, correlation, Korean, L2 acquisition, English

### 1. Introduction

Transfer (or "interference") refers to the carryover of prior linguistic knowledge of native language to the second language context. It is expected that any differences between the first language(L1, Korean) and the second language (L2, English) will create difficulties in L2 production and perception. Most of L2 deviant (or foreign) accents come from the effect of L1 characteristics because L1 production is easily transferred into L2 production. The importance of language transfer has been discussed in numerous studies (Weinreich 1953, Flege 1987, 1995, Selinker 1969, 1992, Gass and Selinker 1993, Odlin 1989, 2003).

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Transfer can broadly be divided into the two types of the aspects: one is “explicit” and the other is “implicit”. The explicit type refers to be primary and can phonologically be defined. Let us consider a few well-known “explicit” examples of L1 Korean on the L2 English context. Many of L2 sounds that do not exist in L1 are easily replaced. For instance, there are no fricatives such as /f, v, θ, voiced-th, r, z, ʒ/ in Korean. The lack of fricatives causes L2 learners to trouble discriminating and producing certain pairs /f/ vs. /p/, /θ/ vs. /t/, /ʒ/ vs. /dʒ/ and so on. Fricatives are easily replaced by stops in L2. Besides, there is phonetically no voicing distinction in utterance-initial position in Korean. Voiced stops [b, d, g] in initial position are replaced by voiceless stops. Similar tendency can be found for L2 vowels. Flege (1995) found that native Korean subjects failed to discriminate English /i/ - /ɪ/, /ɛ/ - /æ/ and /u/ - /ʊ/, and /ɑ/ - /ʌ/. Since there is no tense and lax distinction in vowels in Korean, Korean speakers have difficulty producing and discriminating L2 tense and lax vowels. He suggests that foreign accents are caused, at least in part, by the inaccurate perception of sounds in an L1. It is expected that once listeners fail to perceive L2 sounds accurately, they also fail to produce them accurately. Likewise, although L1 and L2 sounds differ phonetically, L2 sounds that are “identified” with sounds in the L1 are replaced by the L1 sounds. Another L1 interference comes from different syllable structures between L1 and L2. Unlike English, there is no CC cluster in Korean. Therefore, the CC cluster is easily replaced by CVCV for L2 learners. L2 learners unconsciously insert the vowel [i] (where [i] is a mid high unrounded vowel) whenever there is a CC cluster (e.g., “strike” [straɪk] as [si-ti-ra-i--ki]) or when the word ends in fricatives (e.g., bus [bʌs] as [bəsɪ], graph [græf] as [græfi]). This [i] insertion also results in deviant accents by increasing the number of syllables and utterance time. Most of L2 deviant accents may come from these explicit types of transfer. L2 speakers can easily learn what they are.

In contrast, the implicit types are kind of L1 characteristics that are secondary, hidden, and phonetically defined. The voicing-tone correlation which is interested in this study may belong to this because L2 speakers are not aware of it and hard not to produce. The goal of this experiment is to investigate whether one of the L1 implicit characteristics, so-called “voicing-tone correlation”, is “actually” transferred into L2 production.

Phonetic studies have shown that there is a strong correlation between consonant types and tone in Korean: if initial consonant types are voiceless aspirated or voiceless tense, the word has the H pattern (e.g., [t<sup>h</sup>al] ‘mask’ and [t\*al] ‘daughter’), otherwise the word has the LH pattern (e.g., [tal] ‘moon’ and [mal] ‘horse’) (Jun 1993, M.-R. Kim 2000). The consonant-tone correlation is supported by a perceptual study (M.-R. Kim et al. 2002) where to distinguish [t\*al] ‘daughter’ and [tal] ‘moon’, the difference in vocalic tone is more important than the difference between consonantal tense [t\*] and lax [t]. The correlation is not “phonological” since it is fully predictable from initial consonant types and tone in Korean is not lexical (see Kim and Duanmu 2004 for different views).<sup>1)</sup> Although previous studies have discussed that L1

intonation system may affect L2 intonation system, little attention has been paid to the transfer of the voicing-tone correlation in L2 English. In addition, little discussion has been given which aspects of the production of the L1 are actually “transferred” and what causes L2 speakers produce deviant L2 intonation (Koo 1991, 2003, Ueyama and Jun 1996, Jun and Oh 1999, S-H Kim et al 2002). The present experiment will focus on examining the two aspects: (1) whether the voicing-tone correlation in L1 Korean is transferred into L2 production and (2) whether the degree of transfer differs depending on the degree of proficiency in L2.

## 2. Methods

### 2.1 Corpus and speakers

All utterances recorded in the experiment are listed in Appendix. Recording materials consist of words, sentences, and spontaneous small talks. Fifty English words from one to five syllables were designed by varying initial consonant types and stress location. Sentence types such as declarative, imperative, interrogative (Yes-No and Wh-questions) were extracted.

Two American speakers and eight Korean speakers, differing in proficiency, participated in this experiment. All the speakers were females and college students in their early or late 20s. To find a developmental path in L2 acquisition, eight Korean speakers were categorized as two advanced, two intermediate, and four beginning level depending on their L2 proficiency and their years of residence in the USA. The following table shows the description of each Korean learner including the number of years of residence in the United States and other information.

