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Prosodic Analysis of *Wh*-indeterminate Questions in L2 Korean

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Prosodic Analysis of *Wh*-indeterminate Questions in L2 Korean

by

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Abstract

Wh-indeterminate questions in Korean are potentially ambiguous due to the limited use of morpho-syntactic markers. When an explicit morpheme indicating the question type is not used, the disambiguation of the question relies, primarily, on prosodic cues. Drawing from previous studies of L1 Korean, this study examines the production and perception of intonation patterns of English L1 learners of Korean for wh- and yes-no questions in Korean. That examination allows speculation on potential L1 influence in the learners' production. Five English L1 learners of Korean who received formal instruction in Korean at a U.S. university completed a production and perception test consisting of 10 dialogues featuring ambiguous wh-indeterminate questions. Their speech was analyzed for pitch range, boundary tone, and accentual phrasing. The findings revealed that L2 Korean learners are able to produce and perceive wh-questions in a more target-like manner than yes-no questions. Learners' proficiency level significantly influenced pitch peak and pitch range, with advanced learners showing a resemblance to L1 production. However, yes-no questions remained non-target-like across all proficiency levels. Additionally, there was evidence of L1 influence from English in boundary tone choices and pitch ranges, as well as inconsistency in accentual phrasing. These results suggest an interplay between language proficiency and L2 prosody and emphasize the need to incorporate targeted prosodic training within the curriculum for Teaching Korean as a Foreign Language.

Dedication

To Buddy, Toby
and Victoria

Acknowledgements

John, this thesis would have never seen the light without you. Your mentorship inspires me to be not only a better scholar but a great mentor for others. I will forever remember the great support and friendship you have shared. I am excited to continue my work in the field alongside you. Tanya, Alissa, and Steve, I can't thank you enough for giving me opportunities to work in different research projects and for helping me become the well-rounded scholar I am today. The support and care I've received in and outside of school from you have provided a path for me in this field. Ariel, thanks for being my classmate for two straight years of my life. We might be 20 years and 2,600 miles apart, but I'll always be grateful for our friendship.

Victoria, you always believed in me even when I couldn't and made sure I knew what I was capable of. You deserve to be acknowledged for this degree as much as I do. I will be forever grateful for the unconditional love and support you have given me during this time of my life. Thank you for being by my side every step of the way. I would also have given up a million times if I hadn't received unconditional love and companionship from Buddy and Toby. So many nights in front of the computer were bearable because they were always right by my feet. These two kept me going even when things seemed impossible. I'll make sure to pay back the love I got with lifelong walks and treats.

사랑하는 엄마 아빠, 치열한 한국 사회에서 남들 시선 신경 쓰지 않고 내가 좋아하는 것을 찾아 온전히 나로 살아갈 수 있도록 온 힘을 다 해줘서 감사해요.

Mom and dad, thank you for allowing me to grow up to be the person I am today and pursue what I love, in a society where many spend their entire lives trying to fit in.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Prosody often receives limited attention in second language acquisition (SLA) due to its perceived secondary importance in speech. However, it is crucial not only for comprehensible speech but also to accurately and appropriately convey meaning (Chun, 1988); therefore, its impact on communication cannot be overlooked. This is particularly true in the context of L2 Korean, where understanding prosody is fundamental to correctly interpreting and producing wh-indeterminate questions. Korean wh-indeterminate questions are ambiguous due to the limited morpho-syntactic markers in the sentence. The absence of these markers leaves wh-questions and yes-no questions in Korean syntactically identical, leading to lexical ambiguity. For instance, the written form of the wh-indeterminate '어디[ʌdi]' can be interpreted as both wh-interrogative '*where*' and wh-indefinite '*anywhere*'. The disambiguation of these two question types relies on contextual clues and prosodic features, which emphasizes the significant role of prosody in the Korean language.

Example 1.

내일	어디	가요?
[nɛiɾ	ʌdi	gɑjo]
tomorrow	where/anywhere	go-PROG

Wh-question (wh-interrogative): **Where** are you going tomorrow?
Yes-no question (wh-indefinite): Are you going **anywhere** tomorrow?

In foreign language classrooms, where prosodic features often receive less instructional focus compared to grammar and vocabulary, learning to produce and perceive wh-indeterminate questions in Korean can pose a challenge for learners. This calls for a close examination of the prosodic features of wh-indeterminate questions for

both first (L1) and second language (L2) speakers of Korean to develop effective pedagogical strategies. While scarce, several studies have investigated how L1 Korean speakers prosodically disambiguate wh-questions and yes-no questions. (An, 2022; Jun & Oh, 1996; Min, 1998; Park & Ahn, 2002; Yun & Lee, 2022; Yun, 2022, 2023; Yune, 2014) To my knowledge, however, there is no research investigating L2 Korean learners on wh-indeterminate questions in the U.S. academic context. Given the increasing interest in Korean as a Foreign Language (KFL), this research gap is particularly critical.

Building on the framework and findings of Jun and Oh (1996) and Yun and Lee (2022), the present study examines wh-indeterminate questions in the L2 Korean context and analyzes three key prosodic features for disambiguating wh-questions and yes-no questions in Korean: accentual phrasing, the F0 peak on questions words[1], and boundary tones. The purpose of this study is to explore the prosodic features that English learners of Korean employ in producing and perceiving ambiguous wh-questions and yes-no questions to determine if there is any L1 influence. This research aims to enhance our understanding of L2 Korean prosody and inform teachers, curriculum designers, and materials developers in the field of Teaching Korean as a Foreign Language.

In the subsequent sections, this paper begins with a brief overview of the role of prosody in SLA and KFL, then outlines wh-indeterminate questions, Korean intonation patterns, and previous research on the prosodic disambiguation of wh-questions and yes-no questions in the L1 Korean context. The third section poses research questions that guide this study. Details of the methodology used in this study are explained in Section 4.

[1] Referred to as 'wh-words' (either wh-interrogative or wh-indefinite) in Jun and Oh (1996) and Yun and Lee (2022).

Following sections present the findings, starting with the results of the analysis in Section 5 and discussion of the potential L1 influence in Section 6. The final section provides a review of the study and offers insights for future research directions.

Chapter 2: Literature Review

2.1 Prosody in SLA

Cutler et al. (1997) define prosody as "the linguistic structure which determines the suprasegmental properties of utterances" (p.142), which includes elements such as pitch, stress, tempo, or duration. Prosody is embedded in every spoken utterance and plays an integral role in human communication as it functions to provide different types of information in spoken language (Mennen & Leeuw, 2014). There has been a body of research that has explored the use of prosody in three main areas: lexical meaning, syntactic structure, and discourse structure (Cutler et al., 1997). This shows that prosody aids in not only understanding linguistic structures but also signaling paralinguistic information such as emotions and social cues. Therefore, the role of prosody in processing, which adds layers of meaning to spoken language, cannot be overlooked.

Despite this importance of prosody in human communication, however, the main focus in SLA has been on morpho-syntax and segmental phonology (Li & Post, 2014). One reason is that the study of prosody is difficult because it is a sound phenomenon and includes rhythm, pitch, and intonation. In order to master prosody, one needs to understand prosodic structure and prosodic properties of another language (Mennen & Leeuw, 2014) in addition to language-specific intonational meaning (Casillas et al., 2023), which can be extremely challenging even for advanced learners. In addition, L2 learners often experience cross-linguistic influence in producing and perceiving prosody due to distinct prosodic properties of different languages. L1 prosodic influence often leads to non-target-like prosody, which is perceived as “foreign accents” and can cause incomprehensibility and unintelligibility of speech. Therefore, the functions of prosody in

the L2 context extend not only to conveying grammatical and pragmatic meaning in discourse but also to the intelligibility of what is spoken (Crosby, 2013)

Of the SLA studies that have been done, many have addressed the role of prosody in intelligibility and comprehensibility of speech (Anderson-Hsieh et al., 1992; Crowther et al., 2016; Derwing et al., 1998; Gordon & Darcy, 2016; Isaacs & Trofimovich, 2012; Kang et al., 2010; Munro & Derwing, 1999; Saito et al., 2016, 2017; Trofimovich & Baker, 2006 among others). For instance, Anderson-Hsieh et al. (1992) examined the relationship between listeners' judgements of foreign accentedness and segmental-suprasegmental errors in L2 speech. The result of this study revealed that prosody was highly correlated with pronunciation ratings. This was further investigated in Munro and Derwing (1999) through transcription and perceptual tests of spoken data by Chinese learners of English. Their study also indicated that L2 intonation had higher correlation with accentedness and compensability than phonemic errors. Consequently, the application of suprasegmental-focused instruction has been in demand in the field of SLA.

Prosody is also crucial for conveying meaning accurately and appropriately. Several studies have addressed how prosody serves to convey pragmatic meaning in terms of attitudes. Crosby (2013) investigated a possible misunderstanding of attitude or intent caused by L1 transfer due to non-target-like intonation. Their results highlighted the influence of L1 intonation on L2 intonation and suggested a pronunciation training. Another study that has focused on attitude is Casillas et al. (2023). Their study examined how intonation is perceived and processed differently based on learners' proficiency levels; their results indicate that pragmatic skills should be included in measures to help

learners understand intonational meaning in the L2 context, stating "a speaker can use prosody to signal numerous additional pragmatic functions" (p. 915). This body of research in SLA emphasizes the critical role of prosody, especially in L2 interaction where both intelligible speech and pragmatic competence are required for successful communication.

Since the 1990s, Korean linguists have recognized the effect of prosody in language teaching and use. Kim (2010) emphasized the significance of intonational meaning across different sentence types in Korean. Oh and Lee (1994) provided insights into how intonation is used to disambiguate different sentence types that are syntactically and segmentally identical in the language and shared the unique challenges that learners of Korean face due to the intonation patterns of Korean. For instance, the interpretation of a wh-indeterminate question in Seoul Korean could shift between wh-questions and yes-no questions based on its prosody. Owing to the distinct prosodic units in Korean, pronunciation instruction requires a focused approach on suprasegmental features (Kang, 2012). Therefore, it's essential to teach how prosody affects the interpretation of wh-indeterminate questions in Seoul Korean.

2.2 Wh-indeterminates

Wh-indeterminates, as defined by Kuroda (1965), are wh-pronouns that serve a range of functions in different sentence types. These functions include acting as interrogatives (e.g., 'who'), universal quantifiers ('everyone'), existential quantifiers ('someone'), negative polarity items ('anyone'), and free choice items (also 'anyone'). While the functions of wh-indeterminates and their disambiguation in various sentence types differ across languages, Yun (2015) notes that the use of wh-pronouns often leads

to ambiguity between wh-interrogative and wh-indefinite in many languages, including Korean.

The history of wh-indeterminates in Korean is relatively recent. According to Yun (2022), the lexeme that is now wh-indeterminates was initially used exclusively for interrogative readings (e.g., wh-questions). It wasn't until the late 19th century that their indefinite use (e.g., yes-no questions) was fully developed. This shift has led to growing focus on wh-indeterminates in the fields of Korean linguistics and Korean phonology since the 1990s. A number of studies have documented the ambiguity between wh-questions and yes-no questions in Seoul Korean due to the absence of the morpho-syntactic markers in language use (Park, 1990; Lee, 1992; Oh & Lee, 1994; Lee 1996; Min 1998; Heo 2003, among others)

The primary focus of these studies has been on the disambiguation of wh-questions and yes-no questions in Seoul Korean in the context of L1 Korean. Lee (1996) reported that wh-interrogative questions and wh-indefinite questions each have distinct intonation patterns in Seoul Korean due to differing focus within the sentences. For example, in wh-interrogative questions, question words often introduce new information and receive pitch peak to emphasize this new element (e.g., in 'Where are you going?', '*where*' highlights the new information about location). Conversely, in yes-no questions that include wh-indefinites, the question word contributes less to introducing new information and instead emphasizes the occurrence of an event (e.g., in 'Are you going anywhere?', the focus is not on '*anywhere*' but on whether or not the event of going is taking place). In these cases, the prosodic focus shifts to the verb phrase.

Due to these characteristics of Korean intonation patterns, Yune (2014) stressed the importance of teaching intonational meaning and prosodic variations that help disambiguate wh-interrogative and wh-indefinite questions in Korean. Yun (2023) noted that while contextual clues often play a primary role in distinguishing wh-questions and yes-no questions, these sentences typically appear at the beginning of conversations where such clues are rather minimal. Consequently, prosody assumes a more significant role in differentiating two question types in Seoul Korean. This underscores the need for teaching prosody in KFL classrooms to ensure that learners can effectively understand and use these linguistic features in L2 interaction.

