



## Korean University Students' Listening Comprehension and Learning Effects of Connected Speech Processes in English

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## Korean University Students' Listening Comprehension and Learning Effects of Connected Speech Processes in English\*

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The study examined the impact of connected speech process teaching on Korean EFL learners' listening comprehension based on a communicative framework. For such purpose, the study tested 31 Korean EFL learners' and 15 native English speakers' listening comprehension of connected speech processes of linking, vowel reduction/deletion, modal verb/*not* contraction, *h* deletion, and place assimilation. Specifically, the participants filled in the blanks after listening to the sentences containing the target phonological processes. After a pretest, the Korean EFL learners received 3 weeks' instructions on connected speech processes. The results indicated that the Korean EFL learners' listening comprehension was very poor compared to that of the native English speakers. However, there was a significant teaching effect on the learner's listening comprehension, although the effect was varied depending on the types of phonological processes. Further, the learners' performance was correlated with their general English listening scores. Based on the findings, implications for connected speech process teaching are drawn, along with discussions of

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L2 learners' phonetic/phonological representations.

### Keywords

connected speech, phonological processes, listening comprehension, teaching effects, variation in learning, phonological representation/ 연속 발화, 음운현상, 청해, 교수효과, 학습 변이성, 음운표상

## I. Introduction

Pronunciation modifications occur quite frequently in every day speech, especially in casual speech than in formal speech. For instance, function words tend to be reduced or may be lost as can be seen from the massive reduced form of “*because if* [k<sup>h</sup>zɪf]” (Johnson, 2004, p. 31) or the absence of *have* in “*Do you have time?* [dʒutɛm]” (Ernestus & Warner, 2011, p. 253). Likewise, even the pronunciation of content words can be modified due to the influence of adjacent sounds as in *hot cake* [hɑ:kkerk]. Johnson (2004) examined 88,000 word tokens uttered by 40 American English speakers in interviews. According to him, not only function words but also content words in the data show pronunciation variations in which segments or even syllables are missing compared to the words' isolated forms.

These sound changes are assumed to be brought about by ease of articulation and regularity of English rhythms in connected speech. Specifically, a normal speech rate for native English speakers is between 165–180 w.p.m. (words per minute) but the mean rate for conversation is known to be faster (210 w.p.m.) (Rubin, 1994), which causes many sound modifications due to ease of articulation and maintenance of regular English rhythms. The most significant fact about pronunciation modifications, however, is that native speakers of English do not seem to have difficulty understanding what the speakers said in context unlike L2 learners of English. This is because native speakers of English seem to successfully recover most of the speech signal

uttered in connected speech unlike L2 learners. For example, according to Griffiths (1990), low-intermediate ESL learners had difficulty understanding speech when it is faster than 200 w.p.m. Henrichsen (1984) found that native speakers of English were able to retrieve reduced or even missing parts of the speech signal brought about by connected speech processes whereas L2 learners had problems detecting the missing or reduced parts of speech input. Similar results were also reported by Ahn (1987) who examined Korean EFL and ESL learners' listening comprehension of spoken English.

Further, the recognition of pronunciation changes in context is reported to be related to exposure frequency of those changes. Pitt, Dilley, and Tat (2011) showed that native speakers of English display sensitivity to exposure frequency of sound variants. They examined English speakers' recognition of word-medial /t/ variations in four different environments in a lexical decision test: a canonical form [t] (e.g., *faster*), a flap [ɾ] (e.g., *later*), a glottal [ʔ] (e.g., *cotton*), and a deleted form (e.g., *enter*). According to Pitt et al., the variants are recognized more easily when they occur in context in which they are more commonly produced (e.g., [ɾ] in *later* than in *cotton*), suggesting that production frequency is reflected in word classification rates.

The studies examined above indicate that sound modifications are frequently attested in everyday speech and that L2 learners have difficulty recovering the speech signal in connected speech unlike native speakers of English. Further, native speakers' recognition of sound variants is affected by their exposure frequency of the variants. Considering the findings of the studies, one emergent question that should be addressed is whether teaching of sound modifications caused by connected speech processes or simply teaching of connected speech processes to L2 learners has some positive effect on the learners' listening comprehension. Dauer and Browne (1992) found that teaching of connected speech processes like linking, vowel reduction, and

consonant cluster simplification to L2 learners resulted in much improvement in their pronunciation. Lacabex, Lecumberri, and Cooke (2008) examined the impact of training on the perception of English reduced vowels by Spanish learners of English and reported that the learners showed much noticeable training effect.

Even though these studies show that teaching of connected speech processes to L2 learners has some positive effects, Dauer and Browne's study examined L2 learners' pronunciation improvement but not their listening comprehension per se. Their study is also rather limited in that the effect of teaching was not investigated for other phonological processes such as place assimilation and vowel deletion in spite of the fact that place assimilation and vowel deletion are frequently attested in connected speech. Similarly, Lacabex et al.'s study examined only L2 learners' perception of English reduced vowels but not the learners' perception of other connected speech processes like linking and modal verb/*not* contraction, although these processes are known to be important in the comprehension of connected speech (Avery & Ehrlich, 2002).

Thus, the study explores the effect of connected speech process teaching on Korean EFL learners' listening comprehension by conducting experiments. Specifically, the research investigates phonological processes such as linking, vowel reduction/deletion, modal verb/*not* contraction, *h* deletion, and place assimilation because these processes occur quite frequently in every speech, which implies that understanding of these connected speech processes plays a vital role in communication. However, the effect of teaching of these processes on L2 learners' listening comprehension was confined to only one or two of these processes (e.g., vowel reduction) in the previous studies. More importantly, not many studies have investigated whether teaching of aforementioned connected speech processes has any positive effect on Korean EFL learners' listening comprehension ability.

