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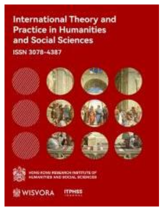

A Statistical Analysis of Factors Affecting VOT and F0 in Plosive Sounds across Chinese, Japanese, and Korean

— Focusing on the Standard Pronunciation of Professional Broadcasters

HUANG Shaoan[1]

[1] *Jeonbuk National University. South Korea*

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Corresponding Author:

HUANG Shaoan

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Abstract

Purpose: To conduct a statistical analysis of the acoustic features of VOT and F0 in plosive sounds across Chinese, Japanese, and Korean. The goal is to determine the impact of three factors—manner of articulation, place of articulation, and tone type—on VOT and F0, providing theoretical support for future "simultaneous cross-linguistic comparison studies" of plosive sounds in these three languages.
Approach/Methodology/Design: A total of 792 word-initial plosives were selected from news broadcasts of official media in Chinese, Japanese, and Korean. Three variables—manner of articulation, place of articulation, and tone type—were set, and the S-N-K test and Bonferroni multiple comparison method were used to evaluate whether these variables had significant effects on the word-initial plosives.
Findings: For VOT, the manner of articulation has the most significant effect across Chinese, Japanese, and Korean. The place of articulation has a lesser impact, while tone type has no effect on VOT, except in Korean, where there is no tone distinction for word-initial plosives. For F0, tone type significantly influences F0 in Chinese, while manner and place of articulation have minimal impact. In Japanese, both manner of articulation and tone type significantly affect F0, but place of articulation does not. In Korean, only the manner of articulation significantly affects F0.
Originality/Value: Previous studies on word-initial plosives in Chinese, Japanese, and Korean have primarily focused on VOT, with limited research on F0, especially for Chinese and Japanese, where studies on F0 are scarce. This study is the first to analyze different tone types of Chinese and Japanese as variables in the acoustic analysis of plosive sounds. Past studies typically involved general native speakers, with little emphasis on the standard pronunciations of professional broadcasters. With the introduction of Chinese-Korean bilingual broadcasting majors in 2021 and Chinese-Japanese bilingual broadcasting majors in 2024 in China, this research also provides theoretical support for the education and training of multilingual broadcasting professionals in Chinese, Japanese, and Korean.

1. Introduction

As key figures in cultural dissemination and “central hubs”, hosts and broadcasters are playing an increasingly vital role as bridges for cultural exchange, information communication, and value transmission amid the deep integration of media in the new era. Young bilingual hosts and broadcasters, in particular, have significant contemporary importance for preserving China's outstanding traditional culture and building a modern civilization of the Chinese nation. Organized by the Communication University of China, the “Global Youth Bilingual Host and Broadcaster Competition” has been successfully held twice since its inception in 2023. The competition aims to promote language exchange and cross-cultural communication, identify and cultivate outstanding bilingual hosts and broadcasters worldwide, and promote bilingual broadcasting culture to share China's fascinating stories with the world. Additionally, since 2021, the Communication University of China has begun enrolling students in bilingual broadcasting and hosting majors, including Chinese-English, Chinese-Korean, and Chinese-Spanish, with the Chinese-Japanese bilingual direction officially added in 2024. This highlights that, under the broader goal of 'telling China's story well,' the cultivation of multilingual broadcasting talent is a call of the times and an inevitable trend. Research on Chinese, Japanese, and Korean pronunciation using acoustic and experimental phonetics methods, shifting from studying general native speakers' pronunciation to that of professional broadcasters, is also a new trend.

2. Literature Review

As early as the 1970s and 1980s, linguists from various countries began conducting practical research in acoustic phonetics. In Chinese linguistics, Wu Z. and Lin M. (1989) explored the acoustic properties of Mandarin vowels, consonants, and tones in their book An Outline of Experimental Phonetics. In Japanese linguistics, Fujisaki H. and Hirose K. (1984) investigated the acoustic characteristics of the Japanese plosives [t] and [d], focusing on glottal closure duration, speech rate, waveforms, and spectral features. Joo H. (2008) offered a comprehensive overview of experimental phonetics and analyzed the acoustic properties of Mandarin, Mongolian, and Korean, highlighting the scarcity of cross-linguistic comparisons. Hi-Gyung Byun (2019) examined the VOT of Japanese plosives and the F0 of subsequent vowels, concluding that a two-dimensional VOT-F0 plot can generally distinguish plosive types, despite some regional overlap. In Korean linguistics, Cho T. et al. (2002) studied plosives in Standard Korean and the Jeju dialect, measuring VOT, burst energy, the F0 of following vowels, H1-H2, H1-F2, intraoral pressure, and airflow, revealing that aspirated plosives have the highest burst energy.