2.3 Intonation Pattern of Seoul Korean

According to K-ToBI[2] (Korean Tones and Break Indices) (Jun, 2000), the intonation of Seoul Korean comprises an intonation phrase (IP) and an accentual phrase (AP). The tonal pattern of an accentual phrase in Seoul Korean is typically characterized as THLH (T = H if the first syllable is aspirated or tense; otherwise, T = L). Jun (2005) explained that an AP is fully realized in phrases with more than three syllables as followed:

> When an AP has more than three syllables, the two initial tones of an AP are associated with the two initial syllables of the AP, and the two final tones of an

[2] K-ToBI (Korean Tones and Break Indices) is a prosodic transcription convention for a standard intonation system for Seoul Korean proposed by Jun (2000). The design principles of K-ToBI follow those of other ToBI systems and are based on the Autosegmental-Metrical theory of intonational phonology. This theory uses two tones, high (H) and low (L) to describe tonal units (Pierrehumbert, 1980).

> AP are associated with the two final syllables of the AP. The syllables between the second and the penult of the AP, if there are any, get their surface pitch values by interpolating between the H tone on the second syllable and the L tone on the penult (p. 206)

This characteristic is due to the nature of Seoul Korean, where there is no fixed stress at the word level but word and phrasal stress that aligns with the intonation pattern. Unlike English, which uses a fixed stressed syllable in each word through pitch accent, Seoul Korean maintains a consistent tonal pattern THLH and adjusts the tone placement within the accentual phrases based on the number of syllables in each phrase. For example, Example 2 shows five sentences with the word '어머니 [ʌmʌni]' placed at the beginning of each sentence, but with varying numbers of syllables. Different morpho-syntactic markers change the syllable count in the accentual phrase, and the tonal pattern LHLH is accordingly adjusted within these structures.

Example 2.

어머니 [ʌmʌni] (mother)

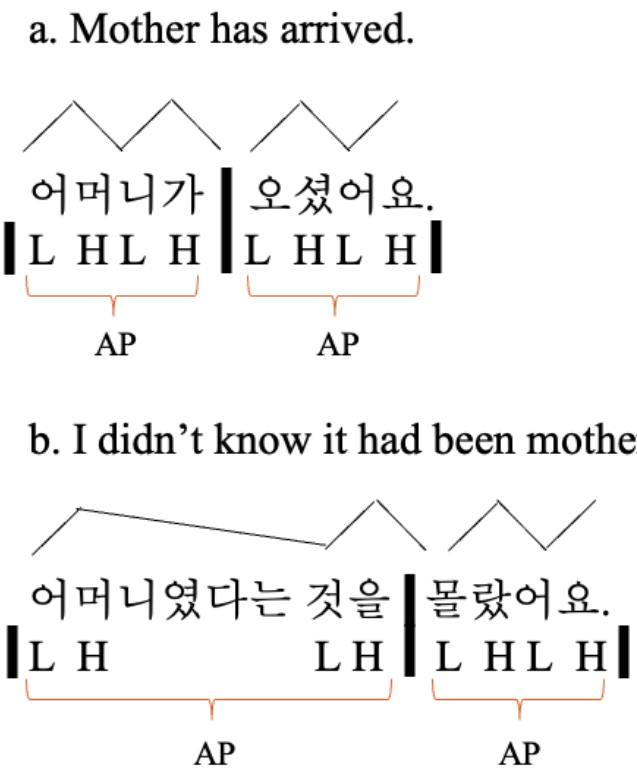
어머니가 오셨어요. (Mother has arrived)
L H L H
어머니하고 전화해요. (I'm on the phone with mother)
L H L H
어머니하고는 안 만나요. (I don't meet with mother)
L H L H
어머니라는 것을 몰랐어요. (I didn't know it was mother)
L H L H
어머니였다는 것을 몰랐어요. (I didn't know it had been mother)
L H L H

Note. These examples were taken from the online textbook "*한국어음운교육론*" distributed by Wonkwang Digital University

Figure 1 depicts how to tonal pattern LHLH is distributed across two sentences with different syllable counts in their first accentual phrase. In a shorter AP '어머니가' in the sentence (a), the tone alternates across the syllables. However, in a longer AP '어머니였다는것을' in the sentence (b), the tonal pattern applies primarily to the first two and the last two syllables (어 L 머 H and 것 L 을 H), with the syllables in between left with a larger tonal gap. This gap is an interval transitioning from the first H to the second L, where gradual decrease in pitch occurs, and it affects different prosodic elements like the rhythm and tonal flow of the speech in Korean.

Figure 1.

Example of Tonal Pattern Placement in APs with Different Syllable Count



Jun and Oh (2005) discussed the challenges of learning Korean intonation

patterns due to the differences in phonological system and phonetic realization between languages. They analyzed the intonation patterns of four English learners of Korean at various proficiency levels to test their realization of intonation patterns producing 40 different sentences. Their findings revealed that the speakers of all levels have a tendency to produce lexical stress on a particular word or syllable that does not fit with the THLH accent phrase expected in Korean, which seems to be L1 interference from English with its rhythmic patterns. Jeong (2002) also noted that English speakers learning Korean tend to stress the first syllable of sentences and accentual phrases due to L1 transfer. Insufficient understanding of Korean intonation patterns can hinder learners from understanding the intended meaning of spoken sentences even if they understand the written language. This highlights the critical need for targeted prosody instruction and intonation patterns in L2 Korean.

2.4 Previous Studies on Korean Wh-indeterminates

While numerous studies have investigated L1 Korean intonation patterns, there is a relatively small body of literature specifically focused on disambiguating wh-questions and yes-no questions. However, existing research has established that accentual phrasing, F0 peak on question word, and boundary tones are three crucial prosodic elements in distinguishing the two sentences in Korean. A seminal study in this area is by Jun and Oh (1996), who examined the prosodic features used for disambiguating three types of sentences with identical written forms, wh-questions, yes-no questions, and incredulity questions. They found that accentual phrasing was a key factor in distinguishing yes-no questions from the other two types, with amplitude on question word and boundary tones being significant indicators for differentiating wh-questions.

Park and Ahn (2002) explored two lexically ambiguous wh-indeterminate questions (who/anyone, when/any time) in their study. They carried out a production test with 10 Seoul/Gyeonggi Korean speakers to investigate whether accentual phrasing operates similarly when adverbial phrases are added in wh-questions and yes-no questions. Contrary to the findings of Jun and Oh (1996), which suggested post-wh L tone deletion, Park and Ahn observed pre-adverbial L tone deletion in their study. Additionally, they noted significant pitch differences at sentence-final intonation between the two types of questions; wh-questions were typically marked by HL% boundary tones, whereas yes-no questions consistently demonstrated H% boundary tones. These results emphasized the critical role of boundary tones in distinguishing yes-no questions from wh-questions.

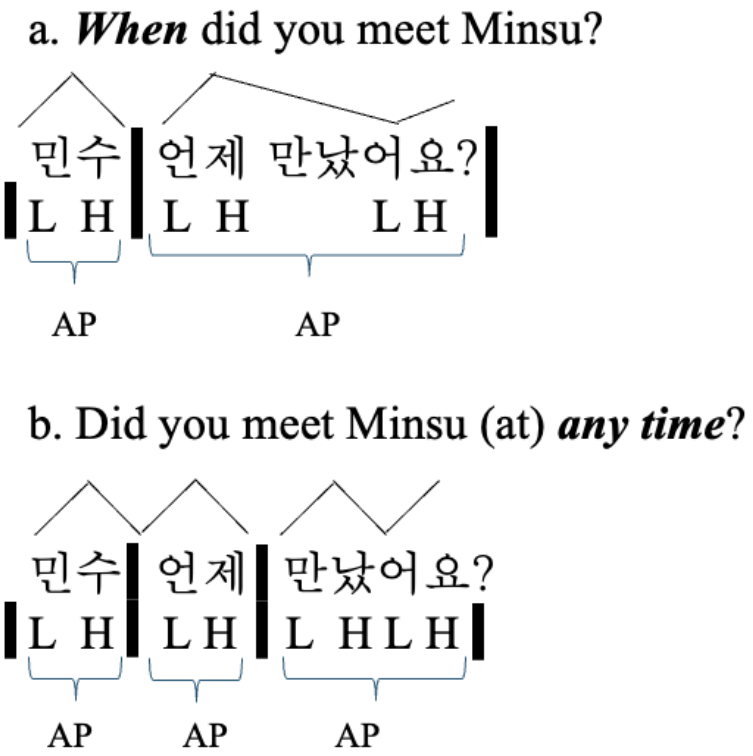
A more extensive study on the intonations of wh-interrogative and wh-indefinite questions in Seoul Korean was conducted by An (2022) with 28 female native Seoul/Gyeonggi Korean speakers in their 20s. The study performed an acoustic analysis to investigate intonation on accentual phrasing, F0 peak on question word, and boundary tones across the two question types. The results indicated F0 peak on the question word in most wh-questions, except for '뭐' ('what/anything'), where the wh-indeterminate in yes-no questions had a higher peak. Their perception test manipulating pitch peak on question word concluded that pitch peak on the question word in wh-questions significantly affects listeners' judgment in differentiating the two question types.

In addition, Yun and Lee (2022) investigated nine native Korean speakers to identify prosodic and perceptual features for disambiguating wh-questions and yes-no questions. The production and perception tests indicated a tendency for post-wh L tone

deletion on the first post-wh syllable in wh-questions, which involves deleting prosodic boundaries after the question word. While Yun and Lee observed variations in boundary tones for wh-questions across speakers, yes-no questions showed a strong correlation with H% boundary tones. The result of this study also shows higher pitch peak on question word in wh-questions than yes-no questions in all their examples. In her later study, Yun and Lee (2022) noted that "... sentence-final intonation is not directly relevant to the disambiguation of the indeterminate wh-words…but rather provides an indirect clue that at least yes-no questions can be singled out" (p. 46). Their study concluded that the accentual phrasing pattern was found to play a crucial role in disambiguation of two sentences. Figure 2 shows the example of AP pattern in wh-questions vs. yes-no questions. The major difference between two sentences is that the wh-phrase in wh-questions is formed as one AP, and the entire sentence is formed with two APs, whereas yes-no questions consist of three APs with the wh-phrase divided into two APs for each question word and verb phrase. However, their findings confirmed that, while its importance varies, all three prosodic features identified by Jun and Oh (1996) are key prosodic elements in disambiguating wh-questions and yes-no questions in Seoul Korean.

Figure 2.

The Example of AP Pattern in Wh-questions vs. Yes-no Questions



Note. 민수: Minsu (name), 언제: wh-indeterminates (when/anywhere), 만났어요: past tense form of 만나다 (to meet)

2.5 Present Study

The field of SLA currently faces a significant paucity of research on L2 Korean, particularly regarding how learners of Korean use prosody to disambiguate wh-questions and yes-no questions. One notable study on the topic is by Yune (2014), which focused on advanced Chinese learners of Korean who reside in South Korea. This study involved conducting a perception test with L1 Korean speakers to analyze the production of wh-questions and yes-no questions by L2 Korean learners, and their results revealed that these L2 speakers were unable to effectively disambiguate the question types using target-like intonation patterns.

To my knowledge, studies examining L2 Korean intonations in this field are limited, with no previous research investigating the disambiguation of wh-indeterminate questions in the U.S. academic context. This study aims to address this gap by analyzing the prosodic features identified in previous studies as key to distinguishing wh-questions and yes-no questions. By conducting production and perception tests with English learners of Korean in the U.S. academic context, this study seeks to provide important insights into how their language background as well as L1 English influence Korean intonation patterns in producing and perceiving ambiguous questions.

Chapter 3: Research Questions

Given the limited scope of existing research on L2 Korean, there is a significant gap in our understanding of how English learners of Korean manage to disambiguate wh-questions and yes-no questions with target-like prosody. This study is designed to delve into this underexplored area by addressing three pivotal research questions:

1. Are L2 Korean speakers with English L1 able to produce wh-questions and yes-no questions with target-like intonation patterns?
    a. Is it target-like with respect to accentual phrasing?
    b. Is it target-like with respect to F0 peak on question word?
    c. Is it target-like with respect to boundary tone?
    d. Can L1 speakers distinguish wh-questions from yes-no questions?
2. Are L2 Korean speakers with English L1 able to disambiguate the wh-questions and yes-no questions?
3. Is there evidence of L1 influence on learners' understanding and use of wh-questions and yes-no questions?