Table 1. Language background information for Korean speakers

Speaker	Proficiency	Age	Yrs. in the USA	Age of residence	Major
TK	Advanced 1	21	5 and half	7-12	English
JS	Advanced 2	29	7 years	23-29	English
JH	Intermediate 1	24	3 years	7, 22-23	Social work
ES	Intermediate 2	28	3 years	26-28	Neuroscience
SK	Beginner 1	20	none	NA	English
JP	Beginner 2	20	10 day	NA	English
*SM	Beginner 3	20	none	NA	English
*AK	Beginner 4	20	none	NA	English

(\*: the results are not reported here)

- 1) Concerning the correlation between consonant and tone in Korean, there are two different proposals. One proposal (Jun 1993) is that Korean has two underlying tone patterns, LHL(H) and HHL(H) depending on AP-initial consonant types and the other proposal (Kim and Duanmu 2004) is that the consonant-tone correlation is viewed as Tonogenesis: voiceless-H and voiced-LH. I will not discuss this point further since this paper is concerned with the actual realization of voicing-tone correlation in L2.

## 2.2 Procedures and F0 measurements

Most of utterances were recorded using a Panasonic Digital Audio Tape Deck SV-3500 in a sound-attenuated studio. The randomized list of target words from one to five syllables was located in the carrier sentence 'repeat \_\_\_\_\_ again'. Each speaker was asked to read utterances in a natural intonation as if talking to someone at a normal rate. Neither stress nor focus was given. All recorded utterances were digitized at a sampling rate of 22.2 kHz and low-pass filtered at 11.1 kHz. A total of 2,400 tokens of words (50 words x 6 repetitions x 8 speakers), 960 tokens of sentences (20 sentences x 6 repetitions x 8 speakers), and spontaneous talks were analyzed using GWI's Soundscope.

F0 measurements were done for all words and utterances to capture their pitch contours as follows: F0 was measured at every 50 ms from onset voicing to 250 ms into voicing for monosyllabic words, at the three points—rime onset, midpoint, and offset—of a syllable for two syllable words, and at the middle of a syllable for longer words and sentences. The onset of a rime (=onset voicing) was defined as the first pulse of a vocalic waveform that shows features typical of a vowel. The onset measure was based on a 25-ms window beginning at rime onset as defined above. F0 was mainly measured using a peak-picking algorithm routine in Soundscope. The peak-picking algorithm identifies the individual cycle in the source wave in order to calculate fundamental frequency. This algorithm produces a sequence of pitch values, one value for each pitch period. Variations in pitch cause this sequence of numbers to be spaced somewhat irregularly in time. F0 was, if necessary, measured at three points, onset, midpoint, and offset for utterance-initial syllables.

## 3. Results and Discussion

For the results, I will focus on describing whether there is a correlation between voicing and tone in utterance-initial position and whether the degree of transfer differs depending on the degree of proficiency. I will omit the results of many other figures which are not necessary to be included in the text. I also skip to discuss the intonation pattern in utterance-medial and final position since it is not the main concern of this study.

### 3.1 Voiceless-H and voiced-LH correlation

Mean F0 contours at the five temporal locations according to voiced and voiceless consonants are presented in Figure 1. Figure 1 shows that for all speakers, F0 values following voiceless consonants are higher than those following voiced consonants. However, there are remarkable differences between Native and L2 speakers in terms of the magnitude (Hz) and size (ms) of the effects of consonantal voicing on F0 contour. The results of Native 1 and 2

show small effects of voicing on F0. It is a well-known fact that in English, voiceless consonants raise their pitch in the following vowel, whereas voiced consonants lower their pitch. It is called an "intrinsic" effect (Hombert et al 1979, Whalen and Levitt 1995). Note that the F0 difference caused by consonantal voicing slightly persists until 50 ms into voicing but collapses at 150 ms into voicing. Among L2 speakers, Advanced 1's contours are similar to Natives. Except for Advanced 1, almost all L2 speakers show remarkable F0 differences (from 30 to 60 Hz) between voiced and voiceless consonants and the F0 perturbation triggered by consonantal voicing persisted to 200 ms into voicing or the end of the syllable. The effect seems hard to be called "intrinsic". Instead, the magnitude (Hz) and the size (ms) of the effect of voiceless and voiced consonant types on F0 are relatively huge to be "tonal". This huge effect caused by consonantal voicing is similarly observed at the results of L1 Korean monosyllables (see Figure 2.2, M.-R. Kim 2000). The results show that there is a strong voicing and tone correlation in L2 monosyllables: voiceless consonants are correlated with a High tone and voiced consonants are correlated with a Low-High tone. This indicates that the consonant-tone correlation in L1 Korean is transferred into the voicing-tone correlation in L2 English. The transfer effect seems to be stronger for less proficient speakers in terms of its magnitude (Hz) of the effect of voicing on F0. F0 differences between voiced and voiceless consonants are about 50~60 Hz for Beginner, 30~40 Hz for Intermediate, and 20~40 Hz for Advanced. This indicates that the degree of transfer differs depending on proficiency level in L2: less proficient stronger correlation; more proficient weaker correlation.