3. Methodology and Procedures

3.1 Data Acquisition

To study the natural pronunciation of professional broadcast announcers during their regular duties, this paper selects audio data from the 2023 news broadcasts of official media in China, Japan, and Korea: China National Radio- China National News (China), NHK News (Japan), and MBC Radio News (Korea).

3.2 Target Plosives Syllables

In this study, we selected a total of 792 plosive syllables from the news broadcast audio data of Chinese, Japanese, and Korean announcers (4 males and 4 females each), adhering to the following three criteria:

- The plosive consonants occur at the beginning of words.
- They are followed by the vowel [a].
- We also considered the four tones in Mandarin Chinese and the two types of accents in

Japanese for analysis. The first and fourth tones in Chinese, as well as the first pitch accent in Japanese, are represented by Ⓗ, while the second and third tones in Chinese and the non-first pitch accents in Japanese are represented by Ⓛ.

3.3 Measurements

In this study, we will outline the measurement criteria used to investigate the acoustics of plosives, focusing on Voice Onset Time (VOT) and fundamental frequency (F0).

3.4 Experimental Process

This experiment will follow these steps (software used is in parentheses):

Step 1: Selection and Download of Audio Date

High-quality news audio data in Japanese, Chinese, and Korean will be downloaded from the websites indicated in section“3.1. Data acquisition”.

Step 2: Extraction of Plosive Sounds (Adobe Audition)

Using“Adobe Audition 2023”, syllables with plosive sounds meeting research conditions will be extracted and saved by word type or gender (see “3.2. Target Plosive Syllables”).

Step 3: Measurement of Parameters (Praat)

Parameter measurements will be carried out using the speech analysis software Praat. Voice Onset Time (VOT) will be manually measured by aligning the audio waveform with the sharply rising vertical line on the spectrogram (spike fill) to the horizontal line indicating the onset of vocal fold vibration (voice bar). F0 values will be extracted using Praat’s automatic pitch extraction function, specifically at the onset of the subsequent vowel.

Step 4: Data Integration and Organization (Excel)

The measured data will be recorded and organized in Excel. For statistical analysis and chart creation, the representation of characters in Chinese, Japanese, and Korean may be visually cumbersome; therefore, the plosives from these three languages will be indicated as follows. In this study, all phonetic symbols are presented according to the International Phonetic Alphabet (IPA).

Table 1. Categories and Phonetic Symbols of Plosives in Chinese, Japanese, and Korean

	Chinese Aspirated	Chinese Unaspirated	Japanese Voiceless	Japanese Voiced	Korean Lenis	Korean Aspirated	Korean Tense
Bilabial	C-[p^h]	C-[p]	J-[p]	J-[b]	K-[p]	K-[p^h]	K-[p*]
Alveolar	C-[t^h]	C-[t]	J-[t]	J-[d]	K-[t]	K-[t^h]	K-[t*]
Velar	C-[k^h]	C-[k]	J-[k]	J-[g]	K-[k]	K-[k^h]	K-[k*]

Step 5: Statistical Data Analysis (SPSS)

The statistical analysis will involve tests for homogeneity of variance: a parametric one-way ANOVA for equal variances, Welch’s ANOVA for unequal variances, or the non-parametric Kruskal-Wallis test. Multiple comparisons will be conducted using the Student-Newman-Keuls (S-N-K) test, with pairwise comparisons applying Bonferroni correction. Box plots will be used to illustrate distribution characteristics. The significance level is set at 0.05. Only the results of the S-N-K test and box plots will be presented.

Step 6: Discussion of Experimental Results

Through statistical analysis results, we will examine the factors influencing VOT and F0 in word-initial plosive sounds across Chinese, Japanese, and Korean, as well as the extent of their effects.

4.Results and Discussion

4.1 Results and Discussion of VOT

4.1.1 VOT of Chinese Plosives

The average VOT values for word-initial Chinese plosives measured in this experiment are shown in Table 2. Figure 1 is a box plot illustrating the distribution of VOT for male and female Chinese speakers.