Chapter 4: Methods

This section outlines the detailed procedures for data collection, which include the recruitment of participants, the criteria for participant selection, the methodologies applied for the production and perception test, as well as a description of the stimuli used. The objective is to offer a comprehensive overview of how the study was conducted to ensure the transparency of the research process.

4.1 Participants

L2 Korean Learners

Participants (n=5) for this study were recruited from a U.S. university that offers Korean language courses as part of its World Languages Program. Eligible participants included students who had completed at least one semester of a Korean language course at the respective university or through a study abroad program, or who were enrolled in a Korean course at the time of recruitment. All participants are U.S. nationals and speak English as their L1. Recruitment methods included outreach through the Korean Student Association, observations in the third-year Korean course in Fall 2023 under the instructor's permission, as well as personal acquaintances within the university.

During the recruitment process, participants were informed that the purpose of the study was to investigate intonation differences between L1 and L2 speakers of Korean. However, the specific objectives of the study were not revealed until after tests were completed. Initially, there was no proficiency criteria at the time of recruitment and data collection; the requirement was that participants had completed at least one semester of a Korean language course. A total of six people were recruited and participated in the data collection. However, it later became clear that a minimum of intermediate proficiency

was needed for this study. Consequently, data from one participant (P6), a beginner-level learner with one semester in the first-year Korean course, were excluded from the final analysis.

L1 Raters

L1 Korean speakers were recruited to rate the production of wh-questions and yes-no questions by L2 Korean learners. The recruitment of L1 listeners was through personal connections. Potential participants received an invitation to participate in the research via direct messages on KakaoTalk, a mobile messaging app in South Korea. A total of 17 L1 Korean speakers participated in the L1 listeners' judgment. Of these, 16 participants were residents of Seoul/Gyeonggi (suburb of Seoul) who speak Seoul Korean, and one participant was an exchange student at a research university at the time of recruitment.

4.2 Pre-test Survey

All participants were asked to complete a pre-test survey about their language background information. This survey was distributed and conducted fully online via Qualtrics, a survey platform affiliated with the institution where the research was conducted. A link to the survey was sent to participants approximately 24 hours prior to the study. The survey posed questions regarding participants' background in the Korean language, including the duration of formal instruction received, their self-rated proficiency, and study abroad experience. The information collected was used to support the findings of the production and perception tests. Although all participants self-rated their proficiency as intermediate-level, the researcher classified two participants (Adv1,

Adv2) as advanced-level during the pre-test stage. This was because their vocabulary use as well as speaking fluency were sufficient to distinguish them from the other participants. The survey questions can be found in Appendix A. The overview of the language background information of the participants are provided in Table 1.

Table 1.

Language Background Information of Study Participants from a Pre-test Survey

ID	Age	Course level	Duration of Study	Duration of Formal Instruction	Study Abroad	Korean Speaking Outside Class	Korean Listening Outside Class
P1 (Int1)	20	3rd year	4 years	3 years	-	A little	A moderate amount
P2 (Adv1)	29	-	12 years	6 years	1 year	A moderate amount	A great deal
P3 (Adv2)	21	-	6 years	3 years	-	A lot	A lot
P4 (Int2)	22	3rd year	4 years	3 years	-	None at all	A moderate amount
P5 (Int3)	20	3rd year	3 years	3 years	-	A little	A little

Note. Participant IDs were labeled by proficiency level in parentheses, and participants are referred to by this label throughout the paper.

4.3. Production Test

4.3.1 Stimuli

In this study, 8 sets of wh-indeterminate sentences were selected as test stimuli. Each set included one wh-question and one yes-no question that shared the same syntactic structure. This resulted in a total of 16 dialogues (8 wh-questions and 8 yes-no questions). The stimuli include four types of wh-indeterminate: *who*, *when*, *where*, and

what. Each wh-indeterminate was represented twice in stimuli. Of the 8 sets of stimuli, some were obtained from An (2022) and some were specifically created to meet the selection criteria for this study. Detailed information about these stimuli can be found in the Appendix B. Table 2 illustrates the four wh-indeterminate words that serve as both wh-interrogative and wh-indefinite in Korean.

Table 2.

Korean Wh-indeterminates Selected for the Study

	누구	언제	어디	무엇 (뭐)
wh-interrogative	who	when	where	what
wh-indefinite	anyone	any time	anywhere	anything

When developing the selection criteria for the study's stimuli, several key factors were taken into consideration for consistency: (1) all sentences are composed of three parts (adverbial phrase, question word, and verb phrase); (2) the question word is positioned as the second word in the sentence and is followed by a verb phrase; and (3) the verb phrase must consist of at least three syllables. These criteria ensure that the wh-phrases (comprising the question word and verb phrase) in the stimuli have a minimum of four syllables, which is necessary for the canonical THLH pattern where intonation is located to indicate the question type. The complexity of the vocabulary used was another consideration. In order to ensure that all participants understand them, the sentences were deliberately composed using simple tenses with basic verb conjugations and elementary-level vocabulary.

4.3.2 Procedure

The data collection took place one-on-one in a private study room at the university library where participants attended. Each participant spent about 20 minutes completing both tests. At the pre-test stage, all participants were verbally informed of the purpose of the research. Before signing the consent form, they were told that they could withdraw at any point of the test. For audio recording, a Zoom H4n Pro recorder with built-in microphones was used for the primary recording device. The audio was recorded in stereo onto an SD card at a 48kHz sample rate. As a secondary measure, an iPhone 13 microphone was used as a backup to ensure that no audio data was lost during the recording process. However, only recordings from the main device were used for acoustic analysis in the study.

In the production test, participants were presented with 15 randomized dialogues on a piece of paper. This included 10 stimuli consisting of ambiguous wh-questions and yes-no questions and 5 non-ambiguous wh-indeterminate questions with morpho-syntactic clues, which served to distract participants from recognizing wh-indeterminate questions during the test. Each dialogue included an answer for either wh-questions or yes-no questions, which is an indicator of what type of wh-indeterminate question it was. Table 3 shows the list of dialogues used in the production test. The participants were instructed to read the dialogues aloud for recording purposes. To facilitate a better understanding of the context for each conversation, all participants were given a 5-minute period to review the dialogues and to ask any questions about vocabulary in the stimuli.

Table 3.

List of Dialogues Used in the Production Test

Wh-questions	Q: 점심에 **뭐** 먹었어요?	A: 김밥 먹었어요.
	What did you eat for lunch?	I ate Kimbap
	Q: 휴가 **언제** 가세요?	A: 다음주에 가요.
	When are you going on vacation?	I'm going next week
	Q: 민형이 **언제** 만났어요?	A: 어젯밤에 만났어요.
	When did you meet Minhyeong?	I met him last night
	Q: 선생님 **어디** 가셨어요?	A: 교무실에 가셨어요.
	Where did the teacher go	They went to the teachers' office
	Q: 오늘 **누구** 만나요?	A: 저녁에 민지 만나요.
	Who are you meeting today?	I'm meeting Minji tonight
Yes-no questions	Q: 내일 **어디** 가세요?	A: 네. 내일 학교 가요.
	Are you going **anywhere** tomorrow?	Yes, I'm going to school tomorrow
	Q: 방학에 **뭐** 할거예요?	A: 네. 부모님 집에 갈거예요.
	Are you doing **anything** during the break?	Yes, I'm going to my parents'
	Q: 교실에 **누구** 있어요?	A: 아니요, 아무도 없어요.
	Is there **anyone** in the classroom?	No, there's no one
	Q: 아침에 **뭐** 먹었어요?	A: 아니요, 배 안고파요.
	Did you eat **anything** for breakfast?	No, I'm not hungry
	Q: 민수 **언제** 만났어요?	A: 네. 저번주에 부산에서 만났어요.
	Did you meet Minsu (at) **any time**?	Yes, we met in Busan last week.
Distractors	Q: 이분은 누구세요?	A: 우리 엄마예요.
	Who is this person?	This is my mom
	Q: 이름이 뭐예요?	A: 저는 이민호 입니다.
	What is your name?	My name is Minho Lee
	Q: 생일이 언제예요?	A: 2 월 18 일이에요.
	When is your birthday?	It's February 18th
	Q: 민지씨는 어디 살아요?	A: 저는 경기도 살아요.
	Where do you live, Minji?	I live in Gyeonggido

	Q: 점심 언제가 좋아요?	A: 내일 괜찮아요.
	When is good for lunch?	Tomorrow is good

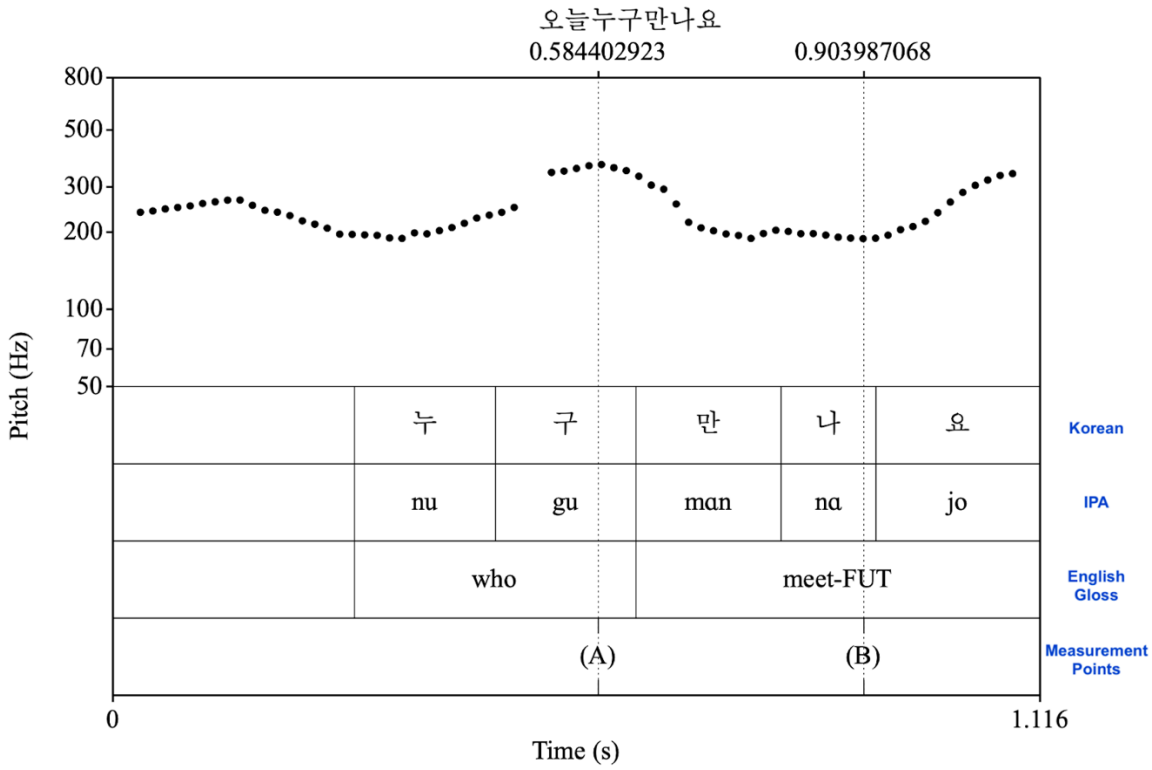
Once the data were collected, I extracted each focused sentence from the audio using Logic Pro for acoustic analysis. A computer software Praat (Paul, 2001) for speech analysis was used for all acoustic analyses in this study. Three prosodic features—accentual phrasing, F0 peak on question word, and boundary tones—were analyzed to determine the speakers' ability to disambiguate wh-questions and yes-no questions by prosody. In order to support the findings of the acoustic analysis from the production test, L1 Korean listeners' judgments were conducted. The listeners' judgment was conducted entirely online on Qualtrics. This will be discussed in detail later in the section.