The results of disyllabic words are more interesting since there is stress. It is a well-known fact that F0 is an essential correlate in word accent (i.e., stress) production. When syllable gets stress, it usually becomes higher in pitch (Hz), louder in amplitude (dB), and longer in duration (ms). From his acoustic study, Ueyama (2000) reports that in English, lexically stressed syllables show higher F0 than unstressed syllables. It will be interesting to see whether L2 speakers still show a voicing and tone correlation in producing L2 disyllables, even along with stress. Figure 2 presents the results of disyllabic words where stress is located on the first syllable.

The fact that stress falls on the first syllable leads us to expect higher pitch in the first syllable. Higher F0 in the first syllable is noticeably observed for Native 2, Advanced, and Intermediate's production. Stress production is not clear for other speakers including Native 1. Surprisingly, most of L2 speakers still show a strong correlation between voicing and F0: voiceless-H(L) and voiced-LH. Advanced and Intermediate speakers show some voicing and tone correlation, even along with stress production. Beginners seem to ignore stress. The degree of correlation differs depending on the degree of proficiency level in terms of the magnitude (Hz) and size (ms) of the effects of voicing on F0. F0 differences between voiceless and voiced consonants are greater and persisted for the two syllables for Beginner, great but persisted the

one syllable for Intermediate, and small but persisted for the two syllables for Advanced. In general, less proficient speakers show a stronger voicing and tone interaction.

The voicing-tone correlation was similarly observed at the results of other disyllables and longer words. Their results are omitted here because of the page limitation of this paper. Next, consider the voicing-tone correlation on L2 sentence production.

### 3.2 Voiced-rising and voiceless-falling correlation

The voiced-LH(L) and voiceless-H(L) correlation in word-initial position leads us to expect the voiced-rising and voiceless-falling intonation in utterance-initial position. Note that the scope of the discussion about the correlation will be limited within the first syllable. Note that the H and LH pattern could be HL and LHL, depending on the boundary tones (H% or L%). Mean F0 contours for declaratives whose initial consonants are voiced are illustrated in Figures 3 and 4. I will mainly discuss whether there is a voiced-rising correlation and whether the correlation differs depending on the degree of proficiency in L2. Let us consider Figure 3 in detail. In Figure 3, although there are some variations in terms of the highest peak and intonation patterns, almost all speakers show a rising intonation pattern in utterance-initial position. The location of the highest peak differs depending on where focus (or accent) is given: focus is given at the second and third syllables for advanced speakers whereas it is at the second syllable for less advanced speakers. Less advanced speakers tend to produce words with a rise-fall intonation pattern throughout the sentences. Note that Advanced patterns' are similar to Natives'. In figure 4, the intonation patterns in utterance-initial position show either falling or rising. Less proficient speakers (i.e., Int2, Beg 1 and 2) show a rise-fall pattern while more proficient speakers (i.e., Int1, Advanced 1 & 2) show a falling. Interestingly but consistently, the intonation patterns of Advanced speakers are similar to those of Native while the intonation patterns of Beginners are similar to those of Intermediates' in both Figures 3 and 4. This indicates that there is some correlation between the intonation patterns and the proficiency level. The other declarative sentences including negatives (i.e., "I don't like the picture on my passport") whose initial consonant is voiced showed similar patterns and their figures are omitted here because of the page limitation of this paper. Note that in this study, focus is not given and utterances are asked to produce naturally. If focus is given in the second syllable, in English as well as in Korean, the high tone is expected in declaratives (Ueyama and Jun 1996). Figure 4 tells us that Native and Advanced speakers seemed to have focus in the first syllable. Despite the fact that there might be focus in different positions, from Figures 3 and 4, overall, L2 speakers show a voiced-rising correlation.

Next let us consider the sentence whose initial consonant is voiceless to see whether there is a voiceless-falling correlation and whether there are some consistent differences in terms of proficiency. This is illustrated in Figure 5. As expected, less proficient speakers (Intermediate

and Beginner) show clearer voiceless-falling correlation than more proficient speakers. Advanced speakers show also a falling pattern but a shallow rise-falling intonation pattern because they seemed to produce accents at the second syllable “want”. Again, note that Advanced speakers’ pattern is similar to Natives’.

Looking at Figures 3 to 5 all together, there are huge F0 differences between voiceless and voiced consonants. For Beginners’ utterances, as an example, the range for a voiced consonant is about 190-242 Hz but that for a voiceless consonant is about 275-301 Hz, showing that a voiceless consonant is correlated with a High tone while a voiced consonant is correlated with a Low tone on L2 sentence production.

The results of imperatives whose initial consonant can be either voiced or voiceless are illustrated in Figure 6. They are very similar to the results of declaratives in Figures 4 to 5. Almost all speakers show a voiced-rising pattern for the sentence “Bring me some breakfast” and a voiceless-falling pattern for the sentence “Put this in the refrigerator”. Note that Native speakers and Advanced speakers show one pattern and Intermediate and Beginner show the other pattern.

The aforementioned results of Declaratives and Imperatives can be generalized as follows: (1) there is a voiced-rising and voiceless-falling correlation in L2 sentence production (2) Less proficient speakers show stronger correlation than more proficient speakers: Mean F0 difference between voiceless and voiced consonants for the first syllable is greatest for Beginner, great for Intermediate, and weak for Advanced. (3) There are some correlations between the intonation patterns and proficiency level. More proficient speakers show one pattern whereas less proficient speakers show the other pattern.