Table 2. Average VOT Values for Word-Initial Chinese Plosives (unit: ms)

		Bilabial		Alveolar		Velar	
		Ⓗ	Ⓛ	Ⓗ	Ⓛ	Ⓗ	Ⓛ
Male	Aspiration	83.917	90.500	82.907	85.417	90.583	91.333
	Unaspirated	11.167	13.917	12.128	11.167	16.917	21.833
Female	Aspiration	71.000	76.583	71.992	77.333	82.667	88.333
	Unaspirated	8.000	9.417	7.875	8.000	12.417	15.417

Differences in Manner of Articulation: Based on average values, the VOT of aspirated sounds ranges from 80 to 90 ms for males and 70 to 90 ms for females, while the VOT of unaspirated sounds ranges from 10 to 20 ms for males and 7 to 15 ms for females. Aspirated sounds have significantly longer VOTs than unaspirated sounds.

Differences in Place of Articulation: Regardless of whether the sound is aspirated or unaspirated, velar sounds have noticeably longer VOTs than bilabial and alveolar sounds, with no significant difference between bilabials and alveolars. This pattern is observed in both male and female participants.

Differences in Tone (High vs. Low) in Chinese: Except for male alveolar unaspirated sounds, in all 11 other tone pairs (high Ⓗ and low Ⓛ), the pattern is "Ⓗ < Ⓛ".

Next, to visualize the interrelationships and overall distribution of VOT for each word-initial Chinese plosive, box plots generated by the Kruskal-Wallis test are presented.

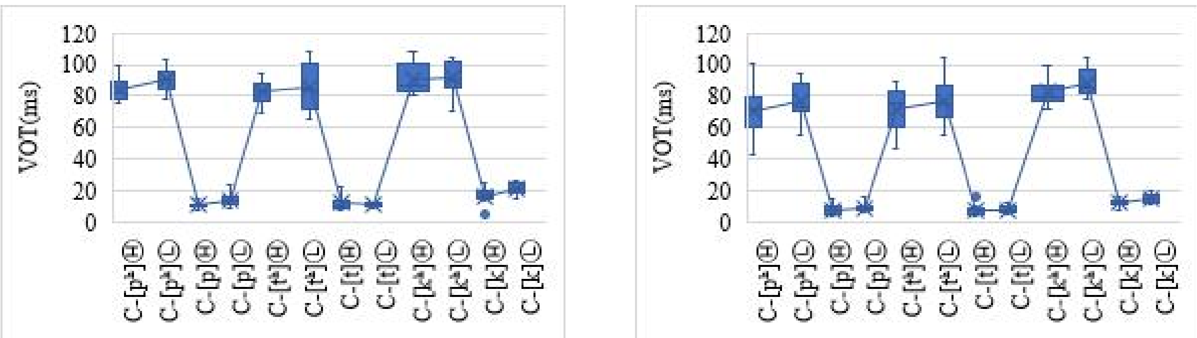

Figure 1: Distribution of VOT for Word-Initial Chinese Plosives (Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing VOT and the degree of their impact.

Manner of Articulation Influence: The difference is significant ($p < 0.05$), meaning there is a significant difference between aspirated and unaspirated sounds, with the VOT of aspirated sounds being clearly longer than that of unaspirated sounds.

Place of Articulation Influence: Regardless of whether the sound is aspirated or unaspirated, the differences due to place of articulation are not significant. However, on average, velar sounds have the longest VOT, while bilabial and alveolar sounds have similar VOT values.

Tone Influence: There is no significant difference in the VOT of word-initial plosives with the same manner and place of articulation when comparing Mandarin tones (high Ⓗ and low Ⓛ) ($p \geq 0.05$). This indicates that Mandarin tones do not influence the VOT of word-initial plosives.

4.1.2 VOT of Japanese Plosives

The average VOT values for word-initial Japanese plosives measured in this experiment are shown in Table 3. Figure 2 is a box plot illustrating the distribution of VOT for male and female Japanese speakers.