Accentual Phrasing

In order to measure the accentual phrasing of wh-questions and yes-no questions, this study followed the frameworks of Jun and Oh (1996) and Yun and Lee (2022), focusing on three main elements: the time difference between the highest F0 of the wh-phrase and the lowest F0 of the wh-phrase following (Jun & Oh, 1996), the absence of the L tone in the first post-wh syllable and the lowest F0 in the rest of the AP (Yun & Lee, 2022). First, all data underwent the same annotation process using Praat. As seen in Figure 3, each sentence was segmented into syllables in both Korean and the International Phonetic Alphabet (IPA), with an English gloss added for clarity. The annotation process also involved marking the highest F0 of the wh-phrase and the lowest F0 following it, to facilitate the analysis of accentual phrasing.

Figure 3.

The Example of Annotation for Accentual Phrasing



Note. The sentence used in the example is "***Who*** are you meeting tomorrow?"

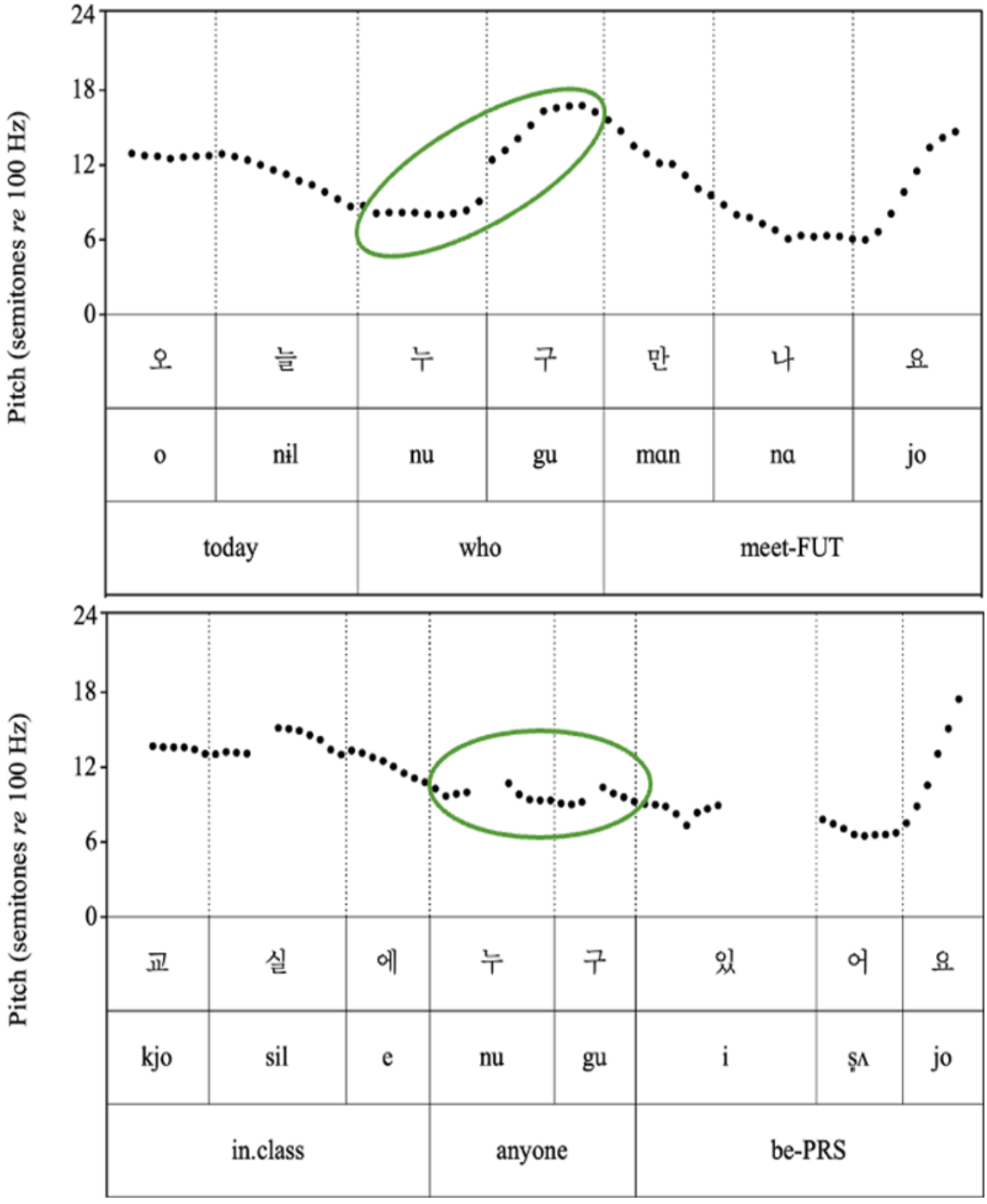
Once the annotations were completed, the time difference between A (the highest F0 of the wh-phrase) and B (the lowest F0 following A) was analyzed and compared to identify accentual phrasing of each question type. For the post-wh L tone, the L tone was annotated as 'present' if B was placed in the first post-wh syllable, and as 'absent' if B did not occur in the first post-wh syllable but appeared later. In this example, the L tone is in the second syllable post-wh, so it would have been coded as absent. The F0 value on the L tone (B) was then measured to find any differences between wh-questions and yes-no questions as well as among participants.

F0 Peak on Question Word

To investigate the F0 peak on the question word in wh-questions, both the mean and maximum F0 values on the question word were measured for comparison. Additionally, the pitch track of each sentence was analyzed to assess the pitch peak of the question word in the pitch contour. For the intonation contours, settings were adjusted to a semitone scale of 100Hz, with a range from 0 – 24 Hz, in order to represent pitch in the way it is perceived by speakers (Hart, Collier & Cohen, 1990). For the question word 'what/anything,' which is the only one-syllable question word, the first post-wh syllable was measured and selected for comparison. Figure 2 demonstrates F0 drawings of wh-questions and yes-no questions with annotations.

Figure 4.

Comparison of F0 peak on Wh-questions vs. Yes-no Questions

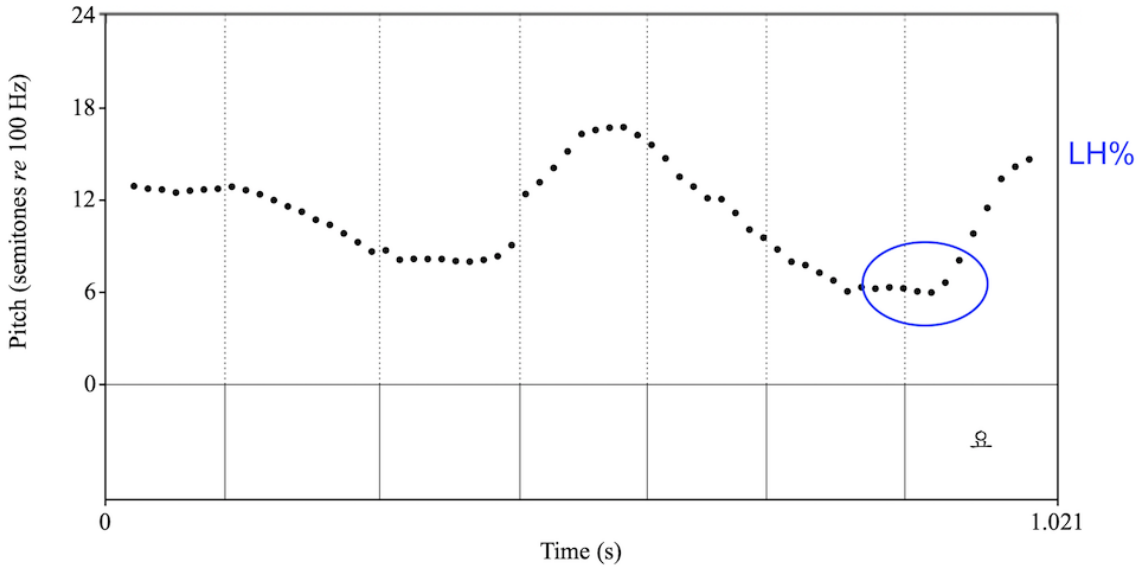


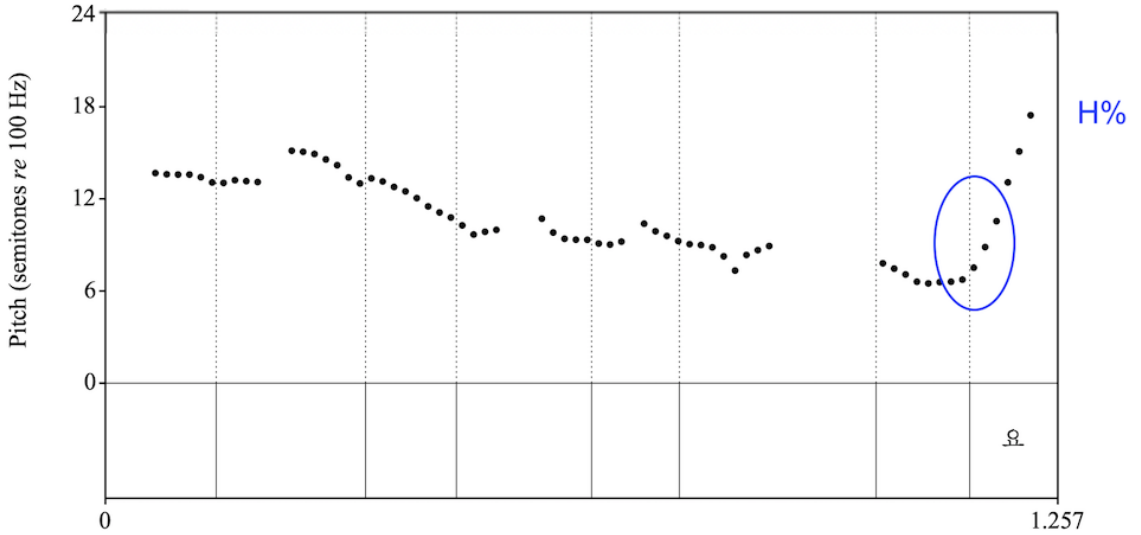
Boundary Tones

This study examined sentence-final intonation choices for each question type across participants, following the framework of Jun and Oh (1996). The analysis focused on the question marker "요[jo]", which is also the final syllable of all stimuli. Syllable boundaries were initially determined based on a spectrogram in Praat, with auditory judgment used as a secondary factor when necessary. The boundary tone was marked according to the eight boundary tones of intonational phrases in K-Tobi. It was marked as LH% if the question marker starts with a plateau or a L tone then rises to a H tone halfway through the syllable, and H% if the question marker didn't show any signs of L tone and the pitch only increased all throughout.

Figure 5.

Comparison of Boundary Tones in Wh-questions vs. Yes-no questions





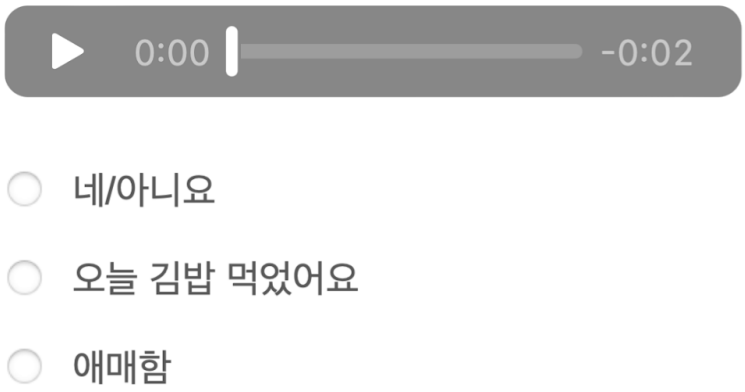
L1 Korean Listeners' Judgment

To evaluate whether L2 Korean speakers produce and disambiguate wh-indeterminate questions in a target-like manner, L1 Korean listeners' judgment was conducted to support the findings of acoustic analysis. This judgment used the same test

format as the L2 perception test but featured 10 audio recordings of the study participants obtained from the production test. Two recordings from each participant were selected for evaluation. The test was conducted entirely online using Qualtrics. L1 raters were provided a link to the survey via email.

Figure 6.

Example of L1 Listeners' Judgment



Before the test began, the L1 listeners were given the written background information on the research topic. The information described that wh-questions and yes-no questions can have the same syntactic structure in Korean. An example dialogue containing one wh-question and one yes-no question was provided with the explanation that the disambiguation of two sentences is through prosodic cues. However, the specific prosodic cues were not revealed for naturalistic reading of the audio. The test included a total of 10 questions, consisting of five wh-questions and five yes-no questions. L1 listeners were given three choice answers, one for wh-question, one for yes-no question, then an additional option to choose "ambiguous" if they were not able to identify the question types.