## II. Literature Review

### 1. Connected Speech Processes

In spoken utterances in English, words are juxtaposed with each other and this causes sound modifications both within and between words. For example, when words run together, unstressed vowels tend to be reduced to schwa or even lost, consonant clusters may be simplified, and two neighboring consonants tend to share the same place of articulation, especially within a thought group. These sound modifications in connected speech are mainly due to coarticulation caused by a rule of economy or ease of articulation (i.e., to save time and energy) (Clarey & Dixon, 1963) and also for the promotion of regularity of English rhythmic patterns (Celce-Murcia, Brinton, & Goodwin, 2010). According to Celce-Murcia et al. (2010) and Avery and Ehrlich (2002), the following pronunciation changes or more generally phonological processes are attested quite frequently in connected speech: contraction, reduction, linking, assimilation, and deletion.<sup>1</sup>

#### 1) Contraction

Contractions are contracted forms where blurred word boundaries are marked by a conventional written form. Function words such as modal verbs and the adverb *not* are frequently contracted in connected speech. For example, the modal verb *have* in *He could've taken the class* has the contracted form 've [v] in connected speech. Similarly, the contracted form of *not* is normally used in everyday speech as in *I wouldn't have canceled the field trip, if it hadn't rained.*

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<sup>1</sup> Celce-Murcia et al., (2010) treat contractions as a subset of blending. In addition, there are processes such as epenthesis (e.g., *classes*, *patted*) and dissimilation (e.g., *fifths* [fəʃs] as [fts]).

## 2) Reduction

Reduction refers to the phenomenon in which word boundaries are blurred together and thus expressions like *kind of*, *going to*, and *want to* sound like a single word *kinda*, *gonna*, and *wanna*, respectively. Reduction also refers to the weakening of unstressed vowels to schwa [ə] or [ɪ].

## 3) Linking

A syllable- or word-final sound is linked to the initial sound of the following syllable or word and this process depends on speech style and speech rate. Although there are different subtypes of linking, intervocalic consonant linking in V(vowel)C(consonant)+V(vowel) sequences and resyllabification in CC+V sequences are known to be important to avoid a characteristic feature of nonnative English speech. For example, *dream on* is realized as [dri:mɔ:n] where the sound [m] straddles both preceding and following syllables. Similarly, *find out* is produced as [faɪn.daʊt] in which the final consonant [d] of the cluster [nd] is realized as the onset of the following syllable.<sup>2</sup>

## 4) Assimilation

Assimilation refers to the process during which a sound becomes similar to an adjacent sound in terms of the place or manner of articulation. For instance, *hot cake* can be produced as [hɑ:kək], and *ten cups* as [tɛŋkʌps] where the word-final [t] and [n] become [k] and [ŋ], respectively, due to the following velar stop. That is, the word-final alveolar stops are assimilated to the following velar stop in place, and thus this process is dubbed place assimilation.

## 5) Deletion

A sound is deleted or is not clearly produced in certain environments. There are several subtypes of deletion as in the

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<sup>2</sup> ‘.’ marks a syllable boundary.

following:<sup>3</sup>

- a. A word-initial unstressed vowel may be deleted when the following vowel is stressed (e.g., *paráde*, *abóut*, *suppóse*, *corréct*).
- b. A word-medial unstressed vowel [ə] or [ɪ] in multisyllabic words may be deleted when the preceding vowel bears stress (e.g., *évery*, *végetable*, *hístory*, *fávorite*).
- c. A syllable- or word-initial [h] and [ð] in pronouns may be deleted (e.g., *ask her*, *tell him*, *help them*).

The present study investigates linking, vowel reduction/deletion, modal verb/*not* contraction, *h* deletion, and place assimilation among the phonological processes reviewed above. This is because Dauer and Browne (1992) reported the effect of teaching for linking/ resyllabification, vowel reduction, and *h* deletion on ESL learners' pronunciation. But they did not examine the treatment effect of these processes on the learners' listening comprehension. More importantly, the impact of teaching for modal verb/*not* contraction, vowel deletion, and place assimilation on the EFL learners' listening comprehension has not been investigated much in spite of the processes' frequent occurrences in connected speech.

## 2. Previous Studies on Connected Speech

L2 learners often have difficulty finding out where words and phrases begin and end in connected speech. Native speakers of English tend to use rhythmic patterns to figure out word

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<sup>3</sup> It has been noted that a sound may not be completely deleted but rather that adjacent sounds overlap in time on to the sound due to coarticulation and thus it is impossible to hear the so-called a lost sound (Farnetani & Recasens, 2010). Further, note that there are other subtypes of deletion such as consonant cluster simplification (e.g., *wild boar*).

boundaries so that they can decode/understand speech. However, many nonnative speakers of English, especially those whose mother tongue does not employ regular rhythms, are known not to depend on rhythmic patterns (Dauer & Browne, 1992). Furthermore, English attests many sound modifications in connected speech but L2 learners often fail to perceive or recognize portions of the speech signal uttered in connected speech, leading to communication difficulty or breakdown. Accordingly, a growing body of research has examined the influence of connected speech on L2 learners' listening comprehension (Henrichsen, 1984; James & Mullen, 1974). For example, James and Mullen (1974) maintained that ESL learners' listening comprehension difficulties were ascribable to sound modifications caused by phonological processes such as deletion and reduction. Rebin (1994) listed 5 major factors affecting listening comprehension: text characteristics, interlocutor characteristics, task characteristics, listener characteristics, and process characteristics. In particular, as for text characteristics, Rubin noted that pronunciation modifications caused by phonological processes pose a challenge for L2 learners to divide the stream of speech, in addition to factors such as level of perception and L1 and L2 differences.

