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The Effect of Explicit Instruction on the Perception of Spanish Stops by Speakers of Korean

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THE EFFECT OF EXPLICIT INSTRUCTION ON THE PERCEPTION OF SPANISH STOPS BY SPEAKERS OF KOREAN

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DEDICATION

I would like to dedicate the fruit of my labors to my family, friends and all of those who, despite having never met me before and being scattered across the globe, prayed for me during the most difficult moments of the process.

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ABSTRACT

Many studies have been conducted on the influence of explicit phonetic instruction on speech perception and production of English as a second (L2) and foreign (FL) language (e.g. Bradlow, Pisoni, Akahane-Yamada & Tohkura, 1997; Derwing, Munro & Wiebe, 1998), some of which have focused on Spanish as a FL learned by American students whose first or native language (L1) is English (e.g. Elliot, 1997; Lord, 2005). Nonetheless, research has only recently been carried out on third language (L3) perception, with an even greater scarcity of studies that have focused on non-native speakers of English (e.g. Llama, Cardoso & Collins, 2008; Llisterri, & Poch, 1987). As Spanish is the most studied FL in the U.S. and its classrooms often contain non-native English students, it is important to take into account how these individuals' perception may affect their acquisition of L3 phonology and strive to discover efficient and effective ways of instruction for these linguistic minorities. This study concentrates on Korean L1 speakers and the influence of explicit phonetic instruction on their perception of word-initial consonant stops in Spanish.

Consonant stops in both Spanish and English are defined by voicing, differing only somewhat in Voice Onset Time (VOT) (Abramson & Lisker, 1973). In Korean, however, consonant stops are not defined by voicing, but rather by two features: tenseness and aspiration (Kim, C. W., 1965; Kim, N., 1990). It has been shown that this Korean system greatly influences the perception of systems whose elements are

distinguished by voicing (Kang, Kyoung-Ho & Susan Guion, 2006).

The participants in this study were 13 native speakers of Korean studying in the U.S. The experiment tested the effect of explicit instruction on participants' perception by having participants listen to 36 voice recordings of Spanish syllables and choose the syllable (written in Latin characters) which best represented the one they heard. The experimental group completed a pre-test before receiving instruction in the form of a video, after which they took an immediate post-test, with a delayed post-test the following week.

Based on previous research, it was hypothesized that L1 Korean speakers would parse the voiced stops with more accuracy than the voiceless ones, but that explicit phonetic instruction would improve participants' perception of the latter. The results of the present study support this conclusion.

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LIST OF SYMBOLS

$f0$	Fundamental frequency.
x^{h}	A tense, aspirated stop *x*.
x’	A tense, unaspirated stop *x*.
μ_x	The mean of population *x*.

LIST OF ABBREVIATIONS

ESL .....English as a Second Language

FL..... Foreign Language

L1 ..... First or Native Language

L2 .....Second Language

L3 .....Third and Consecutive Languages

SLA..... Second Language Acquisition

TL..... Target Language

TLA..... Third Language Acquisition

VOT ..... Voice Onset Time

CHAPTER 1

INTRODUCTION

Although in second language (L2) classrooms the students often come from many different regions of the world and have a wide variety of first languages (L1), foreign language (FL) classrooms rarely contain this much diversity, at times consisting entirely of a homogenous local population lacking even in dialectal diversity. The FL classrooms in the United States are no exception, with the majority of students being made up of native English speakers and heritage learners of the language being studied.

This state of affairs leads educators to view the FL class as more or less linguistically homogenous, an assumption reflected in American FL teaching materials which are tailored to the linguistic majority. This situation, however, leads to neglect of the minority (sometimes quite prominent) of students whose L1 is neither English nor the target language (TL). Despite the fact that there are certain aspects of the FL which may cause problems for these students (e.g. plural morphology), these are, unfortunately, rarely if ever addressed by their instructors. This may be due to the fact that the L1 English students excel in these areas and so eclipse the difficulties faced by their non-native peers, or simply because the teacher is either unaware of the problem or unprepared to address it (Derwing & Munro, 2009).