4.4. Perception Test

4.4.1 Stimuli

For the L2 perception test, 10 sentences from the production stimuli were selected. The audio was recorded by two L1 Korean speakers who are native to Seoul. All four wh-interminate words (*who, when, where, what*) were included for both wh-questions and yes-no questions. To examine consistency in response to identical syntactic structures with prosodic differences, two pairs of wh-questions and yes-no questions were included. In addition, there was one pair that shared the same syntactic structure in wh-phrase but with one different noun in adverbial phrase (dinner vs. lunch). In order to prevent consecutive appearances of the same wh-indeterminate questions, a randomization manipulation was applied within Qualtrics.

Table 4.

List of Stimuli Used in the Perception Test

Wh-questions	저녁에 **뭐** 먹었어요? (**What** did you eat for dinner?)
	휴가 **언제** 가세요? (**When** are you going on a vacation?)
	오늘 **누구** 만나요? (**Who** are you meeting today?)
	방학에 **뭐**할거예요? (**What** are you doing during break?)
	선생님 **어디** 가셨어요? (**Where** did the teacher go?)
Yes-no questions	내일 **어디** 가요? (Are you going **anywhere** tomorrow?)
	점심에 **뭐** 먹었어요? (Did you eat **anything** for lunch?)
	교실에 **누구** 있어요? (Is there **anyone** in the classroom?)
	휴가 **언제** 가세요? (Are you going on a vacation **sometime**?)
	선생님 **어디** 가셨어요? (Did the teacher go **somewhere**?)

Note. Filled in cells are two pairs of stimuli that have been used twice both in wh-questions and yes-no questions.

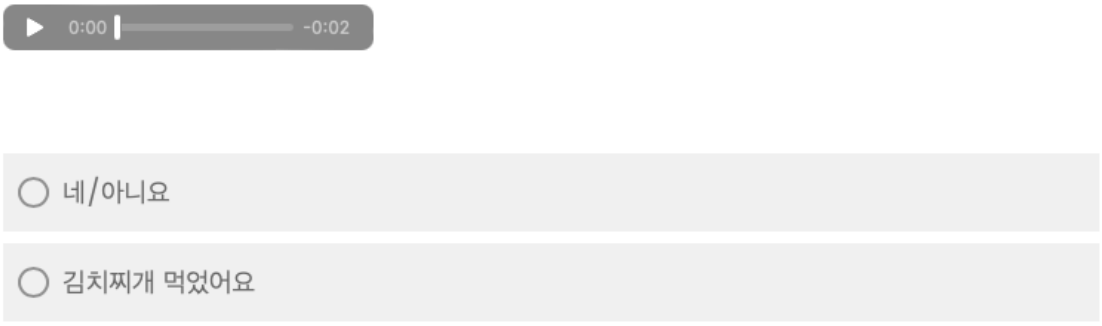
The final selection of stimuli was based on two specific criteria to ensure all participants understood the material: (1) All sentences were composed using simple tenses (present simple and past simple), and (2) All words used in the stimuli had previously appeared in the production test; this means that participants had the chance to ask questions during a 5-minute review period in the production test if there were any words they did not understand or were uncertain of.

4.4.2 Procedure

Participants were informed beforehand that the purpose of the perception test was to evaluate their ability to disambiguate wh-questions and yes-no questions based on prosodic differences. Neither the intonation patterns nor prosodic cues were disclosed until after the test. During the test, participants listened to each recording and were given two choices: one for wh-questions and another for yes-no questions. They were instructed to select the most appropriate answer. Additionally, it was specified that each audio recording could be played up to two times.

Figure 7.

Example of Perception Test



The perception test was conducted online using laptops provided by the researcher. Before the test began, participants were required to enter their full name and were informed that they had 10 minutes to complete the test. The test consisted of five wh-questions and five yes-no questions with only one question displayed on the screen at a time. The stimuli were automatically randomized on Qualtrics under the manipulation that the identical sentences do not follow one another; each participant had a different order of questions.

Chapter 5: Results

5.1 Production Test

Accentual Phrasing

To answer my first research question whether L2 Korean speakers can produce wh-questions and yes-no questions in a target-like manner with respect to accentual phrasing, Table 5 shows the mean time difference (ms) between two measurement points, A (peak F0 of the wh-phrase) and B (the lowest F0 after the peak), used for accentual phrasing. Jun and Oh (1996) reported that the time difference A-B in yes-no questions was "significantly shorter" (p. 49) than wh-questions for L1 Korean speakers. Their study showed that A-B difference in wh-questions was at least three times longer than yes-no questions in all four participants.

In this study, all five participants exhibited a time difference between wh-questions and yes-no questions. However, the extent of this difference varied considerably among participants, showing no consistency that would allow any definitive pattern to be established. As table 5 shows, the overall mean time difference between the two question types across all participants was 8.4 ms, but it ranged broadly from -98 to 74 ms, which accounts for a total spread of 172 ms.

Table 5.

The Mean Time Difference (ms) between A (the peak F0 in wh-phrase) and B (the lowest F0 after the peak) of Wh-questions and Yes-no Questions.

	WHQ (SD)	YNQ (SD)	Difference
Int1	372 (205.08)	418 (188.09)	46
Int2	220 (75.10)	294 (130.17)	74
Int3	420 (53.54)	450 (134.35)	30

Adv1	550 (189.34)	452 (240.20)	-98
Adv2	320 (54.55)	312 (52.59)	-8
Total	**376.80 (121.94)**	**385.20 (76.51)**	**8.4**

In order to determine whether the overall mean time difference between wh-questions and yes-no questions produced by L2 Korean speakers showed any significant differences, a paired sample t-test was conducted. The statistical analysis yielded a t-Statistic of -0.281, with a corresponding p-Value of 0.792. This indicates that the mean time difference between the two question types is not statistically significant at the conventional alpha level of 0.05. This result suggests that L2 Korean speakers and they were not able to disambiguate two questions in terms of the time difference (ms) determining the correct accentual phrasing for each question in their production of questions.

Table 6.

Paired t-Test Results for the Mean Time Difference for Wh-questions and Yes-no Questions

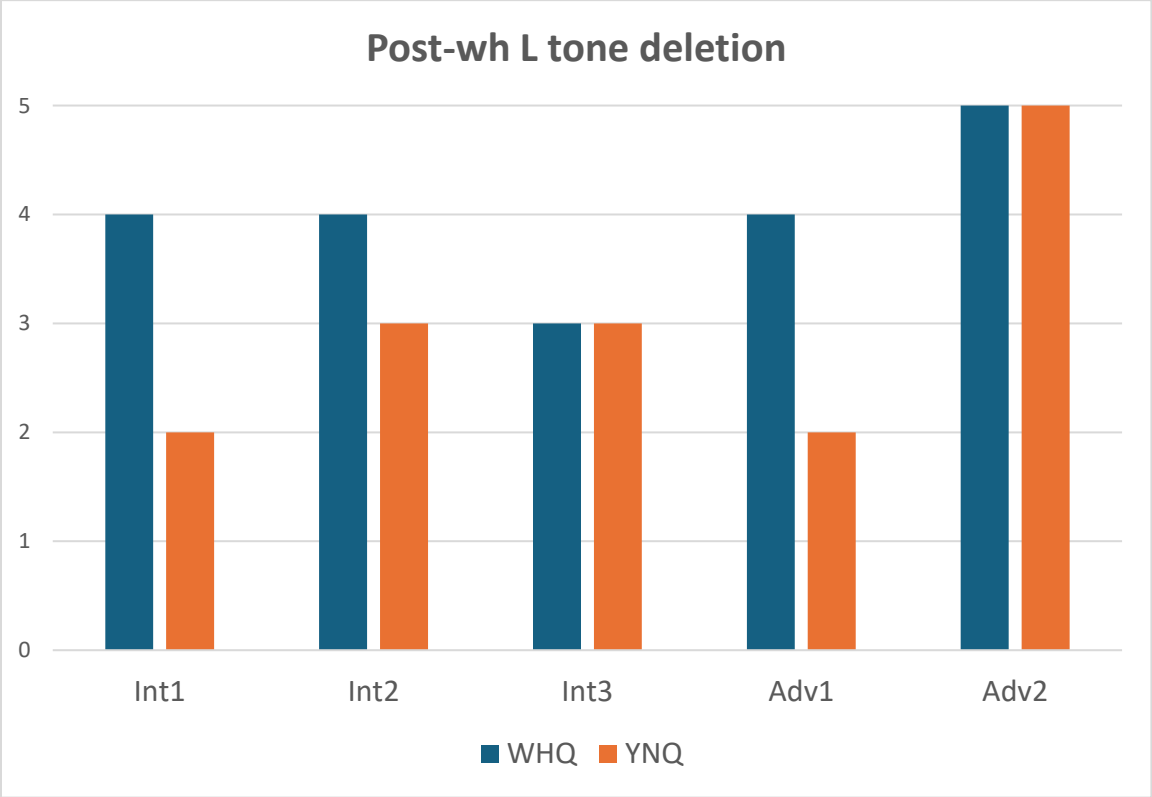
	Wh-questions	*Yes-no questions*
Mean	376.8	385.2
Variance	14869.2	5853.2
Observations	5	5
Pearson Correlation	0.871550979	
Hypothesized Mean Difference	0	
df	4	
t Stat	**-0.281227582**	
P(T<=t) two-tail	**0.792483972**	
t Critical two-tail	**2.776445105**	

In addition, post-wh L tone deletion was observed. Figure 8 shows the frequency of L tone deletion on the first post-wh syllable across both question types from five participants. According to Yun and Lee (2022), the first post-wh syllable in yes-no questions was almost always marked with an L tone, while in wh-questions, it was absent 73% of the time for L1 speakers of Korean. They also reported that the F0 value on the L tone was slightly higher in yes-no questions.

In this study, the first post-wh syllable was rarely realized with an L tone in either type of question; instead, it was predominantly characterized by L tone deletion, especially in wh-questions, with 84% of participants showing L tone deletion across all questions. This suggests that learners of Korean were able to produce wh-questions in a target-like manner in terms of this aspect of accentual phrasing. However, they often retained the same tonal pattern in their production of yes-no questions as in wh-questions. This indicates that the production of yes-no questions was non-target-like.

Figure 8.

The Frequency of the First Post-wh Syllable Marked by L Tone Deletion in Wh-questions and Yes-no Questions



For instance, all participants omitted L tone at least twice out of five attempts in their production of yes-no questions. This also includes one advanced learner (Adv1) who exhibited target-like production more frequently in their yes-no questions compared to other participants. Another advanced learner (Adv2) had post-wh L tone deletion in all their productions; their production showed the characteristics of wh-questions in all instances. Overall, the subtle differences in the frequency of L tone deletion between the two question types present a notable contrast with L1 Korean speakers. Therefore, the results indicate that L2 Korean speakers do not consistently place the L tone in wh-phrases in a target-like manner, especially in yes-no questions. The information on the

frequency of the L tone on the first post-wh syllable in each question is provided in Table 7.

Table 7.