Table 3. Average VOT Values for Word-Initial Japanese Plosives (unit: ms)

		Bilabial		Alveolar		Velar	
		Ⓗ	Ⓛ	Ⓗ	Ⓛ	Ⓗ	Ⓛ
Male	Voiceless	24.583	31.000	29.120	27.163	50.833	51.000
	Voiced	-46.500	-49.000	-16.812	-15.954	-30.167	-39.500
Female	Voiceless	32.500	35.417	38.667	30.750	35.667	45.667
	Voiced	-32.833	-28.667	-8.564	-9.631	-8.750	-8.500

Differences in Manner of Articulation: The average VOT values show that both men and women produce positive VOT for voiceless sounds and negative VOT for voiced sounds, making a clear distinction between the two. It is important to note that the VOT units in this study are measured in milliseconds (ms), so values like '-1' represent '-0.001' seconds, which is very close to zero, and '-3' or '-4' are similarly near zero. For Japanese word-initial plosives produced by broadcasters, we found VOT values close to zero for male alveolar and female alveolar and velar voiced sounds, unlike previous studies on general speakers, which reported positive VOT for voiced sounds (voicing neutralization).

Differences in Place of Articulation: Regarding the place of articulation, for voiceless sounds, except for the non-high tone velar sound in women, both men and women exhibited higher VOT values for velar sounds compared to bilabial and alveolar sounds, with the latter two being similar. This aligns with prior research on VOT differences based on place of articulation. For voiced sounds, examining the absolute VOT values, which reflect the time from vocal fold vibration to the release of the plosive, male participants showed an order of alveolar < velar < bilabial, while female participants showed alveolar ≈ velar < bilabial. In both genders, bilabial sounds had the largest absolute VOT values, and the VOT for alveolar and velar sounds were similar for women. This also agrees with Shimizu's (1996) findings.

Differences in Accent Type (First Pitch Accent vs. Non- first Pitch Accent) in Japanese: The difference in VOT based on Japanese accent type was not significant.

Next, to visualize the interrelationships and overall distribution of VOT for each word-initial Japanese plosive, box plots generated by the Kruskal-Wallis test are presented.

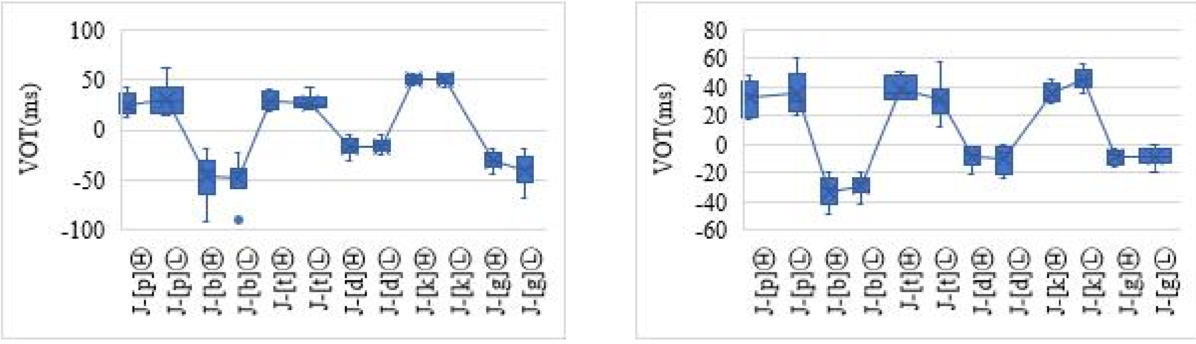

Figure 2: Distribution of VOT for Word-Initial Japanese Plosives (Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing VOT and the degree of their impact.

Manner of Articulation Influence: The influence of the manner of articulation shows a significant difference between voiceless and voiced sounds ($p < 0.05$), indicating that the manner of articulation has a clear effect.

Place of Articulation Influence: Regarding the influence of the place of articulation, in voiceless sounds, velar sounds have the largest VOT, and there is a significant difference between velar sounds and both bilabial and alveolar sounds ($p < 0.05$). However, there is no significant difference between bilabial and alveolar sounds ($p \geqslant 0.05$). In voiced sounds, the effect of the place of articulation was not significant.

Accent Type Influence: For word-initial plosives with the same manner and place of articulation, there is no significant difference in VOT between accent types (head-high Ⓗ and non-head-high Ⓛ) ($p \geqslant 0.05$). This indicates that Japanese accent types do not affect VOT.