### 3.3 Exceptions: Yes-No questions

In Korean, the correlation between consonant and tone occurs regardless of sentence types. If this is true, assuming that L1 intonation system affects L2 intonation system. we can expect that there will be a voicing-tone correlation in Interrogatives, as seen in the results of declaratives and imperatives. In the present results, however, in Yes-No question type, the voicing-tone correlation does not seem to be obvious.

Let us consider the results of Yes-No question type illustrated in Figure 7. In Yes-No question, the voiced-rising and voiceless-falling correlation does not seem to be clear for L2 speakers. Less proficient speakers (Beginner and Intermediate) show a rise-fall pattern both for the sentences “Do you...” and “Could you...” Regardless of the types of voicing, more proficient speakers show either flat or falling patterns. Although there is little correlation between voicing and tone among L2 speakers, there are some relationship between tone patterns and proficiency level. The patterns of Advanced group are similar to those of Native while the patterns of Beginner group are similar to those of Intermediate.

One possibility is that it is probably due to “focus”. Although focus is not asked when recording, all speakers can produce utterances with some focus as a means of natural intonation. It is well known that in English, focus in interrogatives is realized as a low tone (L\*) (i.e., fall-rise) while in Korean, focus in interrogatives is realized as a high tone (i.e., rise-fall) (Ueyama and Jun 1996). If focus is given at the second syllable, we can expect that more advanced speakers show a low tone whereas less advanced speakers show a high tone because of L1 transfer. This is very similar to the present results as if focus is given at the second syllable. Figure 7 shows that Advanced speakers, similar to Natives, show a flat/falling pattern (or L tone) but less advanced speakers show a rising pattern (or H tone). It has been reported that L2 speakers are hard to produce a Low tone for a focused syllable in interrogatives (Koo 2003, Jeon et al 2004). Regardless of the types of voicing in utterance-initial position, however, since L2 speakers show similar patterns, it is not clear whether there is the voicing-tone correlation in Yes-No questions. In Yes-No question, focus seems to override correlation.

The results of interrogatives are slightly different from those of declaratives and imperatives in the following aspects. First, the correlation in interrogatives is not obvious. All L2 speakers show similar patterns regardless of the types of sentence-initial voicing. Second, there is a close relationship between tone patterns and proficiency level. The tone patterns are consistently similar depending on the degree of proficiency level in L2. More proficient speakers' contours are almost always similar to Natives'. Third, focus rather than correlation seems to be stronger in producing Yes-No question types. The tone patterns—rising vs. falling—heavily depended on where focus was. If the focus is given at the second syllable, the rising tone patterns are almost always predictable. If focus is given at the first syllable, the falling tone patterns seem to be predictable. Although the correlation is not obvious, we can still say that L1 intonation is transferred into L2 intonation in Yes-No question because less proficient speakers produce a high tone as the trace of L1 transfer. Since there could be more variations, large amount of data need to be collected for confirmation.