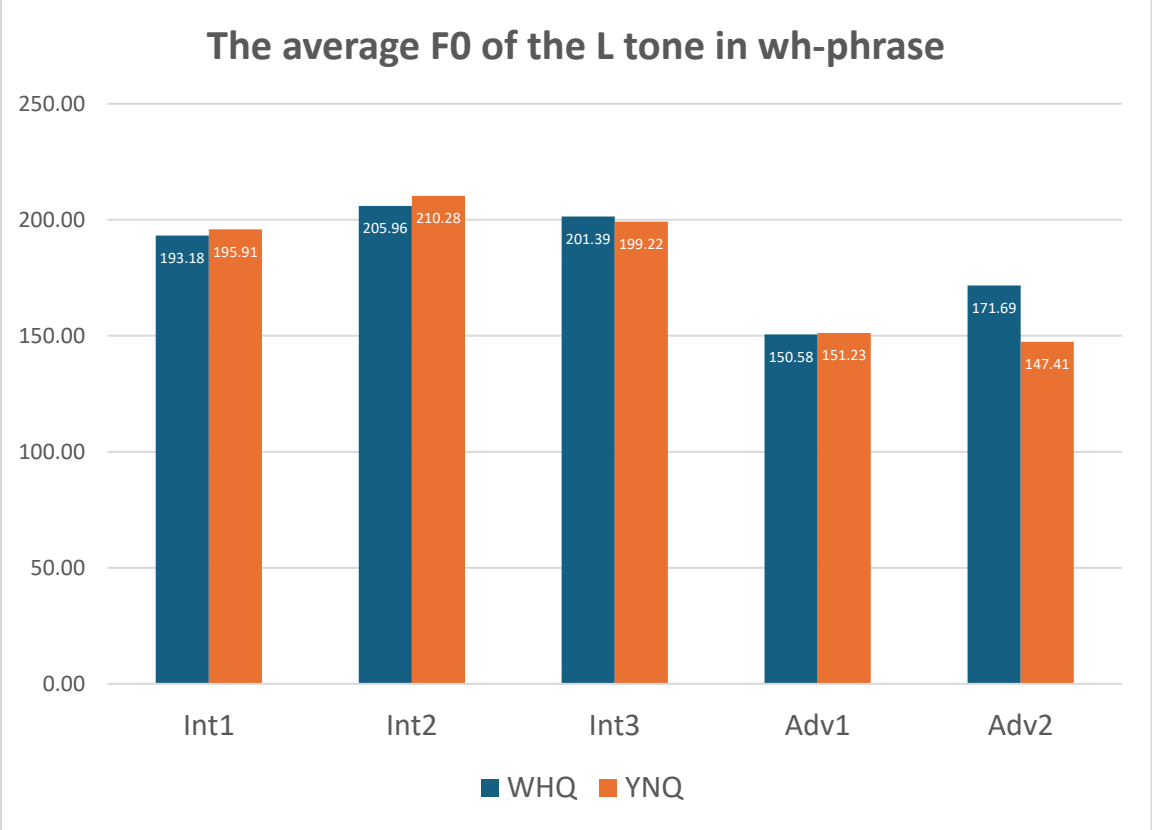
The Frequency of the L Tone on the First Post-wh Syllable in Wh-questions and Yes-no Questions

Post-wh L tone	WHQ	YNQ
Present	16% (4/25)	40% (10/25)
Absent	**84% (21/25)**	**60% (15/25)**

Lastly, the mean F0 value on the post-wh L tone was analyzed and compared between two question types across participants to determine whether they present phonetic differences. Figure 9 below demonstrates the mean F0 value for L tone realization in wh-phrases for each participant. The difference in F0 value between question types are very minimal for all participants except Adv2, and L tone for yes-no questions had a higher pitch than wh-questions in 60% of the participants. It is also notable that two participants (Adv1, Adv2) who are both advanced learners have much lower L tone value in general compared to participants (Int1, Int2, Int3) who are intermediate learners.

Figure 9.

The Average F0 of the L Tone (Hz) in Wh-questions and Yes-no Questions



Overall, the analysis of the average F0 value in the post-wh L tone revealed that there was very little variation in the L tone between two question types for all participants except one (Adv2). Like Adv2, one other participant displayed target-like L tone values with lower pitch in yes-no questions, but it was a minimal difference of 2.16 Hz. Therefore, Adv2 was the only participant to exhibit a distinct difference in F0 between two question types, with a 24.28 Hz difference. As a result, the data indicate that the majority of L2 Korean speakers did not produce the L tone in wh-phrases in a target-like manner and were not able to disambiguate wh-questions and yes-no questions.

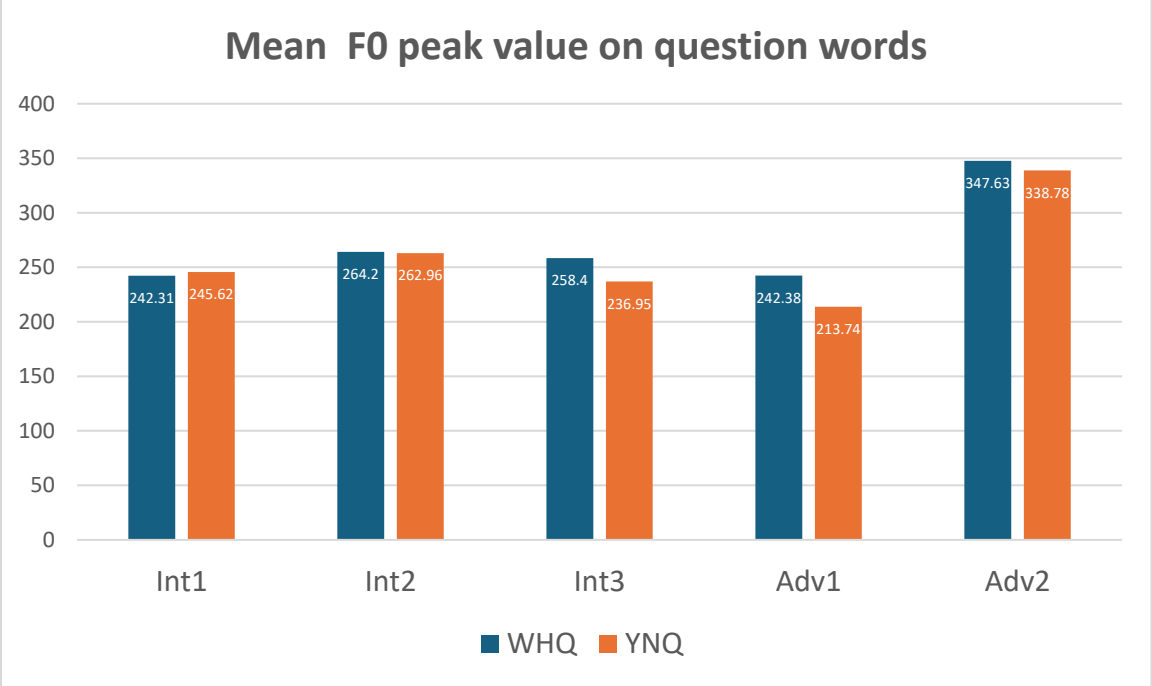
F0 Peak on Question Words

To address the first research question with respect to the F0 peak on question word in wh-questions, Figure 10 illustrates the mean F0 peak values for question words used in both wh-questions and yes-no questions. Yun and Lee (2022) observed that all their participants exhibited pitch peak on the question word in wh-questions. Additionally, their results indicated a tendency for a greater pitch difference on the question word among female speakers, with wh-questions showing higher pitch peak on question word than yes-no questions.

Our study revealed that all five speakers had the tendency of slightly lower F0 peaks on question word in yes-no questions, except for one participant (Int1). To further investigate these variations, a paired t-test was conducted on the mean F0 peak values between wh-questions and yes-no questions. Despite the observed differences, the analysis did not reveal a statistically significant difference in peak F0 on question word between two question types at the 0.5% significance level ($t(4) = 1.87$, $p = 0.135$) among L2 Korean speakers.

Figure 10.

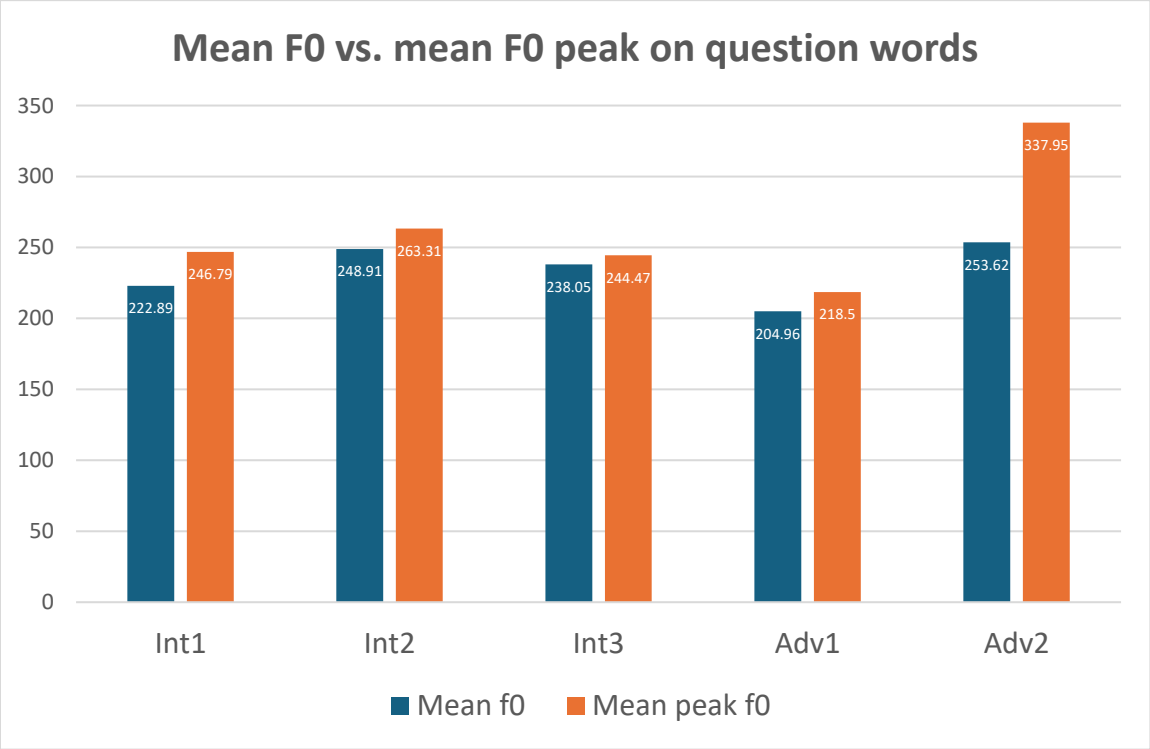
Mean F0 Peak Value on Question Word for Wh-questions and Yes-no Questions



Speakers also had varying F0 values, showing overall inconsistency with their maximum F0 value. The advanced Korean speaker (Adv2) showed target-like production in terms of pitch peak on question word in wh-questions. They presented a much higher pitch value on question word (roughly 33% increase in comparison to their mean F0 value across stimuli), which was never realized by other participants. Other participants' increase ranged only between 2.70% - 10.72%. Figure 11 depicts mean F0 peak value on question words by question types, highlighting the highest value from Adv2. However, this participant consistently used question word peak in both wh-questions and yes-no questions. This resulted in all their responses sounding like wh-questions.

Figure 11.

Mean F0 vs. Mean F0 Peak Value on Question Word for Wh-questions and Yes-no Questions



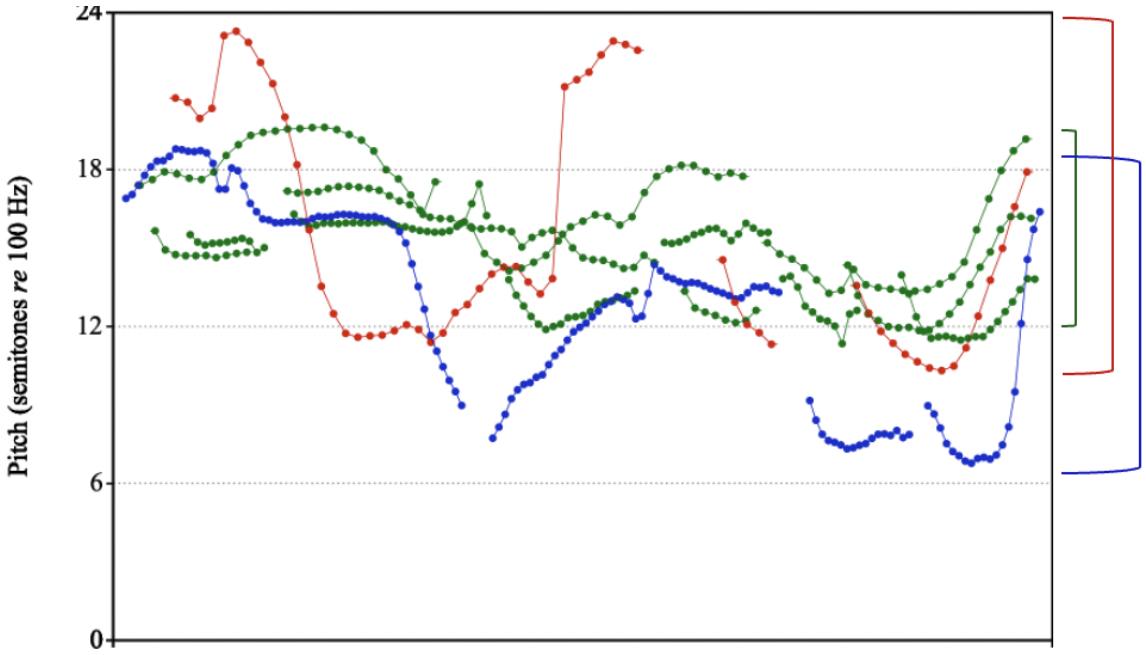
Another notable observation was that all intermediate participants (n=3) exhibited less fluctuation in their overall pitch range across sentences. The intonation contours of all questions produced by these intermediate-level participants were characterized by a very limited pitch range. This pattern appears to be common among intermediate learners with no study abroad experience and the limited exposure to the Korean language outside of classroom settings. In contrast, both L1 speakers and advanced learners demonstrated clear pitch contours on question in their productions.