Similarly, Henrichsen (1984) examined the effect of pronunciation modifications in connected speech on the comprehension of speech input based on the assumption that the presence of phonological processes reduces the perceptual saliency of the input. More specifically, 15 native English speakers and 50 ESL learners divided into two proficiency groups (high vs. low level) wrote down the target sentences after listening to them. Half of the sentences contained sound modifications caused by contraction, reduction, or assimilation (e.g., "*Where did you ever get an idea like that?*", p. 124). Henrichsen found that native speakers of English were able to compensate for the reduced or deleted parts of the speech input created by connected speech

processes since they had considerable knowledge of the English sound system and used this knowledge in listening comprehension. As opposed to native English speakers, L2 learners with a limited knowledge of the English sound system had difficulty compensating for the reduced or missing portions of the input when connected speech processes were present. However, when sound modifications were not present, high-level L2 learners' listening comprehension was significantly better than that of low-level L2 learners. Ahn (1987) also investigated whether Korean EFL learners' (university students) and Korean ESL learners' (graduate students in the US) listening comprehension was influenced by sound modifications caused by connected speech processes and also by affective factors like motivation. He found that the learners' listening comprehension was greatly hampered by sound modifications but not by affective factors. Accordingly, the studies reviewed above show that L2 learners have difficulty with listening comprehension when sound modifications occur due to phonological processes in connected speech.

Further, Dauer and Browne (1992) contended that L2 learners should improve their rhythmic patterns of English and hence their overall intelligibility by explicitly being taught connected speech processes. More specifically, they reported that teaching of connected speech processes such as linking, reduction of function words, and final consonant cluster reduction (e.g., *gifts*, *fifths*, *best movie*) to L2 learners brought about noticeable improvement in L2 learners' pronunciation. Dauer and Borwne also maintained that teaching of connected speech can result in improvement in L2 learners' listening comprehension and intelligibility, along with their psychological relief.

In addition, Lacabex and Lecumberri (2005) studied perception of English vowel reduction by Spanish learners of English and reported that the percentage correct was close to a chance level (56%). Gutierrez and Monroy (2003) examined the effect of

training on the production of English reduced vowels in words such as *support* and *private* by Spanish learners of English and found that the learners did not show any improvement (recited from Lacabex et al., 2008). Lacabex et al. (2008) further investigated the effect of training on the perception and production of English reduced vowels by 41 Spanish students who learned English as a foreign language in a state school. They also attended a private language school where they received training on English vowel reduction for 12 sessions and where they had an exposure to native English speakers' pronunciation. More specifically, one group of the students received perceptual training with discriminatory exercises (perception experimental group) whereas another group received production training with articulatory cues and feedback (production experimental group). Still another group of the students (i.e., control group) did not receive any particular training. A total of 11 minimal-pair words were presented in a two-alternative-forced-choice identification test at the word and sentence level (e.g., "*pillows-pillars; I'm going to say... again*", p. 295). According to Lacabex et al., the students in both experimental groups showed significant/near significant training effects irrespective of their training methods (perception vs. production) unlike those in the control group. Treatment effects on L2 listening skills were also reported by Chung, Thompson, Bowman, Swafford, and Thorkelson (2003).

Thus, the studies reviewed above on the training effect of connected speech processes on L2 learners' speech perception and production reported some conflicting results. For instance, Dauer and Browne (1992) and Lacabex et al. (2008) reported some positive training effects whereas Gutierrez and Monroy (2003) obtained some negative results.

Recently, connected speech processes have drawn much attention among scholars in Korea. For instance, Lee and Jung (2003) analyzed connected speech processes presented in middle-school English textbooks and grouped the processes into 5

categories: linking (resyllabification), consonant cluster reduction, palatalization, flapping, and verb+to reductions. Then Lee and Jung tested 42 middle school 2<sup>nd</sup> graders' listening comprehension of the 5 categories. According to them, the juniors in the middle school showed much difficulty with connected speech processes but no significant correlation was found between the students' listening comprehension and the frequency of the given phonological processes presented in the textbooks.

Further, based on Nam's (2003) study on Korean high school students' listening comprehension of connected speech, Yoo (2005) examined 480 high school students' listening comprehension of resyllabification, assimilation, deletion, and reduction using 20 test sentences. The results of her study showed that the percentage correct was 24.3% and the students had the most difficulty with resyllabification. The results also showed that the students' listening comprehension was related to speech rates and also to the students' English proficiency levels.

As for the effect of connected speech processes on university students' listening comprehension, Song (1997) studied the influence of speech rates on Korean university students' English listening comprehension because speech rate is related to L2 learners' listening comprehension to some extent (Jeon, 2010). However, his study was limited in that he only examined the correlation between speech rates and English listening comprehension, not considering which phonological processes caused the most difficulty to the students' English listening comprehension. Recently, Hwang (2006) examined Korean university students' listening comprehension of connected speech processes such as resyllabification, palatalization, flapping, and deletion. According to her, the overall percentage correct was 41% and the students had the most difficulty with resyllabification, followed by palatalization and deletion in order. Further, the results of Hwang's study showed that there was a very strong correlation between the students' listening

comprehension of connected speech processes and their TOEIC listening scores ( $r=.901$ ) and that the students' listening comprehension of connected speech was influenced by their English levels.

Most previous studies on connected speech processes in Korea are, however, rather limited in that only a small number of stimuli or phonological processes were tested in the studies. For instance, those studies have not investigated phonological processes such as vowel deletion and place assimilation even though they are frequently attested in connected speech. Although Hwang (2006) examined vowel deletion, *h* deletion, and place assimilation unlike other studies, she used only two items for vowel deletion and *h* deletion and thus her results may not be generalized. Further, not many studies have compared Korean EFL learners' listening comprehension of connected speech with that of native English speakers. More importantly, most previous studies have not investigated the impact of connected speech process teaching on Korean EFL learners' listening comprehension. Besides, if there is any training effect, the question of which phonological process(es) is(are) most beneficial to improving the learners' listening comprehension has not been much investigated.

Thus, the study investigates the effect of connected speech process teaching on Korean EFL learners' listening comprehension. More specifically, the study explores the following research questions: 1) Does short-term intensive training on connected speech processes such as linking, vowel reduction/deletion, modal verb/*not* contraction, *h* deletion, and place assimilation improve Korean EFL learners listening comprehension; 2) If there are learning effects, do the effects show variations depending on the types of phonological processes?; 3) Is Korean EFL learners' listening comprehension of connected speech processes correlated with their general English listening scores, as argued by Hwang (2006)?