4.1.3 VOT of Korean Plosives

The average VOT values for word-initial Korean plosives measured in this experiment are shown in Table 4. Figure 3 is a box plot illustrating the distribution of VOT for male and female Korean speakers.

Table 4. Average VOT Values for Word-Initial Korean Plosives (unit: ms)

		Bilabial	Alveolar	Velar
Male	Lenis	50.786	56.002	75.878
	Aspirated	89.229	61.172	73.029
	Tense	3.211	12.058	5.911
Female	Lenis	45.329	62.131	83.047
	Aspirated	72.214	67.969	74.884
	Tense	5.663	9.599	5.951

Differences in Manner of Articulation: Regarding the differences in manner of articulation based on average values, the VOT for bilabial and alveolar sounds follows the pattern of “tense < Lenis < aspirated”. For velar sounds, the VOT pattern is “tense < aspirated < Lenis”. This trend was observed in both male and female participants.

Differences in Place of Articulation: As for the differences in place of articulation based on average values, in lax sounds, the VOT follows the order of “bilabial < alveolar < velar”, a pattern observed in both genders and consistent with general acoustic phonetic principles regarding VOT. For tense sounds, the VOT follows the order of “bilabial < velar < alveolar”, again seen in both male and female results. Lastly, in aspirated sounds, there are gender differences: for males, the VOT follows the order of “alveolar < velar < bilabial”, whereas for females, it is “alveolar < bilabial < velar”. While the relationship between bilabial and velar sounds is reversed, both genders show that alveolar sounds have the shortest VOT.

Next, to visualize the interrelationships and overall distribution of VOT for each word-initial Korean plosive, box plots generated by the Kruskal-Wallis test are presented.

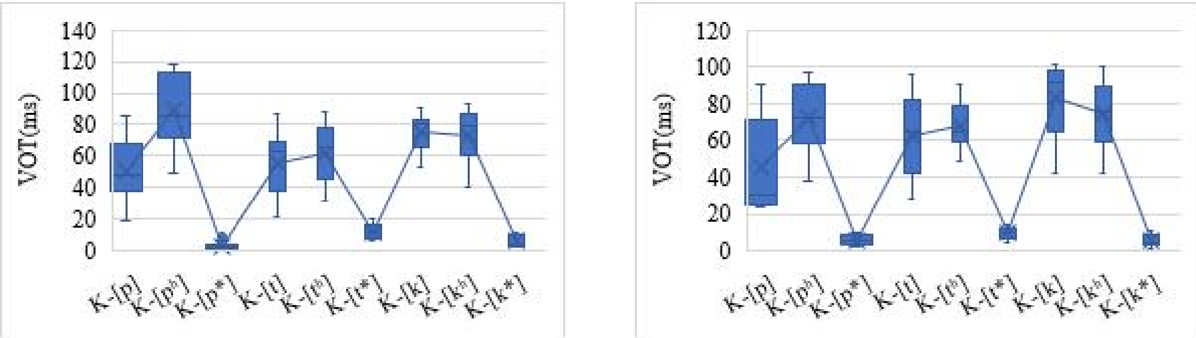

Figure 3: Distribution of VOT for Word-Initial Korean Plosives (Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing VOT and the degree of their impact.

Manner of Articulation Influence: The VOT values for tense sounds are the smallest, with significant differences observed between them and the other two types of plosives ($p < 0.05$). Although there are significant differences between Lenis and aspirated sounds, the relationships between them are not absolute and vary depending on the place of articulation.

Place of Articulation Influence: Regarding the place of articulation, the S-N-K test results show no significant differences in VOT for tense sounds based on the place of articulation ($p \geqslant 0.05$). For Lenis and aspirated sounds, the relationships between the places of articulation are not absolute and depend on the manner of articulation.

4.2 Results and Discussion of F0

4.2.1 F0 of Vowels Following Chinese Plosives

The average F0 values of vowels following word-initial Chinese plosives measured in this experiment are shown in Table 5. Figure 4 is a box plot illustrating the distribution of F0 for male and female speakers.