To illustrate the example of differences in range of pitch, I selected one sample question that was representative of the range differences among participants. Figure 12 depicts the pitch tracks of the same stimulus by all five participants. It particularly

illustrates the variation in pitch range according to their proficiency in Korean. Two advanced learners, red and blue, demonstrated dynamic pitch contours with ranges of 6 - 18 semitones (blue) and 12 - 24 semitones (red). Despite potential individual differences in vocal range, both advanced learners showed a very similar pitch range of approximately 12 semitones. In contrast, three intermediate learners (all green) exhibit a narrower pitch range of 6 semitones in total (12 - 18 semitones). Thus, the pitch range of advanced learners is twice as great as that of intermediate learners.

Figure 12.

Pitch Contour Differences by Advanced Learners and Intermediate Learners for "When are you going on vacation?"



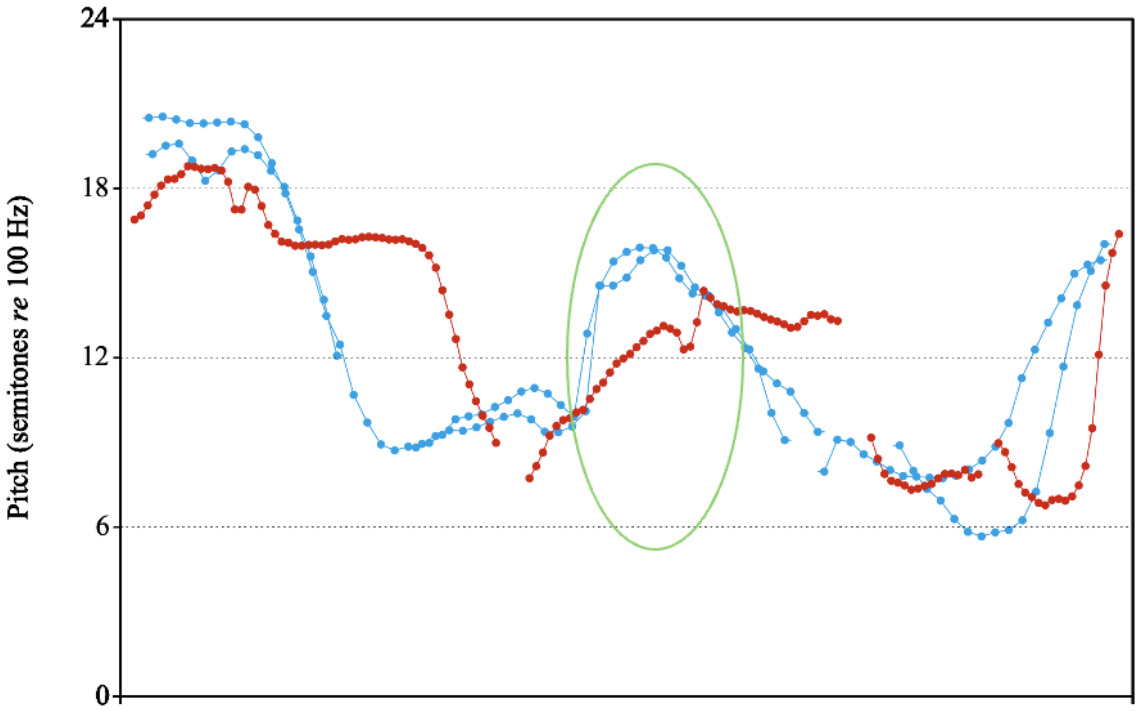
Note. Green: Int1, Int2, Int3, Blue: Adv1, Red: Adv2. Pitch contour was based on range in semitone (re 100Hz) frequency range (st) set at 0 - 30.

The difference in pitch range by language proficiency became more evident when the pitch track of an advanced-level learner (Adv2) was compared with that of L1 Korean

speakers. Two L1 speakers from a pilot study exhibited nearly identical pitch contours, each ranging from 6 to 20 semitones, approximately 18 semitones in total. Notably, the pitch contours of these three speakers showed a distinct increase in pitch in the middle of the sentence (circled), emphasizing the pitch peak of the question word. This difference in pitch range between advanced and intermediate learners suggests that intermediate learners do not achieve target-like F0 peaks on the question word in wh-questions, nor do they replicate the overall pitch contour of wh-questions and yes-no questions as accurately as more proficient speakers.

Figure 13.

Pitch Contour Differences between Adv2 and Two L1 Korean Speakers for "When are you going on vacation"?



Note. Red: Adv2, Cyan: two L1 Korean speakers. Pitch contour was based on range in semitone (re 100Hz) frequency range (st) set at 0 - 30.

Boundary Tones

To answer the first research question with respect to boundary tones, the analysis revealed that English learners of Korean are non-target-like in their production of yes-no questions. Remember that Korean boundary tones have LH% for wh-questions and H% for yes-no questions. Table 8 demonstrates the boundary tone choices for each wh-indeterminate question from five participants. It shows that participants have the tendency to use either H% or LH% in sentence-final intonation in both questions. No other types of boundary tones occasionally observed among L1 speakers in the previous study (HL%, HLH%) were observed in this study.

There was a strong consistency in the choice of boundary tone for both wh-questions and yes-no questions. LH% was predominantly observed across participants and question types. LH% was recorded 80% of the time in wh-questions and 92% in yes-no questions; in total, it occurred 86% (43/50) of the time. While H% was observed more frequently in wh-questions, the overall instances were very few, which shows the participants' strong preference towards LH%.

Table 8.

Boundary Tone Choices for Each Wh-indeterminate Question Across Participants

Wh-questions					
Target-like: LH%					
Int1	LH%	LH%	LH%	LH%	LH%
Int2	LH%	LH%	LH%	LH%	LH%
Int3	LH%	LH%	LH%	LH%	LH%
Adv1	H%	H%	H%	LH%	H%
Adv2	LH%	LH%	LH%	H%	LH%

Yes-no questions					
Target-like: H%					
Int1	LH%	LH%	LH%	LH%	LH%
Int2	LH%	LH%	LH%	LH%	LH%
Int3	LH%	LH%	LH%	LH%	LH%
Adv1	LH%	H%	LH%	H%	LH%
Adv2	LH%	LH%	LH%	LH%	LH%

Note. The filled in cells indicate target-like production with respect to boundary tone for each question type.

The preference of boundary tone choice did not vary much except for one participant (Adv1), an advanced learner with study abroad experience in Korea for one academic year. Adv1 used H% most frequently in their production, accounting for 85.7% (6/7) of the H% tone usage all across. Another advanced learner (Adv2) used both H% and LH%, but they showed a preference towards LH% in addition to pitch contour of wh-question in all productions. Conversely, the intermediate learners (n=3) who were enrolled in third-year Korean at the time of data collection showed a consistency in their preference for boundary tone LH% all across their production regardless of the question type.

L1 Korean Listeners' Judgment

The last method used to determine the target-like nature of the L2 Korean speakers question production was to ask Korean L1 speakers to give their interpretation of L2 speaker production. Table 9 depicts the result of L1 listeners' judgment rating on wh-questions and yes-no questions produced by the L2 speakers. Among 10 speech data, two (Q4, Q11) were rated as target-like from all L1 raters. One (Q6) received a 'target-

like' rating from 16 raters (94% accuracy). All three speech data were wh-questions. From 170 answers collected, 17 responses were rated as "ambiguous", which takes up 10% of the total answers. The results showed evidence that the L2 speakers' production of wh-indeterminate questions were target-like for wh-questions but non-target-like for yes-no questions.

Table 9.

Total % of Rating for 'Target-like' and 'Ambiguous' for Each Question

	Q1 WHQ	**Q2 YNQ**	**Q3 YNQ**	**Q4 WHQ**	**Q5 YNQ**	**Q6 WHQ**	**Q7 YNQ**	**Q8 WHQ**	**Q10 YNQ**	**Q11 WHQ**
Target-like	53%	**53%**	18%	**100%**	18%	**94%**	6%	47%	6%	**100%**
Ambiguous	12%	-	24%	-	12%	6%	24%	12%	12%	-

Note. Bold cells indicate higher frequency of results.

Table 10.

Distribution of Overall Judgment of Question Type and % Accuracy rate

	Judgment of Question Type	**% Accuracy Rate**
Wh-question	82.35%	78.80%
Yes-no question	17.65%	20.00%
Ambiguous	10%	-

The answers for the remaining seven questions varied across listeners, with significantly lower accuracy rate for yes-no questions. Two wh-questions (Q1, Q2) had correct responses of 53% and 47% while four yes-no questions were mostly responded as wh-questions with only 6% and 18% of accurate choice. There was one instance of yes-no question where more than 50% of the listeners agreed, and the speaker of this recording was an advanced learner (Adv1) with study abroad experience. Overall, listeners' judgment revealed that both judgment of question type and % of accurate

choice were much higher for wh-questions as yes-no responses were chosen only 18% of the time with 20% accuracy rate.

5.2 Perception Test

To address my second research question whether L2 Korean speakers with English L1 are able to disambiguate wh-questions and yes-no questions, table X shows the L2 speakers' perception test outcomes. Overall, the accuracy rate for wh-questions was significantly higher at 96%, with 24 out of 25 questions answered correctly. In contrast, the accuracy rate for yes-no questions was considerably lower, at only 8%, with just two correct responses out of 25 questions. This indicates that L2 speakers tended to hear most questions as wh-questions.

Table 11.

Answer Sheet of the Perception Test for Wh-questions and Yes-No Questions by L2 Korean Speakers

	Wh-questions					**Yes-no questions**				
Int1	O	O	O	O	O	X	X	X	X	X
Int2	O	O	O	O	O	X	X	X	X	X
Int3	O	O	O	X	O	X	X	X	O	X
Adv1	O	O	O	O	O	X	O	X	X	X
Adv2	O	O	O	O	O	X	X	X	X	X

Note: Filled in cells with "O" represent correct answers and "X" indicate incorrect answers.

This answer choice by the participants shows a substantial disparity. For instance, wh-questions were selected as the answer 94% of the time. On the other hand, yes-no questions were chosen only 6% of the time, amounting to just 3 out of 50 responses. The

low frequency and accuracy rate of yes-no questions suggest that this option was not only rarely chosen by participants but also frequently incorrect.

Table 12.

A Frequency of Question Types Chosen and Accuracy Rate from the Perception Test

	Question Types Chosen	**% Accuracy Rate**
WHQ	94% (47/50)	96% (24/25)
YNQ	**6% (3/50)**	**8% (2/25)**

Overall, the perception test outcomes indicate that L2 speakers of Korean were able to correctly identify wh-questions with 96% accuracy. However, the results also suggest a strong bias toward wh-questions, based on the result that wh-questions were chosen as an answer 47 times out of 50 questions across participants. Yes-no questions, however, were rarely identified correctly by the L2 speakers. This leads to the conclusion that L2 Korean speakers are not able to disambiguate wh-questions and yes-no questions.

Chapter 6: Discussion

The purpose of this study was to examine the production and perception of wh-indeterminate questions by English learners of Korean in order to determine whether these learners can disambiguate wh-questions and yes-no questions using the appropriate prosodic cues. The findings indicate that L2 speakers of Korean are proficient at producing and perceiving wh-questions in a target-like manner, whereas yes-no questions were consistently non-target-like. Therefore, the result of the study suggest that L2 Korean speakers are not able to disambiguate wh-questions and yes-no questions.

Moreover, the study uncovered a strong preference for wh-questions among participants. This potential bias might be the result of L1 transfer from English due to the linguistic differences between Korean and English, particularly in terms of intonational patterns, the use of wh-indeterminate words, and variations in pitch range. The subsequent sections delve into the influence of L1 on each of the prosodic features investigated in this study in order to provide insights into the difficulties English learners of Korean may encounter and to discuss pedagogical implications for KFL teaching and learning.