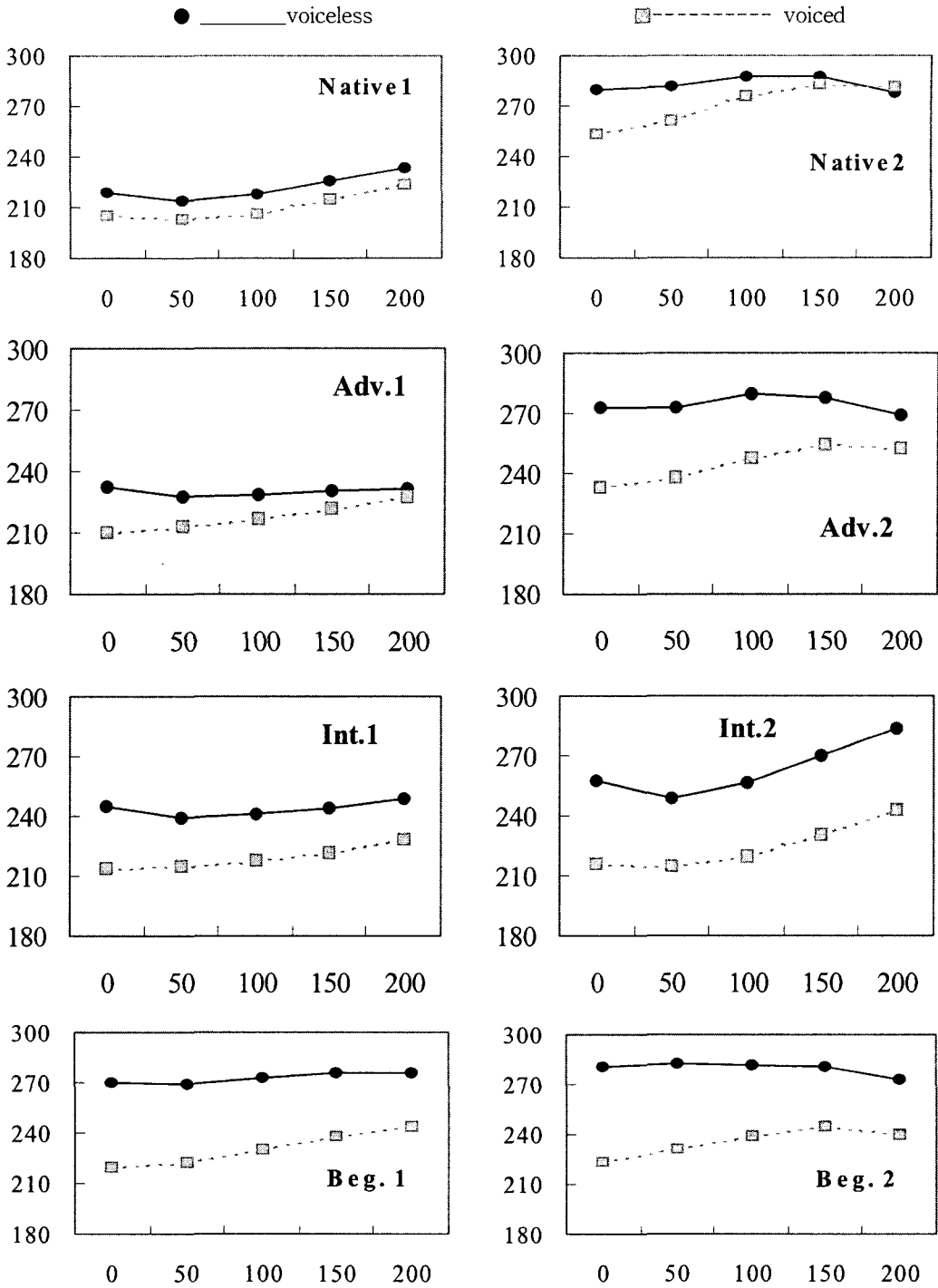


Figure 1. Mean F0 contours at the five temporal locations according to voiced and voiceless consonants of L2 (English) monosyllabic words produced by 2 Native and 6 Korean female speakers averaged across 60 words (10 monosyllabic words x 6 repetitions).

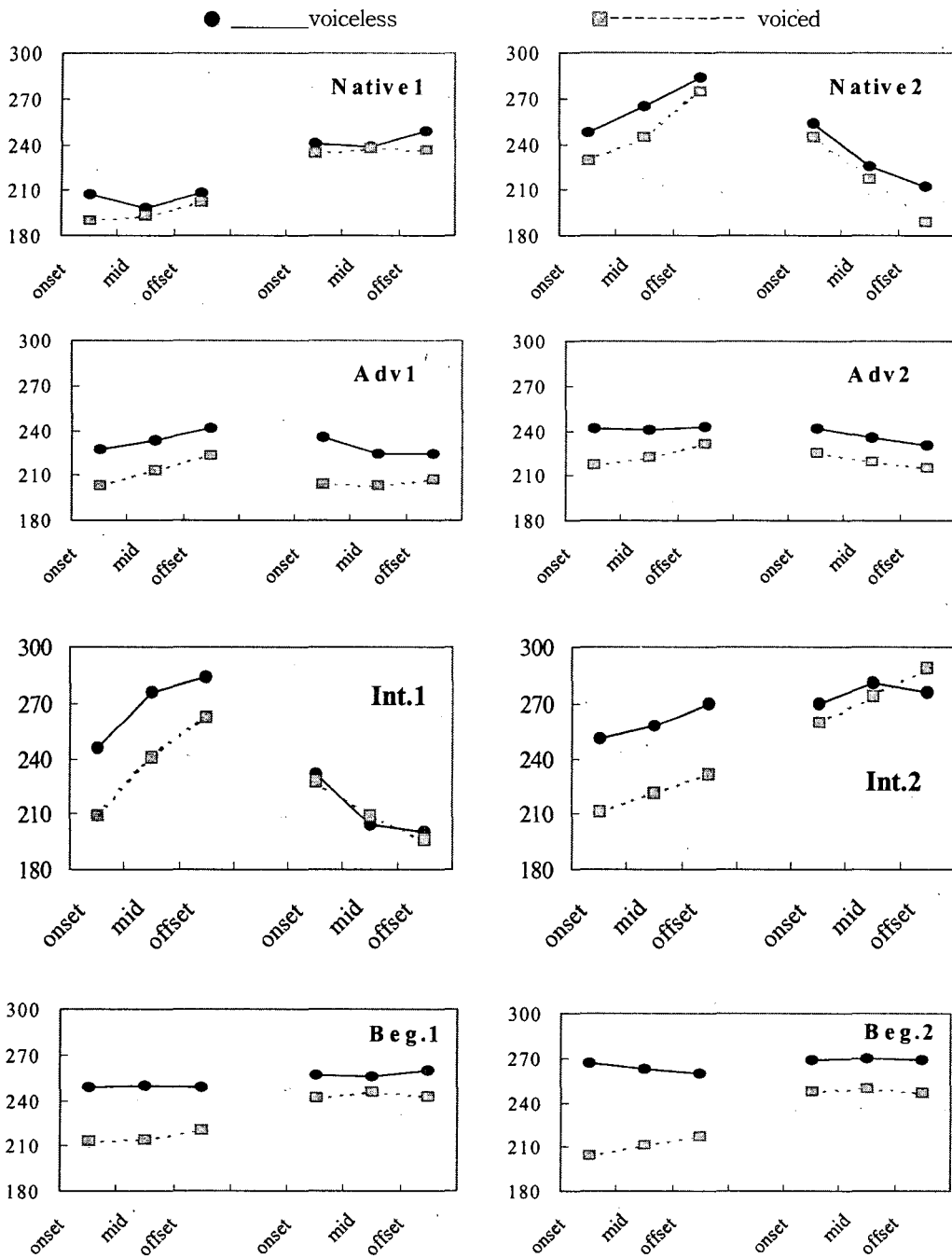


Figure 2. Mean F0 contours at onset, midpoint, and offset according to voiced and voiceless consonants of L2 (English) disyllabic words produced by 2 Native and 6 Korean female speakers (averaged across 30 words = 5 disyllabic words x 6 repetitions). Stress falls on the first syllable.