Table 5. Average F0 Values of Vowels Following Word-Initial Chinese Plosives(unit: Hz)

		Bilabial		Alveolar		Velar	
		Ⓗ	Ⓛ	Ⓗ	Ⓛ	Ⓗ	Ⓛ
Male	Aspiration	195.942	106.984	180.330	98.117	177.133	102.008
	Unaspirated	177.083	108.543	203.367	112.400	196.217	125.425
Female	Aspiration	257.433	182.233	262.767	184.167	268.050	172.375
	Unaspirated	246.025	187.125	280.133	203.975	292.975	203.775

Differences in Manner of Articulation: Regarding the manner of articulation, excluding the bilabial sounds with high pitch (Ⓗ) in both male and female speakers, all 10 pairs of aspirated and unaspirated sounds show the pattern “aspirated < unaspirated”.

Differences in Place of Articulation: As for the place of articulation, no consistent patterns were found.

Differences in Tone (High vs. Low) in Chinese: Looking at the average values, in all 12 pairs of plosives with the same place of articulation and manner of articulation, the F0 for high pitch (Ⓗ) is noticeably higher than that for low pitch (Ⓛ). This suggests that Chinese tones likely have a significant influence on F0.

Next, to visualize the interrelationships and overall distribution of F0 of Vowels Following Chinese Plosives, box plots generated by the Kruskal-Wallis test are presented.

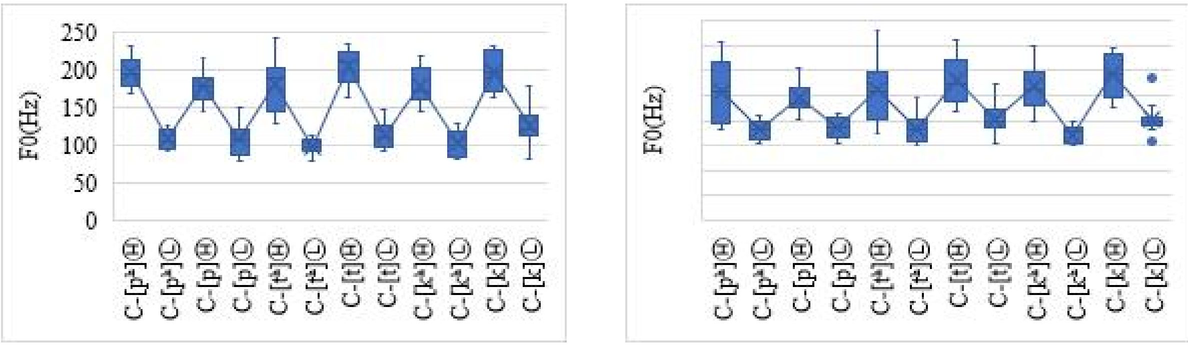

Figure 4: Distribution of F0 for Vowels Following Word-Initial Chinese Plosives
(Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing F0 and the degree of their impact.

Manner of Articulation Influence: There is no significant difference based on the manner of articulation ($p \geqq 0.05$), indicating that the influence of the manner of articulation is not prominent.

Place of Articulation Influence: There is no significant difference based on the place of articulation ($p \geqq 0.05$), suggesting that the place of articulation does not have a notable effect.

Tone Influence: The influence of Chinese tones on F0 is significant ($p < 0.05$).

4.2.2 F0 of Vowels Following Japanese Plosives

The average F0 values of vowels following word-initial Japanese plosives measured in this experiment are shown in Table 6. Figure 5 is a box plot illustrating the distribution of F0 for male and female speakers.

Table 6. Average F0 Values of Vowels Following Word-Initial Japanese Plosives(unit: Hz)

		Bilabial		Alveolar		Velar	
		Ⓗ	Ⓛ	Ⓗ	Ⓛ	Ⓗ	Ⓛ
Male	Voiceless	145.492	114.117	132.817	115.650	140.175	125.758
	Voiced	118.925	107.567	113.843	106.633	128.350	118.700
Female	Voiceless	235.683	198.292	204.654	187.513	207.691	182.817
	Voiced	196.442	184.708	184.821	165.700	219.086	194.942

Differences in Manner of Articulation: For the differences based on the manner of articulation, when comparing F0 values of plosive sounds with the same place of articulation and the same accent type, all show “voiced < voiceless” (excluding velar sounds in women). In the case of female velar sounds, the pattern is reversed. Overall, for the four types of plosive sounds with the same place of articulation, the F0 of the voiceless sound with a first-pitch accent Ⓗ is the highest, followed by the voiceless sound with a non-first-pitch accent Ⓛ and the voiced sound with a first-pitch accent Ⓗ, with these two values being close. Finally, the F0 of the voiced sound with a non-first-pitch accent Ⓛ is the lowest.