One such disadvantaged group in the FL classroom is that of native Korean speakers, a population experiencing a growing presence throughout the United States in recent years (Ha, Johnson, Kuehn, 2009). Among the FLs which they would have the

opportunity to study, the most prominent taught in the U.S. today is, indisputably, Spanish. Over the past decade, it has retained an enrollment rate of over fifty percent of FL students among institutions of higher education, according to the Modern Language Association (Furman, Goldberg & Lusin, 2010), and over seventy percent among K-12 schools (ACTFL, 2011). It is for this reason that the focus of the current study is on native Korean speakers learning Spanish as a FL in the U.S.

Among the complexities which L1 Korean speakers face when learning Spanish, one could argue that pronunciation is the least of these. Compared to their L1 English counterparts, Korean speakers share certain key phonological characteristics with Spanish, such as syllable-timing and a comparable vowel inventory, which allow them to successfully imitate multisyllabic Spanish words with little difficulty (Ha, *et al*., 2009). Nonetheless, the phonological system of Korean differs from Spanish significantly concerning word-initial stops.

In order to make contrasts between consonant stops, the languages of the world distinguish them through the interaction of diverse acoustic features (Lisker & Abramson, 1964). Languages like English and Spanish divide these phonemes by the distinctive feature of voiceness (e.g. /b/ vs /p/), while other languages (e.g. Mandarin) classify them by the distinctive feature of aspiration (e.g. /p/ vs /p^h/). Some languages (e.g. Hindi) even distinguish stops by both of these features at the same time (e.g. /b/ and /p/ vs /b^h/ and /p^h/, respectively) (Choi, 2002). The distinctive features which concern this study are the features of aspiration (mode of articulation) and voiceness which divide the groups of stops having the same *place* of articulation (e.g. bilabial stops /b/ and /p/). Although English relies on aspiration to distinguish these and Spanish relies on pre-voicing, both of

these languages' techniques depend on Voice Onset Time (VOT) (Abramson & Lisker, 1973).

Most researchers had agreed until recently that the standard VOT for American English word-initial voiced stops was around zero, and that the VOT for the voiceless stops is quite positive, whereas in Spanish, both of these are located a step backwards (where the voiced stops have a negative VOT and the voiceless are around zero). However, most studies excluded the pre-voiced stops in American native speakers of English data, a factor which could help explain why these speakers can perceive voiceness in Spanish despite the negative shift in VOT (Kang & Guion, 2006; Ha, Johnson & Kuehn, 2009). This fact is what makes the perception of Spanish word-initial stops a non-issue for most American students whose L1 is American English, although it does little to assist their production (Lord, 2005). Korean, on the other hand, is not so easily compared, for, as once suggested by Abramson (1977), there is more to Korean stops than just VOT.

According to the accepted theory by the majority of linguists, in order to distinguish these stop phonemes in Korean, two distinctive features are utilized: aspiration (defined as exhibiting a positive VOT) and tenseness (characterized by a low *f*0 value in the subsequent vowel). This last characteristic is unique to Korean, as no other language in the world has been discovered which uses this feature to distinguish consonants. What sets Korean even further apart from other languages such as English and Spanish is that it lacks the distinctive feature of voiceness. This can make it difficult for native speakers of Korean when they are faced with learning a language which does have this distinction, because they will tend to perceive this new phonological system

through that of their L1. This is called category assimilation (Kang & Guion, 2006) or perceptual assimilation (Martin & Peperkamp, 2011). As Martin *et al*. (2011) quotes: "In the words of Trubetzkoy, the native phonology acts as a sieve during speech perception, in that non-native sounds and sound sequences are perceived as native ones, a phenomenon also called perceptual assimilation" (p. 4). This implies that, if a person is a late bilingual, or simply is studying a second or foreign language, they will perceive the new phonemes as if they were the similar phonemes from their L1. That is, they will place these new phonemes within the phonological system already established by their maternal language.