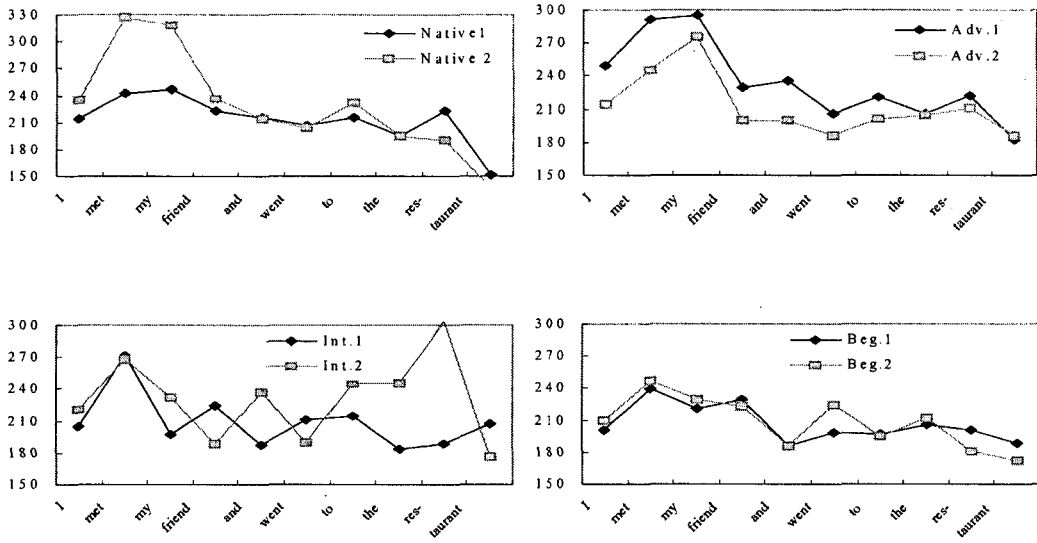


Figure 3. Mean F0 contours at the middle of each syllable for a declarative sentence “I met my friend and went to the restaurant” produced by two native and six female Korean speakers. The sentence begins with a voiced consonant.

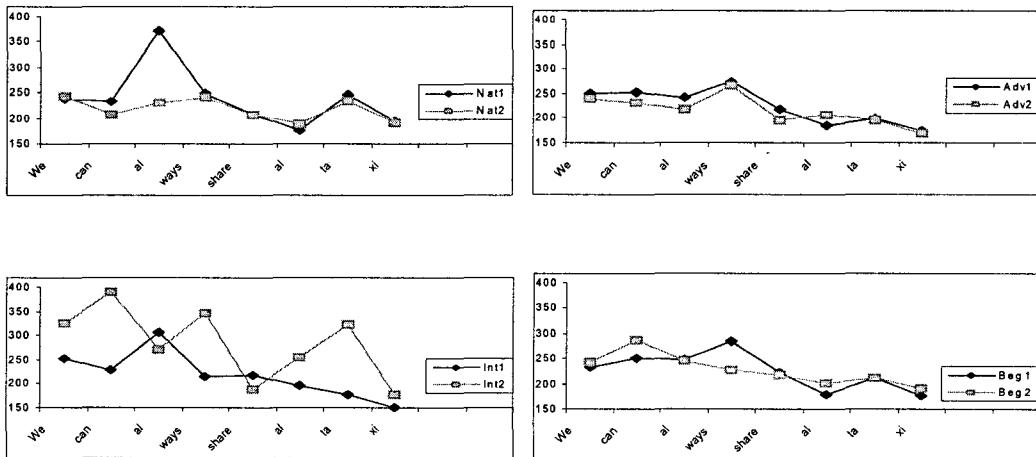


Figure 4. Mean F0 contours at the middle of each syllable for a declarative sentence “We can always share a taxi” produced by two native and six female Korean speakers. The sentence begins with a voiced consonant.