### III. Methods

#### 1. Subjects

Subjects were 31 Korean EFL learners who majored or double majored in English language education at a private university in Seoul. They were taking *English Phonetics and Sound Structure* and participated in the experiment in partial fulfillment of the requirements for a course credit. The researcher asked the students whether they had received a lesson or any specific training on connected speech processes in English before taking the class and found that they had not received any prior training on connected speech processes. In addition, 15 native speakers of American English took part in the experiment as a control group. Most of them were instructors teaching English at a university in Seoul.

#### 2. Materials

The study investigated 5 representative phonological processes in English: linking, vowel reduction/deletion, modal verb/*not* contraction, *h* deletion, and place assimilation. As reviewed earlier, previous studies have shown that many Korean EFL learners have difficulty identifying or recognizing words/phrases when the words/phases are modified due to the application of phonological processes. Specifically, Yoo (2005) and Hwang (2006) showed that Korean EFL learners had the most difficulty with resyllabification (or linking) and thus it is necessary to examine whether the students in the present study show similar difficulties with regard to linking. Moreover, most studies have not investigated vowel deletion, *h* deletion, or place assimilation or used only a small number of stimuli to examine these processes in spite of the fact that these processes are frequently attested in everyday speech. Also, modal verb/*not* contraction and vowel reduction are known

to be important to enhance listening comprehension (Celce–Murcia et al. 2010).

The test materials consisted of 46 sentences which were created based on several resources (Celce–Murcia et al., 2010; Hewings, 2007; Mojsin, 2009; Naver Online English Dictionary) to examine the 5 phonological processes. More specifically, there were 12 sentences each for linking, vowel reduction/deletion, and place assimilation, but there were 4 questions for modal verb contraction, 2 questions for *not* contraction, and 4 questions for *h* deletion. However, one question for modal verb contraction has 2 blanks and 2 questions for *not* contraction each have 2 blanks. Consequently, there were 49 questions in total as each blank was counted as one question. Also, there were two types of vowel deletion; aphaesis or word-initial unstressed vowel (schwa) deletion and syncope or word-medial unstressed vowel (i.e., [ə] or [ɪ]) deletion.<sup>4</sup>

The sentences were produced by a native speaker of American English from Rhode Island. He was teaching English at a university in Seoul. He produced the sentences in casual speech 3 times in a sound-controlled room so that words and phrases should show properties of connected speech. The second or third sentence was used in the experiment. For instance, the native speaker produced *hot cake* as [hɑ:kkerk] so that place assimilation can be perceived as categorical rather than as gradient. As for vowel deletion, words containing word-initial schwa or word-medial schwa were inspected using Praat. When there were

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<sup>4</sup> The number of stimulus sentences for modal verb contraction, *not* contraction, and *h* deletion was small compared to that of other phonological processes. This was because modal verb and *not* contraction were collapsed into the category of contraction and *h* deletion was grouped into the category of deletion when the experiment was first designed. Additionally, an anonymous reviewer raised a question about the authenticity of the stimuli as the present study used isolated sentences without given contexts. However, isolated sentences are also used to diagnose ESL learners' listening comprehension of connected speech processes as in Henrichsen (1984).

weak vowel formants for the schwa, the whole sentences containing the so-called deleted vowels were recorded again. The rerecording was done in order to make sure that the deleted vowels were invisible or at least hard to hear because even missing segments or syllables are known to be gradient rather than categorical in character. That is, the so-called missing or reduced portions of speech signal are reported to contain some phonetic/phonological cues, even though one cannot segment the speech signal into a discrete sequence of sounds.

Moreover, the sentence productions were examined by another native speaker of American English to make sure that all the sentence productions were as natural as possible. The sentences were recorded using Audacity and a microphone (SONY ECM-MS907) on a laptop at 44,100Hz. The recordings of the production were saved as wave files for editing. The stimuli used in the test are provided in Appendix A.

### 3. Procedures

Students took the pretest before receiving lessons on connected speech processes. The test was in a fill-in blank format in which target words or phrases for the phonological processes under investigation were left out. The present study used this test format as the students were not able to provide correct answers unless they recognized the missing words/phrases accurately, thus showing their listening skill and command of the target language (Nation, 1991). The students were asked to fill in the blanks after listening to the sentences. Inter-stimuli interval was 5 seconds. They listened to each sentence once. The students listened to the sentences spoken through loud speakers in a sound reduced classroom.

The students also took a general English listening test which was adapted from *Pro TEPS Listening* (Lee, 2008). The listening test was composed of 30 questions made up of 4 different types:

7 questions for statement and response, 8 questions for completing short conversations, 8 questions about conversations, and 7 questions about monologues. The listening test was administered in order to examine whether the students' performance on connected speech processes was correlated with their general English listening ability (Appendix B).

After the pretest, the students received 3 weeks' instructions on connected speech processes to improve their listening comprehension, on the basis of 5 phases of a communicative framework; description and analysis, listening discrimination, controlled practice, guided practice, and communicative practice (Celce-Murcia et al., 2010). The present study employed the communicative framework since the framework is suitable for intermediate or advanced level learners of English who can grasp the target language (Chela-Flores, 2001).<sup>5</sup> More specifically, Table 1 shows the schedule and contents of the instructions during 3 weeks. Training materials were selected from several books with audio CDs (Celce-Murcia et al., 2010; Hewings, 2007; Mojsin, 2009). On the 1<sup>st</sup> week, various phonological processes which occur in connected speech including coalescence and neutralization were introduced to the students with specific examples. However, more attention was paid to the phonological processes under investigation on the 2<sup>nd</sup> and 3<sup>rd</sup> weeks and not all the 5 phases were employed for some phonological processes due to the time constraint. Sample activities for place assimilation are illustrated in Table 2.

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<sup>5</sup> The participants in the present study could be regarded as high-intermediate or advanced level learners of English as their TEPS listening scores ranged between 80 and 100 with mean scores of 94 when the scores were converted into a 100 point scale. Accordingly, the participants were not divided into two subgroups (high-level vs. low-level) based on the results of the general English listening test.