As has already been mentioned, in Spanish (just as in English) the two groups of phonemic stops which are articulated in the vocal tract are differentiated by way of the distinctive feature of voiceness: the voiced stops (/b, d, g/) and the voiceless stops (/p, t, k/). The voiceless stops have virtually no aspiration (*i.e.* they have a VOT near zero) and are produced with much more tension than in English. The voiced stops, on the other hand, are characterized by pre-voicing, or, voicing during occlusion (*i.e.* they have a negative VOT) (Abramson & Lisker, 1973).

Korean, however, lacks the distinctive feature of voiceness (although voicing does occur allophonically between voiced sounds such as vowels (Kim, N. 1990; Grayson, 2009)) and in its place has two distinctive features mentioned earlier: tenseness and aspiration. Consequently, there are three groups of phonemic stops in Korean which are traditionally grouped in the following way: lax stops (/p, t, k/), tense stops (/p', t', k'/), and aspirated stops (/p^h, t^h, k^h/).[1] The lax stops are defined by a lower *f*0, making them

[1] The transcription and the terms used here are adapted from Choi (2002), Hume, Johnson, Seo & Tserdanelis (1999), and Kim, N. (1990)

perceptually very similar to the voiced stops in both English and Spanish (Kang & Guion, 2006; Kim, M., 2004). The tense stops are produced with tenseness well above that of English, but are similar in VOT with Spanish (near zero) (Choi, 2002; Kim, N. 1990). The aspirated stops are characterized by a high degree of aspiration (positive VOT), much higher than in English (Choi 2002; Kim, N. 1990).

However, this simple three-way distinction is not as clear as it may seem. For example, aspirated stops (/p^h, t^h, k^h/) are also characterized as being tense, and lax stops (/p, t, k/) are also aspirated: Kang & Guion's (2006) results show that, in monolingual Korean speakers' production of lax and aspirated word-initial stops, both of these two sets are equal in VOT. The results of other research has shown a similar overlap in VOT for these two categories (Kim, M., 2004; Kim, Beddor & Harrocks, 2002). Therefore, in accordance with Kim, C.W. (1965), it can be said that Korean speakers primarily rely on tenseness to distinguish the stop contrast, manifested in their *f*0 values, while English speakers listen exclusively for VOT (Ha, *et al.*, 2009). Nevertheless, Kim, M. (2004) noticed that VOT was also used by Korean speakers to distinguish between the tense stops (/p', t', k'/ and /p^h, t^h, k^h/), showing this to be a secondary marker used for differentiating these two sets.

Although we see that native Korean speakers face a higher level of complexity when learning to perceive the Spanish stops, this difference is minimal between English and Spanish and is therefore rarely, if ever, addressed in the FL classroom, and then only in advanced linguistic courses (Lord, 2005). This avoidance of phonetic instruction in FL classrooms in the U.S. has been attributed, by some, to the popularity of Communicative Language Teaching (CLT) which deems explicit phonetic instruction to be inefficient

(Arteaga, 2000). Nevertheless, researchers have begun to look at problems in the pedagogy of phonology similar to the ones stated above, especially in the realm of pronunciation, and have been searching for an effective way to teach this to students (e.g. Bradlow, Pisoni, Akahane-Yamada, Tohkura, 1997; Elliot, 1997; Lord, 2005; Sturm, 2013). However, as has been stated above, little is being done in the area of perception, and even less concerning L3 learners. For this reason, the current study attempts to address this dearth of research by focusing on a particular population where such an analysis is very much needed.

Although the scope of the research is limited, the broader goal of the present study is to provide a methodological and theoretical framework by which others can analyze specific areas of complexity which non-native English speakers are faced with in the American FL classroom. The purpose of which is the development of explicit phonetic lessons designed for unique classroom populations in order to address these trouble areas in an efficient and effective manner.