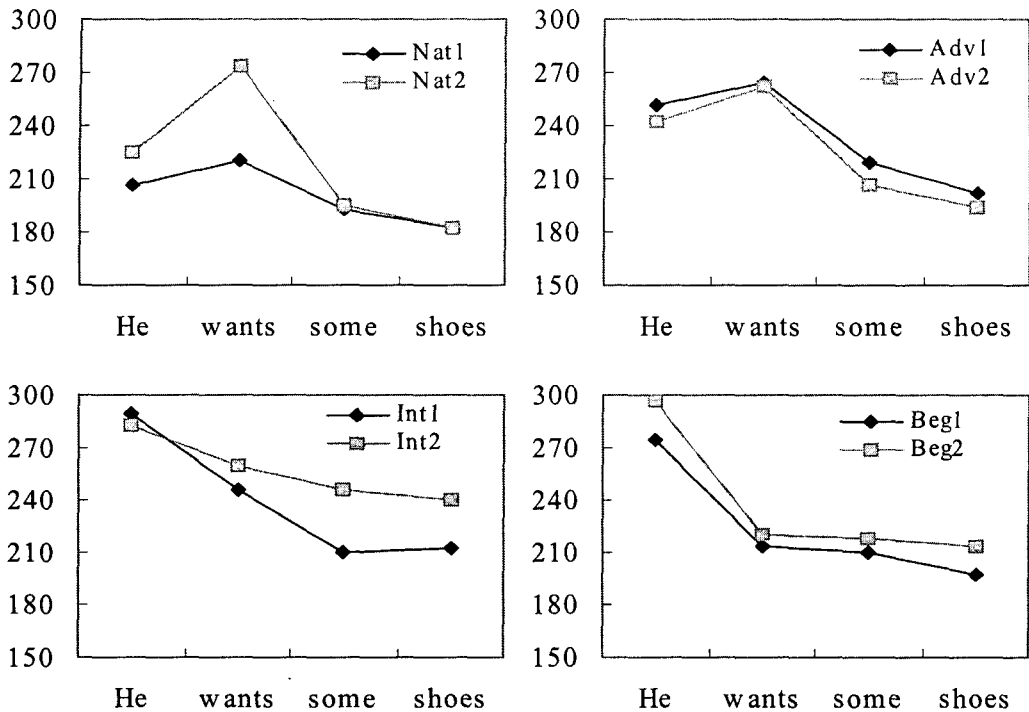


Figure 5. Mean F0 contours at the middle of each syllable for a declarative sentence “He wants some shoes” produced by two native and six female Korean speakers. Sentence begins with a voiceless consonant.

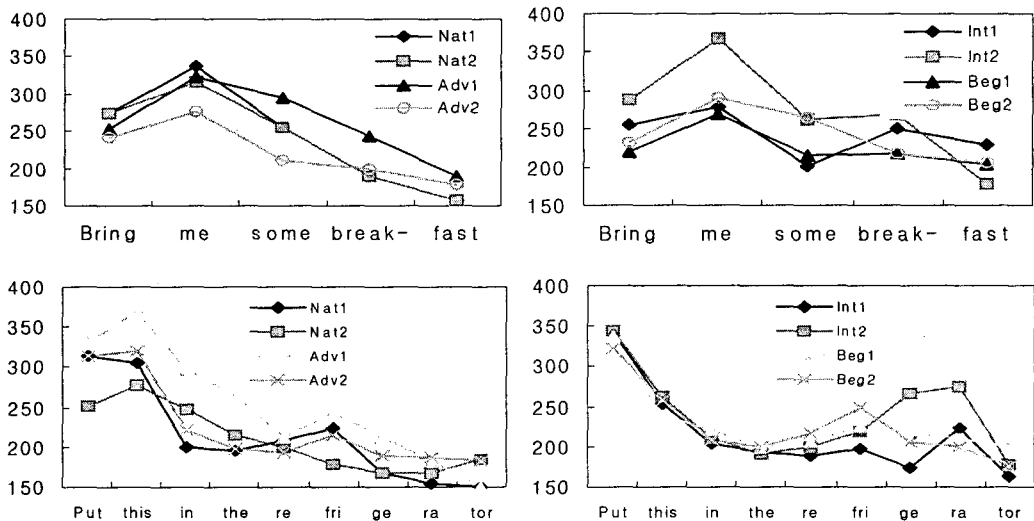


Figure 6. Mean F0 contours according to voiced and voiceless consonant at the middle of each syllable for imperatives ‘Bring me some breakfast’ in the upper figures and “Put this in the refrigerator” in the lower figures produced by two native and six female Korean speakers.