**Table 1**  
**Teaching Schedule and Contents**

Week	Class hour	Phases	Content	Activities
1 <sup>st</sup>	1 <sup>st</sup> class	-Description & Analysis -Listening discrimination	-Vowel reduction/deletion -Consonant deletion/consonant cluster reduction -Linking	-Explain & identify phonological processes -Listen & repeat
	2 <sup>nd</sup> class	-Description & Analysis -Listening discrimination	-Place/manner assimilation -Contraction -Vowel insertion -Coalescence -Neutralization -Metathesis	-Explain & identify phonological processes -Listen & repeat
2 <sup>nd</sup>	1 <sup>st</sup> class	-Listening discrimination -Controlled practice	-Vowel reduction/deletion -Place assimilation	-Individual/pair work -Listening & speaking practice
	2 <sup>nd</sup> class	-Listening discrimination -Controlled practice	-Linking - <i>h</i> deletion -Contraction	-Individual/pair work -Listening & speaking practice
3 <sup>rd</sup>	1 <sup>st</sup> class	-Controlled practice -Guided practice	-Linking - <i>h</i> deletion -Modal verb/ <i>not</i> contraction -Vowel reduction/deletion -Place assimilation	-Individual/group work -Listening & speaking practice
	2 <sup>nd</sup> class	-Communicative practice -Review	-Linking - <i>h</i> deletion -Modal verb/ <i>not</i> contraction -Vowel reduction/deletion -Place assimilation	-Individual/pair /group work -Listening & speaking practice

**Table 2**  
**Sample Activities for Place Assimilation**

Target process	Phase	Description/Activities
Place assimilation	-Description & Analysis	-Description of the target process using power point materials and worksheets: Word-final alveolar stops /t, d, n/ may assimilate to following labial/velar stops /p, b, m, k, g/ (e.g., <i>that pen</i> [ðæp pən], <i>bad guys</i> [bæg gaɪz], <i>ten cars</i> [tɛŋ kɑːrz])
	-Listening discrimination	-Students were asked to distinguish between place assimilated and unassimilated words after listening to randomly presented place assimilated and unassimilated forms (e.g., <i>a hot pizza, a good price, light green, a bed cover seven people, ten cars, etc.</i> )
	-Controlled practice	-Students were presented with a short dialogue and were asked to read it with their partner and to identify where place assimilation occurs. Then students listened to the dialogue and practiced it with their partner. -Sample dialogue: A: <i>Next Friday I'll meet you around four.</i> B: <i>By the bus station.</i> A: <i>No, the art gallery. Then we can collect Steve at five.</i>
	-Communicative practice	-Students were asked to make their own story about their 'summer trip' with their partner or group members in which many phonological processes such as place assimilation, linking, deletion, etc. can occur. Then they were instructed to practice the story with their partner/group members, focusing on place assimilation and hand it over to the instructor as an assignment.

The posttest was administered one week after the instructions.

This was to avoid an immediate training effect on the test and also to examine a delayed training effect. The same materials tested in the pretest were employed in the posttest but the stimuli were randomized differently from the pretest. Importantly, examples or sentences which were tested in the pretest and posttest were not used during training.

#### 4. Scoring

When the students' answers were correct, they were entered as 1, otherwise they were entered as 0 and their total percentage correct was calculated. When there was a typo (or when there were minor typos) in the answer, it was coded as 1.

### IV. Results and Discussion

#### 1. Group Results

Subjects' responses were binary data expressed as percentage correct and thus their data were analyzed using a generalized linear mixed model with logit link function (IBM SPSS 20). First, let us consider group results. The pretest results of the Korean students were compared with the results of the native English speakers since the native English speakers took only the pretest. As given in Table 3, the English speakers' overall percentage correct was very high (94%) and their percentage correct for each phonological process was over 90% except *h* deletion. In contrast, the Korean students' overall performance was very poor (52.3%) except linking. *T*-tests showed that not only the overall mean difference between the Korean students and the English speakers but also the mean difference between each phonological process was all statistically significant, as shown in Table 4.

**Table 3**  
**T-tests between Korean and English Speakers at the Pretest**

Group	Means	Std. Error	Korean vs. English		
			<i>t</i>	df	<i>p</i>
Korean	52.3	1.7	-20.215	220	<.001
English	94.0	1.2			

**Table 4**  
**T-tests between Korean and English Speakers by Phonological Processes at the Pretest**

Phonological process	Group	Mean	Number of items	Std. Error	<i>t</i>	df	<i>p</i>
Linking	Korean	70.2	12	2.8	-7.814	220	<.001
	English	96.1	12	1.7			
Vowel reduction/deletion	Korean	39.5	12(4/8)	3.0	-13.654	220	<.001
	English	92.2	12(4/8)	2.4			
Modal verb/ <i>not</i> contraction	Korean	52.0	9(5/4)	3.6	-8.181	220	<.001
	English	90.4	9(5/4)	3.0			
<i>h</i> deletion	Korean	50	4	5.4	-5.244	220	<.001
	English	88.3	4	5.0			
Place assimilation	Korean	48.9	12	3.1	-14.506	220	<.001
	English	97.8	12	1.3			

In particular, the Korean students performed very poorly on vowel reduction/deletion followed by place assimilation whereas the English speakers did not have difficulty with any of the processes. Thus, the results indicate that the Korean students overall had much difficulty comprehending connected speech processes, similar to the findings of the previous studies (Hwang, 2006), especially processes of vowel reduction/deletion.

## 2. Learning Effects and Phonological Processes

One of the questions posed in the present study was whether the Korean students' listening comprehension of connected speech processes was correlated with their general English listening

scores. The Pearson Monument Correlation coefficients showed a moderate correlation ( $r=.437$ ,  $p<.05$ ), which means that the students' listening comprehension of connected speech processes was correlated with their general English listening ability to some extent. Accordingly, the students' general English listening scores were entered as a covariate and test (pretest vs. posttest) and phonological process (5 phonological categories) were entered as fixed factors. That is, the present study explores whether there was improvement in the students' listening comprehension due to training on the phonological processes and also whether the students' performance was different depending on the phonological processes, and hence test and phonological process were entered as independent variables. First, let us consider the overall results.