CHAPTER 2

BACKGROUND

In the recent years there has been a growing interest in researching when and how to teach phonetics in the language classroom and whether or not it is effective to do so at all (e.g. Arteaga, 2000; Cunningham, 1990; Derwing, Munro, Wiebe, 1998; Elliot, 1997; Lord, 2005; Sturm, 2013). In much of this work there has been a focus on L1 and L2 acquisition as well as FL learning, with attention only recently being paid to L3 learners and even less to how they acquire phonology of the L3 (Amaro, 2013; Jaensch, 2013).

2.1 EXPLICIT INSTRUCTION

Recently, there has been much discussion on the utility of explicit instruction for increasing phonemic awareness during the process of L1 and bilingual acquisition in children, especially relating to literacy (Cunningham, 1990; Swanson, Rosston, Gerber, Solari, 2008; Ukrainetz, Cooney, Dyer, Kysar, Harris, 2000; Yang, H., Yang, S., Kang, 2014). However, there has been very little done in the area of L3 acquisition, which focuses on this type of awareness, let alone on how to assist in its development.

Addressing the question of whether or not explicit phonetic instruction is necessary among adult learners, Arteaga (2000) maintains that it is indeed a vital part of a speaker's communicative competency. She claims that, with the shift from the Audiolingual method of teaching, which emphasized perfect pronunciation, to that of the

current Communicative Language Teaching (CLT), phonetic instruction has been nearly removed from the classroom. She argues, however, that, if CLT claims to focus on communication and intelligibility, it should therefore be concerned with pronunciation and include it in the curriculum. Other researchers have also noted the importance of pronunciation in language teaching, stating that even "exemplary grammar and impeccable vocabulary can be obfuscated by what is perceived as a foreign accent," (Lord, 2005, p. 557).

In addition to intelligibility, Arteaga (2000) also notes that foreign-accented language can carry with it certain social penalties in the TL culture, giving all the more reason for us to instruct our students in this area. In final support for her argument, she brings attention to the fact that the only documented L2 speakers who ever reached native-like pronunciation had all, without exception, received explicit phonetic instruction, proving, according to her, the effectiveness of this method. However, none of these studies have mentioned the importance of teaching perception.

2.2 PHONETIC INSTRUCTION FOR L2 LEARNERS

Many studies have been conducted with various L2 and FL learner populations to test for the effectiveness of explicit instruction on both their production and perception of a wide range of areas in phonology, as well as to test for whether there is a link between these two (e.g. Bradlow, *et al*., 1997; Derwing, *et al*., 1998; Elliot, 1997; Lord, 2005).

In an exemplary study conducted with L2 learners, Derwing, *et al*. (1998) tested how explicit segmental instruction (at the phonemic and syllabic level) faired against explicit global instruction (prosody and other general pronunciation techniques at the suprasegmental level), as well as how both of these compared to non-phonetic instruction

among students of English as a L2 (ESL) in Canada. They tested only for production at the sentence level and the narrative level. What they found was that the segmental instruction showed to be the most effective in pronunciation, but only at the isolated-sentence level. The least effective of the three groups on production was the non-phonetic instruction. These results present a good argument for segment-level explicit instruction, but only for improving individuals' production.

One study of FL learners by Bradlow, *et al*. (1997) focused not only on the production, but also the perception of English /r/ and /l/ by Japanese learners in order to find whether or not perception drives, or at the very least assists, production. Among the students who received explicit instruction, they found a significant improvement in the participants' perception, but with a lag in production, giving evidence that perception precedes production.

A number of studies, similar to the present one, have also been conducted on explicit phonetic instruction in the FL Spanish classroom in the US. In Elliot (1997), American students of an intermediate university Spanish course were instructed in this way for a brief period during each of their class meetings for a whole semester. At the end of the term, the results showed that this explicit phonetic instruction yielded significant improvement in student pronunciation, and that those who received input alone with no explicit instruction showed no improvement. Similarly, Lord (2005) designed a Spanish phonetics course for her American students, focusing on a number of elements which contrast with, or are articulatorily distinct from, English. After this explicit phonetics course in Spanish, she found there to be extensive gains in their

pronunciation on all counts. Although outside the scope of her experiment, she also argued for the utility of explicit phonetic instruction even at the beginning levels.