Differences in Place of Articulation: The differences in F0 based on the place of articulation are not considered significant based on the mean values.

Differences in Accent Type (First Pitch Accent vs. Non- first Pitch Accent) in Japanese: Regarding the differences in F0 based on Japanese pitch accent, in all 12 pairs of Ⓗ and Ⓛ contrast, the F0 of the first-pitch accent Ⓗ is consistently higher than that of the non-first-pitch accent Ⓛ.

Next, to visualize the interrelationships and overall distribution of F0 of Vowels Following Japanese Plosives, box plots generated by the Kruskal-Wallis test are presented.

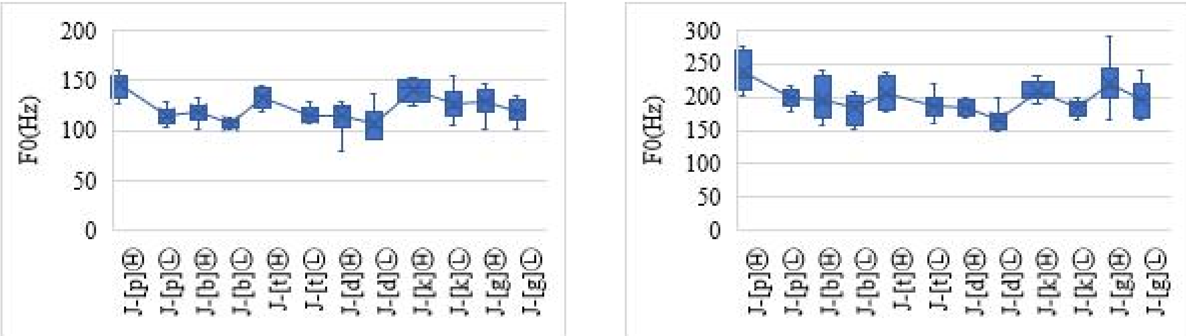

Figure 5: Distribution of F0 for Vowels Following Word-Initial Japanese Plosives
(Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing F0 and the degree of their impact.

Manner of Articulation Influence: Regarding differences in the manner of articulation, the F0 of the four types of plosive sounds with the same place of articulation shows that the F0 of the first-pitch accent (Ⓗ) voiceless plosives is the highest, followed by the F0 of the non-first-pitch accent (Ⓛ) voiceless and first-pitch accent (Ⓗ) voiced plosives, with the non-first-pitch accent (Ⓛ) voiced plosives being the lowest. In other words, The manner of articulation affects the F0 of Japanese word-initial plosive sounds.

Place of Articulation Influence: The differences based on the place of articulation were not significant.

Accent Type Influence: Concerning accent type, for plosive sounds with the same manner and place of articulation, the F0 of the first-pitch accent (Ⓗ) was observed to be higher than that of the non-first-pitch accent (Ⓛ). In other words, the accent type influences the F0 of Japanese word-initial plosive sounds.

4.2.3 F0 of Vowels Following Korean Plosives

The average F0 values of vowels following word-initial Korean plosives measured in this experiment are shown in Table 7. Figure 6 is a box plot illustrating the distribution of F0 for male and female speakers.

Table 7. Average F0 Values of Vowels Following Word-Initial Korean Plosives(unit: Hz)

		Bilabial	Alveolar	Velar
Male	Lenis	121.723	112.196	119.808
	Aspirated	169.217	143.567	138.833
	Tense	153.358	144.142	149.583

	Lenis	183.692	194.350	184.300
Female	Aspirated	276.692	257.358	224.775
	Tense	257.267	248.317	261.883

Differences in Manner of Articulation: bilabial sounds follows the pattern “lenis < tense < aspirated”, while for alveolar and velar sounds, the pattern is “lenis < aspirated < tense”. For women, the F0 of bilabial and alveolar sounds follows “lenis < tense < aspirated”, and for velar sounds, the pattern is “lenis < aspirated < tense”. In summary, for Korean word-initial plosive sounds, it is clear that “lenis sounds have the lowest F0, but the relationship between aspirated and tense sounds is not absolute.

Differences in Place of Articulation: Regarding the differences in F0 based on the place of articulation, for men, bilabial sounds have the highest F0 among plosives with the same manner of articulation. The relationship between alveolar and velar sounds is not absolute. For women, the differences based on the place of articulation do not follow a consistent pattern.