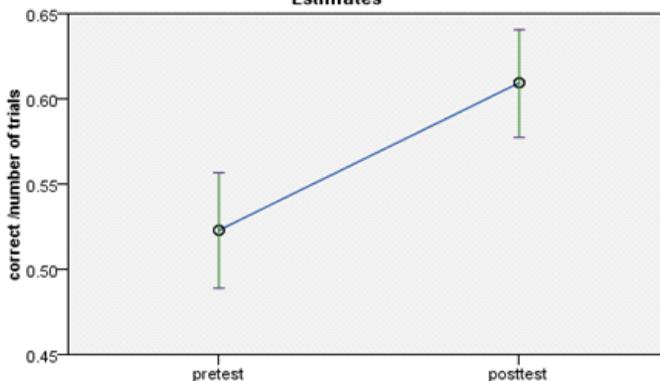
**Table 5**  
**Results of Factor Analysis**

Source	<i>F</i>	df1	df2	<i>p</i>
Test	13.388	1	299	<.001
Phonological process	29.820	4	299	<.001
English listening score	67.010	1	299	<.001
Process× Test	0.565	4	299	.688

As can be seen from the table above, all the factors were statistically significant except the interaction between phonological process and test. Namely, the results indicate that there were learning effects but the students' performance was varied depending on the phonological processes. Further, the effect of the phonological processes was not different in terms of the pretest and the posttest. More specifically, as for the significant main effect of test, the difference in means between the pretest (52.3%) and the posttest (61%) was significant, which means that the Korean students' performance improved noticeably after having received 3 weeks' training, as further shown in Figure 1. Accordingly, the results support the findings of Lacabex et al. (2008) and Dauer and Browne (1992) concerning treatment effects

of connected speech processes on L2 learners' listening comprehension (or on L2 learners' production ability in the case of Dauer & Browne's study).

**Figure 1**  
**Mean Differences between the Pretest and Posttest**  
**Estimates**

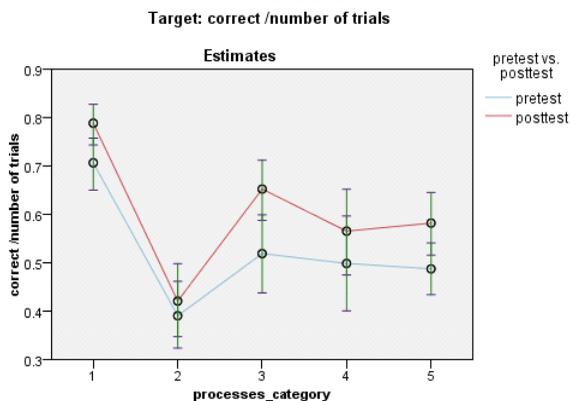


Moreover, the factor of phonological process was statistically significant as the students' performance showed much variation in terms of the phonological processes. The students' performance on linking was much better than other phonological processes at the pretest. At the posttest, the students also performed better on linking relative to other phonological processes, but somewhat different pictures emerged as modal verb/*not* contraction and place assimilation showed noticeable improvement after training. Accordingly, the results are not in line with the findings of Yoo (2005) and Hwang (2006) as linking (or resyllabification) posed the most difficulty to the participants in their studies. In particular, the differences in means between the pretest and the posttest for linking, modal verb/*not* contraction, and place assimilation were all statistically significant. As opposed to these phonological processes, vowel reduction/deletion and *h* deletion did not show much improvement, as given in Table 6 and Figure 2.

**Table 6**  
**T-tests between the Pretest and Posttest by Phonological Processes**

Phonological process	Test	Mean	Std. Error	<i>t</i>	df	<i>p</i>
Linking	Pretest	70.2	2.7	2.364	299	<.05
	Posttest	78.9	2.1			
Vowel reduction/ deletion	Pretest	39.1	3.5	0.583	299	.560
	Posttest	42.1	3.9			
Modal verb/ <i>not</i> contraction	Pretest	52.0	4.1	2.559	299	<.05
	Posttest	65.3	3.2			
<i>h</i> deletion	Pretest	50	5.0	0.983	299	.327
	Posttest	56.6	4.5			
Place assimilation	Pretest	48.8	2.7	2.205	299	<.05
	Posttest	58.2	3.3			

**Figure 2**  
**Mean Differences between the Pretest and Posttest by Phonological Processes**



*Note:* Category 1 stands for linking, category 2 vowel reduction/deletion, category 3 modal verb/*not* contraction, category 4 *h* deletion, and category 5 place assimilation.

Further, in order to figure out which phonological processes posed a more challenge to the students' listening comprehension relative to other phonological processes, post-hoc tests were performed on each pair of the phonological processes. Among the pairs compared, the differences in means between the following pairs were all significant, as shown in Table 7.

**Table 7**  
**Post-hoc Tests for Phonological Processes**

Test	Pairs of comparison	<i>t</i>	df	<i>p</i>
Pretest	Linking vs. Vowel reduction/deletion	7.090	299	<.001
	Linking vs. Modal verb/ <i>not</i> contraction	3.785	299	=.001
	Linking vs. <i>h</i> deletion	3.621	299	=.002
	Linking vs. Place assimilation	6.671	299	<.001
	Linking vs. Vowel reduction/deletion	8.335	299	<.001
Posttest	Linking vs. Modal verb/ <i>not</i> contraction	3.563	299	=.003
	Linking vs. <i>h</i> deletion	4.446	299	<.001
	Linking vs. Place assimilation	5.244	299	<.001
	Modal verb/ <i>not</i> contraction vs. Vowel reduction/deletion	4.632	299	<.001
	Place assimilation vs. Vowel reduction/deletion	3.170	299	=.008

The phonological processes of vowel reduction/deletion and modal verb/*not* contraction were further analyzed because they combined similar phonological processes together. Let us first examine vowel reduction/deletion in detail. There were 4 items for vowel reduction and 8 items for vowel deletion as the latter consisted of 4 items each for word-initial unstressed vowel deletion and word-medial unstressed vowel deletion. The percentage correct of vowel reduction was 45.9% at the pretest and it was 44% at the posttest, showing that the students' performance was slightly regressed at the posttest. The correct percentage of word-initial unstressed vowel deletion was 25% at the pretest and 30% at the posttest. The correct percentage of word-medial unstressed vowel deletion at the pretest and posttest was 47.5% and 54%, respectively. Thus, the results of vowel reduction/deletion reveal that the students in the present study benefited from training only for vowel deletion but not for vowel

reduction, which implies that different teaching skills or materials should be developed for vowel reduction.