Adding an additional factor to this argument, Derwing, Thomson, Foote & Munro (2012) state that, in ESL classes, "time is limited […] and many teachers focus very little on pronunciation, [. . . for which] reason it is vital that instructors know which aspects of pronunciation would benefit their students most in class" (261). This call for research has been answered by many, as seen in the studies just reviewed, but nearly every one of these focuses on pronunciation as the goal of phonetic instruction. Nevertheless, now that we know explicit instruction is effective and even necessary in the language classroom for promoting communication and intelligibility, we must search for a way to teach it effectively and efficiently, which, according to Bradlow, *et al*. (1997), would mean beginning with perception. Driven by this need and the scarcity of studies in the existing literature, the research question which led to the present study was:

Q: Can explicit, phonetic instruction improve perception of foreign phonemes among a given population? And, if so, can these effects be maintained over a period of 1 week?

CHAPTER 3

EXPERIMENTAL DESIGN & METHODOLOGY

3.1 PARTICIPANTS[2]

All of the participants ($N = 13$)[3] were native Korean speakers. Four were studying at intensive English institutes located near the local university and the remainder were undergraduate and graduate students at this same university. They had an average age of 26.7 years, with a range of 32 years. The amount of time they had spent in the US varied between 2 weeks and 7.5 years (average: 3.5 years). Each had studied non-intensively in their home country for an average of 9.3 years. By sex, there were 10 male and 3 female. The experimental group ($n = 9$) was made up of 6 male participants and 3 female. The control group ($n = 4$) consisted of 4 male participants. (For the entire breakdown of the participants' background information, see table 3.1.)

3.2 TARGET STRUCTURE

The target structure tested was the voicing feature in Spanish stops, manifested as the main distinction between the two groups of stops /b, d, g/ and /p, t, k/ (for a more detailed discussion of these, please refer to Chapter 1). These stops were recorded in tokens of paired syllables (e.g. "[ka…ka]") with a time space of a second in between the

[2] For the form used to gather sociolinguistic data from participants, see Appendix A.
[3] Three participants were excluded from the experimental group. One male had lived and studied in Peru for over 3 years. Another male had been explicitly taught the voicing distinction in and intensive ESL class for graduate students. One female had been unable to hear the recordings due to excessive background noise during the time of testing.

Table 3.1 Participants' Sociolinguistic Background Data

Participant	Treatment	Age	Sex	L1	L2	Yrs L2 (Engl) Study	Years in U.S.	Yrs L3 (Span) Study	Exposure to Spanish
1	Control	23	M	Korean	Eng	13	2 mo	-	Friends
3	Exp	36	M	Korean	Eng	10+	7.5	-	-
4	Exp	26	M	Korean	Eng	10	8 mo	-	-
5	Exp	32	F	Korean	Eng	10	1	-	-
6	Exp	19	M	Korean	Eng	5	3	1 (hs)	Coworkers
7	Exp	23	M	Korean	Eng	10	2 weeks	-	-
8	Exp	25	F	Korean	Eng	13	5	-	-
9	Exp	19	M	Korean	Eng	10	7***	1 (hs)	Coworkers
10	Control	21	M	Korean	Eng	7	6	1 (hs)	-
11	Control	23	M	Korean	Eng	16	6	-	-
13	Exp	23	F	Korean	Eng	7	5****	0.5 (univ)	-
15	Exp	26	M	Korean*	Eng	8	5****	-	-
16	Control	51	M	Korean	Eng**	4 mo	4 mo	-	-
Average		27				9.3	3.5	3 mo	

Note: Informed consent was received from all participants before testing was conducted.