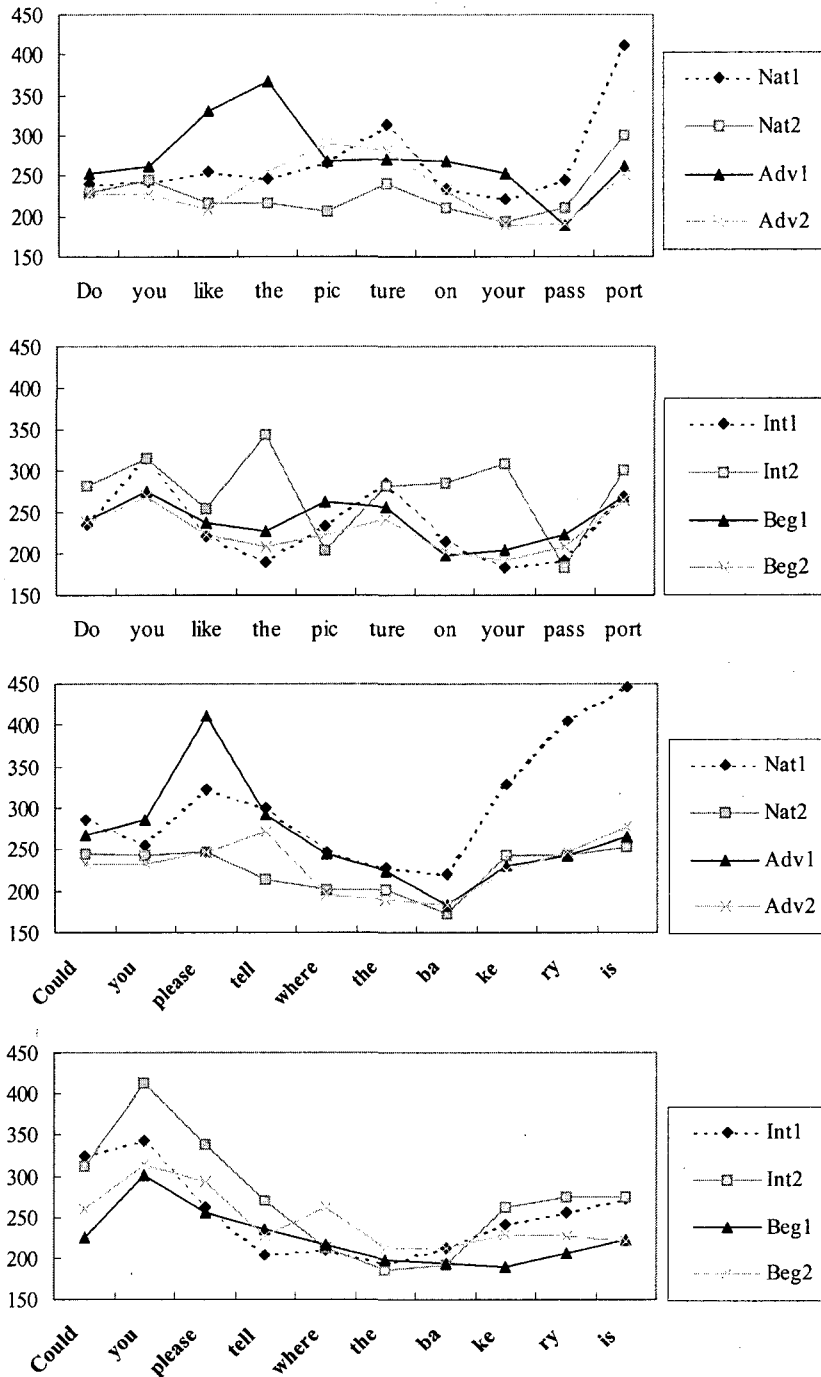


Figure 7. Mean F0 contours according to voiced and voiceless consonant at the middle of each syllable for interrogatives "Do you like the picture on your passport?" and "Could you please tell where the bakery is?" produced by two native and six female Korean speakers.

#### 4. Conclusion

In this experiment, I examined the F0 contours of words and sentences to see whether there is a voicing-tone correlation in utterance-initial position. I show that there is a strong correlation between voicing and tone patterns: voiceless-H(L) (i.e., flat high or falling) and voiced-LH(L) (i.e., rising or rise-fall). The correlation was not clear for only Yes-No question types probably due to focus. The voicing-tone correlation in L2 (English) production is very closely related with that in L1 (Korean) production, indicating that L1 production is transferred into L2 production. The transfer effect was always strongest for Beginner, stronger for Intermediate, strong (weak or little) for Advanced in terms of the magnitude (Hz) and size (ms) of the effects of voicing on F0. Advanced speakers' patterns were almost always similar to Native speakers', indicating that the more proficient speaker is, the weaker the transfer effect is.

The present results has two implications in the area of the second language acquisition. First, the voicing-tone correlation could be one of important aspects that cause L2 speakers to provide deviant accents and intonation. If then, the correlation transfer needs to be acknowledge and should be introduced as a NEW type of transfer in L2 acquisition. Second, the correlation can be generalized in the other areas of second language acquisition. The results lead us to expect that Korean speakers may show similar correlation when learning other foreign languages such as German, French, and Chinese etc. If then, it may apply to not only L2 English but also other foreign languages as a second language. Thus, it needs to be introduced as one of the important implicit interferences in the acquisition of a second language.

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**Appendix.** Corpus (from *Clear speech*, from Gilbert 1993)

Set 1. Self Introduction: Tell me about you briefly in English (Name, age, school, year, major, hobby, interest, future hope)

Set 2 (conversation)

A: John! How are you doing today?

B: Hi, Kathy! Fine thanks. How about you?

A: What did you do during the weekend?

B: Well, I met my friend and went to the restaurant.

A: Do you like the picture on your passport?

B: No, he doesn't like the picture on his passport.

A: Could you please tell where the bakery is?

B: Sure. It's on the corner of Race Drive and Gray's Alley.

A: Do you think it is harder to speak or to hear a new language?

B: I think it is harder to speak a new language.

Set 3 Word list in the carrier sentence 'repeat \_\_\_\_\_ again'

1-syllable words:	bean, dean, mean, lean, eel, pean, team, seem, keen, him, boon, pawn,
2-syllable words:	language, basket, sentence, happy, parade, below, correct, garage, apple, address
3-syllable words:	happiness, argument, desperate, analysis, banana, pollution, antelope, moribund, clandestine, endormorph, amorphous, magnanimous
4- or longer syllable words:	dictionary, calculator, geography, political, calculation, medication, laboratory, California, departmentalism, satisfactory, participation, examination, identification, telecommunication, derogatory, predatory

Set 4 (sentence)

1. The dog chased a rabbit	6. Put this in the refrigerator!
2. What happened to the electricity?	7. We can always share a taxi.
3. I didn't loose my key.	8. Bring me some breakfast!
4. Here's a package for you	9. There's too much traffic.
5. I broke the record!	10 He wants some shoes.