As for modal verb/*not* contraction, there were 5 items for modal verb contraction while there were 4 items for *not* contraction. The accuracy rate of modal verb contraction at the pretest and posttest was 71.6% and 88%, respectively, showing a huge training effect. The percentage correct of *not* contraction was 27.4% at the pretest and it was 36% at the posttest, hence demonstrating training effects.

In sum, the findings of the study showed that the students benefited from training on the phonological processes in improving their listening comprehension, similar to the results of Lacabex et al. (2008), but the treatment effects were varied depending on the phonological processes. That is, the results indicate that the Korean students in the present study still had much difficulty with word-initial unstressed vowel deletion and *not* contraction although they showed some learning effects. The students also had difficulty correctly identifying pronouns when the initial [h] sound was deleted. Further, vowel reduction did not show any training effects. As noted earlier, the findings of the present study were rather different from those by Yoo (2005) and Hwang (2006) since the participants in the present study did not have much difficulty with linking unlike the participants in Yoo and Hwang. Even the participants in Hwang's study were reported to perform relatively well on *not* contraction unlike the participants of the present study. The different results between the present study and Hwang's study (and also Yoo's study) may be ascribable to participant- and stimulus-effects, even though there may be other factors, too. That is, the test materials used in the present study and those used in the previous studies were all isolated sentences and hence the participants' linguistic knowledge and their English proficiency may have played a role to some extent, along with the stimuli sentences themselves (Henrichsen, 1984; Rubin, 1994). However, it should be noted that

the connected speech processes investigated in the present study were rather different from those in Yoo's study and Hwang's study and hence direct comparisons between the present study and the previous studies have some limitations.

## V. Conclusion and Implications

According to Strange and Shafer (2008), L2 learners are more likely to depend on their L1 perceptual patterns as a function of the increasing cognitive load imposed by perceptual tasks and listening conditions. Even advanced L2 learners need to have recourse to more cognitive resources for word recognition if perceptual tasks or listening conditions are challenging, although some contextual information (e.g., semantic cues) is provided. Strange and Shafer contend that L2 learners' non-robust perceptual performance relative to native English speakers can be ascribable to the fact that L2 learners depend on "different weightings of acoustic parameters than those used by native listeners" (p. 170). Then, the Korean students' poor performance even after training compared to the native English speakers' performance can partly be due to the fact that 3 weeks' training may not be enough for the learners to learn more robust acoustic-phonetic information or cues used by native speakers of English.

Moreover, according to Call (1985), memory span for L1 speech input is longer than L2 speech input and short-term memory is an important factor in listening comprehension. Bond and Garners (1980) reported that L1 listeners employ not only phonological, lexical, and syntactic information but also heuristic strategies like finding a word or phrase during the process of listening comprehension (Rubin, 1994). In contrast, Conrad (1985) found that L2 learners tend to depend more on syntactic information than contextual semantic clues, especially when their L2 proficiency decreases. Then the Korean EFL learners' poor

performance may also be attributed to L2 learners' short memory span for L2 speech input and their rather limited use of information and strategies unlike native speakers of English.

As for teaching of connected speech processes to L2 learners, they should be exposed to authentic connected speech which is employed by most native English speakers. In order for L2 learners to communicate effectively with native English speakers at a normal speed, they should explicitly be taught connected speech processes but not a slow word by word form of speech. (Dauer & Browne, 1992). That is, L2 learners should be taught which pronunciation modifications occur in English and also to what extent the variant forms are predicted to occur. In particular, the results of the present study suggest that more attention should be paid to processes such as word-initial unstressed vowel deletion and *not* contraction as the Korean students' listening comprehension of these phonological processes was very poor even after training. However, given that the students' performance on vowel reduction was slightly regressed at the posttest compared to the pretest, more effective teaching skills for vowel reduction should be developed. Further, L2 learners should be taught which acoustic/phonetic cues native speakers of English use in order to understand connected speech processes. If this kind of information about connected speech is available to L2 learners, L2 learners' listening comprehension ability can be facilitated and the naturalness of their production can be increased, which enables L2 learners to have more adequate phonological competence.

In addition, because stress, rhythm, and intonation also greatly contribute to assigning meaning in English, L2 learners should be trained to rely on these prosodic features in order to enhance listening comprehension (Anderson-Hsieh, Johnson, & Koehler, 1992; Celce-Murcia et al., 2010). Also, exposure to variable training materials such as speech samples produced by multiple speakers is known to be effective to generalize L2 perceptual

learning. For example, according to Bradlow and Bent (2003), native English speakers who were exposed to multiple Chinese-accented English speakers during training showed a generalized perceptual learning pattern when they heard a new Chinese-accented English speaker. In contrast, English speakers with only a limited exposure to a single speaker during training demonstrated only speaker-specific learning. Further, in both EFL and ESL settings, many teaching resources such as movies, the internet, audio books, and computer-assisted language software can provide L2 learners with many opportunities for authentic input.