6.1 Production Test

Accentual Phrasing

The result indicates that, despite the time differences between the measurement points (A-B) in wh-questions and yes-no questions participants exhibited, there was no correlation found between the time differences and question types for all five participants. This result contradicts the findings of Jun and Oh (1996), where the time difference in A-B was significantly shorter in yes-no questions. In their study, the

difference was at least three times longer in wh-questions for all their participants, which was not realized by any of the participants in our study.

Contrary to the hypothesis for L1 speakers of Korean that, H tone is on question word (usually the second syllable of the question word) for both question types and the following L tone is present on the first post-wh syllable in yes-no questions and absent in wh-questions, our data showed that L2 Korean speakers did not use L tone in the first post-wh syllable regardless of question types. This result contrasts with Yun and Lee (2022), where the first post-wh syllable was realized with L tone 90% of the time in yes-no questions and L tone was absent in 73.3% of the time in wh-questions.

In addition, Yun and Lee (2022) reported that the first post-wh syllable L tone was slightly higher in wh-questions than those in yes-no questions. Our study showed that only two participants were target-like, with a very minimal difference in pitch value overall. This means that the L2 Korean speakers in my study do not consistently produce the L tone in wh-phrases in a target-like manner to disambiguate wh-questions and yes-no questions. However, the result also revealed that advanced-level participants had considerably lower pitch on the L tone in wh-phrase in comparison to intermediate-level participants, which resembles L1 production.

This inconsistency in accentual phrasing suggests that L2 Korean speakers have not yet developed a Korean intonation pattern or its associated intonational meanings, which are necessary to distinguish wh-questions and yes-no questions. Unlike English, where the nucleus tone extends from the syllable with a pitch accent to the last syllable in the intonation phrase, Korean does not have pitch accents and instead places a nucleus tone, also known as a boundary tone, only on the last syllable of the intonation phrase

(Lee & Lee, 2013). Therefore, the inconsistency in L2 speakers' accentual phrasing might be L1 transfer due to the differences in intonation patterns between two languages.

It should also be noted that the varying L tone F0 value among participants is potentially influenced by their exposure to the Korean language outside the classroom. Two speakers with lower L tone values (Adv1, Adv2) reported significantly more exposure to Korean on a daily basis, choosing "a great deal" and "a lot," compared to other participants who selected little exposure overall. Both speakers also mentioned during the post-test interview that they have L1 Korean speakers in their life whom they regularly speak to. This suggests that the amount of exposure to the language could be correlated with developing more target-like prosodic features.

F0 Peak on Question Words

Yun and Lee (2022) reported that L1 Korean speakers had higher F0 peak value in wh-questions than yes-no questions "in all pairs across speakers" (p.15). While some instances of higher F0 peak on question words were observed among participants in my study, it was rather inconsistent. A paired t-test result suggests that the differences in F0 peak values between the two question types are not statistically significant, reinforcing the conclusion that L2 Korean speakers do not produce pitch peak on question word in wh-questions in a target-like manner.

There was one participant (Adv2) who showed target-like production in all wh-questions with clear pitch difference. While this participant does not have study abroad experience and has received formal instruction in Korean, the post-test interview revealed that the participant communicates in Korean on a daily basis at their workplace where most customers are Korean children. They said that they learned most of their Korean

from talking to L1 Korean speakers at work. However, this participant used the same intonation patterns for all question types thus was not able to produce yes-no questions in a target-like manner.

In addition, differences in pitch contour and pitch range were observed. The pitch contours of intermediate learners displayed a much narrower pitch range compared to both advanced learners and L1 speakers, whose contours showed pitch peak on question word and a wider pitch range. This pattern of a narrow pitch range among intermediate learners may be influenced by their language background. Yang (1996) reported that Korean speakers have higher fundamental frequencies than English speakers due to smaller vocal tracts. Lim et al. (2016) also noted that Korean speech generally has higher fundamental frequencies than English speech, partly because it lacks voiced consonants. Therefore, the narrower pitch range could be the result of L1 transfer as well as their limited exposure to the Korean language outside of classroom settings.

Boundary Tones

The findings of Jun and Oh (1996) and Yun and Lee (2022) revealed that H% boundary tone showed a statistically significant correlation with yes-no questions, highlighting it as one of the key prosodic cues for disambiguation of wh-questions and yes-no questions. Our result revealed that L2 Korean speakers used LH% at a 86% frequency and was able to show correlation between wh-questions and LH% However, they rarely used H% for either questions and ultimately were not able to differentiate two wh-indeterminate questions.

Their frequent use of LH% in yes-no questions might be influenced by L1 English, where low-rise intonation predominates in yes-no questions. (Hedberg, Sosa, &

Görgülü, 2017). Notably, H% was primarily used by one participant (Adv1), at an 85.7% rate, who showed a strong preference for H% in their sentence-final intonation. Among participants, Adv1 was the only one with study abroad experience for one academic year as an exchange student at a university located in Seoul. Therefore, their first-hand exposure to naturalistic Korean while attending the university courses during their stay might account for their strong bias towards H%.

L1 Korean Listeners' Judgment

Overall, L1 listeners' judgment revealed that wh-questions were rated as more target-like than yes-no questions. This suggests that L2 Korean speakers are more likely to produce yes-no questions as wh-questions, or that L1 Korean speakers are generally biased towards wh-questions. This aligns with the findings of Jun and Oh (1996), who observed a possible bias towards wh-questions in their listeners' judgments. They reported that responses to wh-questions were accurate, while incorrect answers to yes-no questions were frequently identified as wh-questions[3].

Consequently, the results of the L1 listeners' judgment showed that yes-no questions produced by L2 Korean speakers were often perceived as wh-questions, suggesting that L1 speakers were unable to disambiguate wh-questions and yes-no questions produced by L2 Korean speakers. This highlights the need for a pedagogical focus on the prosodic differences and intonational meanings of wh-indeterminate words in Korean.

[3] Jun and Oh (1996) compared three types of questions (wh-questions, yes-no questions, incredulity questions) , which makes the preference even more apparent.

6.2 Perception Test

The perception results demonstrated a strong preference and potential bias among L2 Korean speakers towards wh-questions. This suggests that English learners of Korean are inclined to perceive both wh-questions and yes-no questions as wh-questions, possibly due to L1 transfer from English. In English, direct wh-interrogative words are exclusively used for interrogative purposes, whereas in Korean, they can serve both interrogative and non-interrogative functions, such as indefinite readings (Yun, 2018). Additionally, while Korean typically places both wh-interrogative and wh-indefinite words at the beginning of sentences, English often positions wh-indefinites at the end. (e.g. Are you going **anywhere**?)These linguistic differences between Korean and English may lead English learners of Korean to perceive all Korean wh-indeterminate questions as wh-questions.

Chapter 7: Conclusion

The study explored how English learners of Korean distinguish ambiguous wh-questions and yes-no questions in Seoul Korean. The prosodic analysis revealed that L2 Korean learners are able to produce and perceive wh-questions more in a target-like-manner than yes-no questions. Our findings showed that learners' proficiency level played a significant role in pitch peak and range; advanced learners with the extensive exposure to the Korean language outside the classroom and study abroad experience showed a resemblance to L1 production. However, yes-no questions were considered non-target-like across all levels of learners. The results also indicate that there is evidence of L1 influence from English in their boundary tone choices as well as narrower pitch ranges. Another potential L1 transfer was inconsistency in accentual phrasing due to the distinct accentual phrase intonation pattern of Korean.

While the results of the study indicate the potential benefits of integrating targeted prosodic training within the curriculum for Teaching Korean as a Foreign Language, they come from a limited sample of just five participants. Therefore, a larger-scale study with a more diverse group of participants is essential to support these findings more definitively. Future research can investigate how learners of Korean with different L1s compare, in order to examine if an L1 speaker from a language with a similar prosodic phonology would be able to produce and perceive Korean questions more easily than L1 speakers of English. This will provide a more holistic understanding of intonation patterns of L2 Korean speakers. Another suggestion for future research is to focus on talk-in-interaction wh-indeterminate use to obtain more naturalistic data. This will help examine different contextual elements around wh-indeterminate questions and its

disambiguation in language-in-use. Due to the scarcity of research in L2 Korean, especially in wh-indeterminate questions, the field can benefit from more diverse research on this topic.

Footnotes

[1]Referred to as 'wh-words' (either wh-interrogative or wh-indefinite) in Jun and Oh (1996) and Yun and Lee (2022).

[2]K-ToBI (Korean Tones and Break Indices) is a prosodic transcription convention for a standard intonation system for Seoul Korean proposed by Jun (2000). The design principles of K-ToBI follow those of other ToBI systems and are based on the Autosegmental-Metrical theory of intonational phonology. This theory uses two tones, high (H) and low (L) to describe tonal units (Pierrehumbert, 1980).

[3]Jun and Oh (1996) compared three types of questions (wh-questions, yes-no questions, incredulity questions) , which makes the preference even more apparent.

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Appendix A

Pre-test Survey Questionnaire

The pre-test survey used in this study was designed to gather participants' language background information in Korean. The questionnaire includes questions related to participants' language learning history, self-assessed proficiency levels, and exposure to Korean. The list of questions can be accessed at the following link: Pre-test Survey Questionnaire

Appendix B

List of Stimuli

This appendix contains the list of stimuli used in the experiments of this study. The stimuli include sentences designed to test participants' understanding and production of prosody in wh-indeterminate questions in Korean.

	Wh-interrogative (wh-questions)	**Wh-indefinite (yes-no questions)**
누구 [nugu] (who/anyone)	(1) Q. 오늘 **누구** 만나요? (**Who** are you meeting today?) A. 저녁에 기숙이 만나요. (I'm meeting Gisuk tonight)	(2) Q. 오늘 **누구** 만나요? (Are you meeting **anyone** today?) A. 아니요. 집에 있어요. (No, I'll be home)
	(1) Q. 교실에 **누구** 있어요? (**Who** is in the classroom?) A. 선생님 있어요. (There is a teacher)	(2) Q. 교실에 **누구** 있어요? (Is there **anyone** in the classroom?) A. 아니요. 아무도 없어요. (No, there is no one)
어디 [ʌdi] (where/anywhere)	(1) Q. 내일 **어디** 가세요? (**Where** are you going tomorrow?) A. 내일 부산에 가요. (I'm going to Busan tomorrow)	(2) Q. 내일 **어디** 가세요? (Are you going **anywhere** tomorrow?) A. 네. 내일 학교 가요 (Yes, I'm going to school tomorrow)
	(1) Q. 선생님 **어디** 가셨어요? (**Where** did the teacher go?) A. 교무실에 가셨어요. (They went to the teachers' office)	(2) Q. 선생님 **어디** 가셨어요? (Did the teacher go **anywhere**?) A. 네. 점심 먹으러 가셨어요. (Yes. They went to have lunch.)
언제 [ʌndzɛ] (when/any time)	(1) Q. 민형이 **언제** 만났어요? (**When** did you meet Minhyung?) A. 어제 밤에 만났어요 (I met him last night)	(2) Q. 민형이(민수) **언제** 만났어요? (Did you meet Minhyung **(any time)**?) A. 네. 저번주에 만났어요. (Yes. I met him last week)
	(1) Q. 휴가 **언제** 가세요? (**When** are you going on vacation?) A. 다음주에 가요 (I am going next week.)	(2) Q. 휴가 **언제** 가세요? (Are you going on vacation **any time** soon?) A. 아니요. 이번에 아무데도 안가요. (No. We're not going anywhere this time)
무엇 (뭐) [muʌt (mwʌ)] (what/anything)	(1) Q. 점심에 **뭐** 먹었어요? (**What** did you eat for lunch?) A. 오늘 김밥 먹었어요 (I ate gimbap today)	(2) Q. 점심(아침)에 **뭐** 먹었어요? (Did you eat **anything** for lunch?) A. 아니요. 배 안고파요. (No. I'm not hungry)
	(1) Q. 방학에 **뭐** 할거예요? (**What** are you doing on break?) A. 여행 갈거예요 (I'm going on a trip)	(2) Q. 방학에 **뭐** 할거예요? (Are you doing **anything** on break?) A. 네. 부모님 집에 갈거예요 (Yes. I'm going to parents' house)