Key: *mo* signifies month, *hs* signifies high school, and *univ* signifies university.

*Late Japanese bilingual (had studied for 8 years) and had studied one university course in French

**Had studied 1 year of Japanese in Japan

***Lived in Canada (1 mo) and NZ (2 mo), and in Hawai'i (1 yr) when he was 8yrs old

****Lived in Australia for ~3 years

two. Each stop (e.g. /d/) was presented in two separate tokens (e.g. [da…da] and [de…de]).

The vowel context for these tokens was chosen to correct for any phonological phenomena, such as Umlaut with high-front vowels or additional aspiration from back-vowel environments (Choi, 2002; Hume, *et al*., 1994; Kang & Guion, 2006). The most "unreactive" or neutral vowel in this case is /a/, due to the high frequency of its first formant, but /e/ was also chosen in order to more accurately test for successful perception. This is because front vowels reduce the salience of voiceless stops by lowering their *f*0 values, especially in the case of /k/, demanding from the listener a higher level of accuracy in their perception (Hume, *et al*., 1994).

3.3 PREVIOUS RESEARCH

In 2012, the researcher conducted an empirical assessment study, presented at New Sounds 2013 in Montreal, in which ten Korean-speakers were tested in order to find which areas had the highest phonological complexity when perceiving word-initial Spanish stops. It was found that voiced stops were the simplest for Korean speakers to parse as they corresponded evenly with the lax stops in Korean. The voiceless stops were the most complex as the Korean-speakers were observed to rely on the degree of tenseness to define them and, as tenseness is not contrastive in Spanish, this acoustic feature varied between stops, causing confusion for the participants. This finding is supported by the fact that the voiced stops in Spanish have the lowest *f*0, neatly corresponding to the Korean lax stops, whereas the voiceless ones cause Koreans speakers to perceive them incorrectly because, in the absence of aspiration, they only had the *f*0 to go on, which is variable in Spanish. (Kim, M., *et al*, 2002).

This study also brought the researcher's attention to a number of potentially confounding factors in the experimental design. First, certain elements in the phonological context of the carrying syllables for the stop tokens (such as the presence of a liquid consonant or a high or back vowel) influenced the participants' perception of these. Also, the participants were asked to choose from answers written in the Korean writing system, then to choose from answers written in the Latin alphabet. This protocol was later hypothesized to have influenced the phonological processing of the participants, predisposing them to perceive the sound through the Korean phonological system (their writing system expressly demonstrates the phonetic distinction of tenseness and aspiration). These issues were corrected in proceeding experiments by defining a more neutral phonological context for the carrying syllables (CV only, with specifically neutral vowels) and by allowing only choices written in the Latin alphabet, reflecting English norms.

In 2013, the researcher conducted a pilot version of the current study in which a small population of six native Korean ESL students was tested immediately before and after receiving a treatment consisting of explicit phonetic training. Similar to the findings of the previous empirical assessment study, it was found that the participants were 100% successful in parsing the voiced stops. This was hypothesized to have been due to the fact that Spanish voiced stops more closely resemble the lax stops in Korean, based on their lower *f*0, and are not easily confused with the other stops. The voiceless stops, however, seemed to be parsed sporadically by participants. This was assumed to be because they attempted to judge these stops based on tenseness rather than voiceness and, as this feature is in free variation in Spanish, they would become easily confused.

In sum, it was found that all participants performed perfectly in perceiving voiced Spanish stops, as per the researcher's expectations, and that, most importantly, the treatment seemed to have a positive effect on the participants' perception of voiceless stops when compared to that of the control group. This study was, however, found to have an important limitation, besides the miniscule sample size, which was the lack of evidence to indicate whether the participants retained what they had learned from the experimental treatment. This was corrected in the current study by adding a delayed post-test in addition to the immediate post-test and pre-test.