As for L2 learners' phonetic/phonological representation, abstractionist models of representation, which assume that words are stored in the mental lexicon as sequences of discrete segments or phonemes, should be modified in order to account for the processing of sound modifications in connected speech. That is, the models should specify the production and comprehension mechanisms for the sound changes attested in connected speech (Ernestus & Warner, 2011). By contrast, pure exemplar models contend that all tokens of words uttered by speakers and perceived by listeners are stored in the mental lexicon even with detailed information including acoustic properties of the tokens and the context in which the word tokens are uttered or perceived (Goldinger, 1998; Pierrehumbert, 2001). Accordingly, exemplar models appear to take account of the fact that native speakers of English recognize sound modifications in connected speech without much difficulty.

However, the fact that the Korean EFL learners in the present study still had much difficulty recovering correct words and phrases even after 3 weeks' training seems to indicate that exemplar models may not be adequate enough to account for L2 learners' language acquisition. Moreover, it is noted that the full form of a word also plays a particular role in speech perception and production (Pitt et al., 2011), implying that pure exemplar

models may need some mechanisms to account for this finding (Ernestus & Warner, 2011; Ranbom & Connie, 2007). On the other hand, hybrid models assume that the pronunciation of a word is stored in the mental lexicon in terms of both exemplars and abstract representations. As for L2 learners' phonetic/phonological representation, then, it is speculated that the exemplars of a target word may not be fully activated unless L2 learners have been exposed to an adequate amount of authentic input unlike native speakers of English. This is at least partly because listeners encode pronunciation variants they experience in proportion to the frequency they experience them (Pitt et al., 2011).

This study has some limitations as it did not consider immediate or long-delayed effects of training. Moreover, the study did not include an EFL control group in order to compare the training effects between the experimental group and the control group. For future research, a longitudinal study which measures the effect of training on L2 learners' listening comprehension and the retention of training should be conducted with more diverse connected speech processes and with a large number of L2 learners (Derwing, 2008). This is because pronunciation modifications have significant consequences for speech perception, production, and especially for second language teaching.

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## Appendix A

### Phonological Processes in Connected Speech

#### (1) Linking

- Ink stains don't rub off easily.
- We had a bag of walnuts left over from the party.
- It's on the other side of the make up counter.
- We're almost all sold out.
- Should I leave it on the table?
- I didn't expect him to pass away so young.
- Her voice was shaking with anger.
- The Canadian flag has a maple leaf on it.
- The mirror over there is very expensive.
- We are going to beer up at the bar.
- All of us went to the Thanksgiving party.
- Their eyes are full of hope just like yours.

#### (2) Vowel reduction/deletion

##### ■ Vowel reduction

- I think that she ought to know it better.
- It's in the nature of things.
- Did you go shopping at break?
- Please tell me what's six and seven.

##### ■ Word-initial vowel deletion (aphesis)

- Check that the password is correct and then try again.
- Pickpockets were hard hit by a police crackdown.
- There's a big supermarket near the marina.

- I didn't know where the tomato came from until yesterday.
- ▣ Word-medial vowel deletion (syncope)
- I am going to the opera this evening.
- They sell all kinds of batteries in the store.
- When I lived in Beijing, I was interested in traditional Chinese food.
- I had a miserable time in secondary school

(3) Modal verb contraction/*not* contraction

▣ Modal verb contraction

- I could've taken him to the movies.
- There must've been something wrong with this camera.
- He said he would've come if he'd known about it earlier.
- You should've told me about the book.

▣ not contraction

- If you hadn't been driving so fast, you wouldn't have gotten a ticket.
- I wouldn't have recognized Lisa, if you hadn't pointed her out.

(4) *h* deletion

- Do you want me to give him a call?
- She has her dance class next door to mine.
- When are you going to tell her the secret?
- I just saw him a few days ago.

(5) Place assimilation

- We traveled on a tight budget.
- We keep extra light bulbs in the closet.
- Spoon over hot cake until all liquid is absorbed.
- The man at the counter ordered a white coffee.
- There is a good possibility that such things will happen.
- Peter left his red briefcase on the train.
- I am not sure that there is a wide gap at present.

- I hear he's out today with a bad cold.
- Interestingly, brown bears are largely vegetarian.
- Add green bell pepper and the rest of the ingredients.
- There were ten caves in the central part of the mountain.
- I also want to make a plea for green cars.

## Appendix B

### English Listening Exam: Sample Questions

Part I: Choose the most appropriate response to the statement.

1. M: Your house is beautiful.

W: \_\_\_\_\_.

- (a) I'm pleased you like it.
- (b) I can't make it.
- (c) Don't go home.
- (d) Isn't my house beautiful?

Part II: Choose the most appropriate response to complete the conversation.

8. W: Your new glasses are very stylish.

M: Thanks. They only cost fifty dollars.

W: Wow, where did you get them?

M: \_\_\_\_\_.

- (a) At the grocery store.
- (b) At a store downtown.
- (c) I might buy them.
- (d) They came by post.

Part III: You will hear a conversation and its corresponding question. Then you will hear four options. Choose the option that best answers the question.

16. W: Tim, we're going to miss the museum tour.

M: Sorry, I got carried away looking at this gorgeous ocean

view.

W: Well, the tour bus is picking us up in ten minutes.

M: I know, but I just can't get over how beautiful it is.

W: Why don't you take some pictures of it?

M: Good idea. It'll just take me a couple of minutes.

Which is correct about the man according to the conversation?

- (a) He doesn't want to go to the museum.
- (b) He forgot his camera.
- (c) He is amazed by the scenic view.
- (d) He is looking at photos of beautiful scenery.

Part IV: You will hear a monologue and its corresponding question. Then you will hear four options. Choose the option that best answers the question.

24. Are you looking for a way to make professional, studio quality track recordings using your own real instruments and home computer? You will find the answer with our new software package which allows you to record a limitless number of layered tracks. Each track can be manipulated using a range of tools and techniques, which give you a professional sounding recording on your very own computer. The software allows for the recording of any instrument through a direct input or microphones.

What is mainly being advertised?

- (a) A new home computer
- (b) A range of musical instruments
- (c) Audio recording software
- (d) The use of a professional recording studio

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