Next, to visualize the interrelationships and overall distribution of F0 of Vowels Following Korean Plosives, box plots generated by the Kruskal-Wallis test are presented.

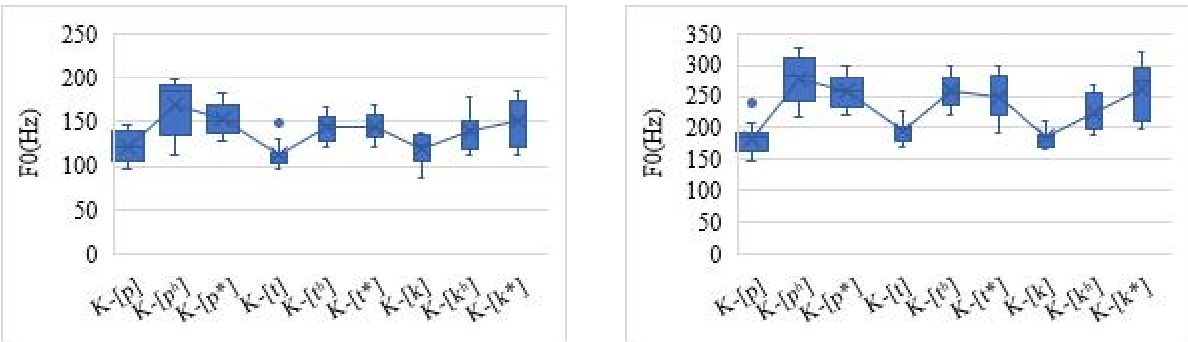

Figure 6: Distribution of F0 for Vowels Following Word-Initial Korean Plosives
(Left: Male. Right: Female)

Finally, through the results of the S-N-K test and pairwise comparisons, we will discuss whether the differences between each plosive are significant and summarize the factors influencing F0 and the degree of their impact.

Manner of Articulation Influence: Regarding the differences based on the manner of articulation, there is a significant difference between lenis sounds and both aspirated and tense sounds ($p<0.05$), but there is generally no significant difference between aspirated and tense sounds ($p \geqq 0.05$). This indicates that the manner of articulation significantly affects the F0 of Korean word-initial plosive sounds.

Place of Articulation Influence: Regarding the differences based on the place of articulation, there is no significant difference among plosive sounds with the same manner of articulation ($p \geqq 0.05$). This suggests that the place of articulation does not have a significant effect on the F0 of Korean word-initial plosive sounds.

5.Conclusion and Suggestion

This paper analyzes 792 word-initial plosive sounds from news broadcasts in Chinese, Japanese, and Korean official media, examining three variables: articulation method, articulation position, and pitch type. Using S-N-K tests and Bonferroni multiple comparison methods, the study evaluates whether these variables have a significant impact on word-initial plosive sounds. The results are as follows: Regarding VOT, articulation method has the most significant impact on VOT in all three languages, while articulation position also affects VOT, though not as prominently. Pitch type does not influence VOT (except in Korean, as Korean word-initial plosives do not distinguish pitch). Regarding F0, in Chinese, pitch type significantly affects F0, while articulation method and position have minimal impact on Chinese plosive F0. In Japanese, both articulation method and pitch type affect F0, but articulation position does not. In Korean, articulation method significantly affects F0, while articulation position does not.

Previous research on word-initial plosives in Chinese, Japanese, and Korean has mainly focused on VOT, with limited studies on F0, especially for Chinese and Japanese. This study contributes to filling that gap. Moreover, this paper is the first to analyze the effect of different pitch types in Chinese and Japanese as variables in the acoustic analysis of plosives. Prior research on acoustic phonetics in these three languages has mostly involved general native speakers, with little attention to the standard pronunciation of professional broadcasters. With the establishment of bilingual broadcasting programs (Chinese-Korean in 2021, Chinese-Japanese in 2024) in China, this research also provides theoretical support for the education and training of multilingual broadcasters in China.

For future research, the scope will be expanded beyond plosives to include vowels and other consonants such as fricatives, as well as factors like speech rate, volume, and intonation changes throughout entire sentences. The goal is to develop a comprehensive acoustic profile of standard pronunciation for broadcasters in Chinese, Japanese, and Korean.

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