3.4 PRESENT RESEARCH QUESTIONS & HYPOTHESES

The purpose of the present study is to test the effectiveness of explicit instruction in teaching Spanish word-initial consonant stops to Korean-speaking students in the US (Korean L1, English L2). To refresh the reader's memory, the original research question broadly asked whether explicit, phonetic instruction could improve the perception of foreign phonemes among a given population, and if so, could these effects be maintained after the immediate post-test. This question is now narrowed by asking whether or not an efficient, explicit phonetic lesson on the binary voiceness distinction in Spanish can effectively improve the perception of Spanish stops by speakers of Korean, despite the quaternary feature system of Korean stops where tenseness and aspiration are the distinguishing features.

The current study intends to search for an efficient way to teach these, keeping in mind the distinctions noted above. The first hypothesis for this experiment is based on the trend observed in the previous assessment and pilot studies and predicts that:

I. Native speakers of Korean (L2 English) will have the most difficulty with voiceless, word-initial stops (versus voiced ones) due to their placing the Spanish stops within the phonological system of their L1.

The second hypothesis is based on the research conducted on speakers of languages other than Korean (e.g. Bradlow, *et al*., 1997 and Lord, 2005) and proposes that:

II. With simple, explicit, phonetic instruction, native Korean speakers will enhance their perception of the voiceness distinction in Spanish word-initial stops, displayed primarily by an improved perception of voiceless stops, and will show significant retention at one week after the initial post-test.

This hypothesis assumes that explicit phonetic instruction will cause a marked improvement in the results from the perception tests completed by Korean L1 speakers, particularly in their area of greatest complexity—voiceless stops.

To sum up, here are the revised research questions guiding the present study:

1. Do word-initial, voiceless Spanish stops pose a greater challenge to L1 Korean speakers than voiced ones?
2. Does explicit, phonetic instruction improve perception of these stops and, if so, are these effects maintained in a delayed post-test administered one week after the experimental session?

3.5 DESIGN

The experiment was conducted with two groups: the experimental group (n = 9) which received instruction and the control group (n = 4) which did not. The participants in the experimental group first took a pre-test; they then received instruction from a pre-recorded video; immediately following instruction, they were given a post-test; a week

later, they were each given a delayed post-test. The control group received a placebo form of instruction (a reading task concerning cognates which contained no audio input or phonological instruction of any kind, see Appendix B) followed by an immediate post-test, and finally a delayed post-test a week later. The control group was deliberately not given a pre-test in order to guard against any effects of exposure to the target forms.

3.5.1 ASSESSMENT INSTRUMENT & PROCEDURE

The test was created on Praat version 5.3.57© and consisted of 12 tokens and 24 distractors. The tokens were paired recordings of identical repeated syllables (e.g. "[ka…ka]") with a time space of a second in between the two. After each participant listened to the repeated syllable, they were given one second before three buttons appeared on the screen giving them a choice between two syllables as well as a "Not sure" choice. They then had to select as quickly as possible either the button with the written syllable (e.g. "ka" or "ga") which best matched the syllable that they heard or the "Not sure" button. Their response times were also recorded.

The distractors were purposefully chosen due to their salience in being minimal pairs in Spanish but not contrastive in Korean, thereby causing the participant to pay closer attention to these. Each test was randomized both within each participant (by recordings and button placement) and between participants (each participant received one of two versions of the test, and a new pair of test versions was made for each time: Pre, Post, and Delayed Post). All of the recordings were created using Audacity® 1.3.14-beta©, with a USB microphone/headphone combination from Plantronics®. These headphones were also used for the participants to listen to the recorded tokens, as well as

to record them imitating the sounds they heard and (as they were encouraged to do) conducting think-aloud protocol.

3.5.2 EXPERIMENTAL INSTRUCTION

The video of explicit phonetic instruction was recorded on Dell Webcam Central 2.01.18© and consisted of PowerPoint® 2010 slides of the different stops within single syllables, similar to the tokens in the test. These were shown with a voice-over by the investigator while he explained the voicing feature in Spanish, beginning by introducing how it is done in English. The investigator appeared for less than a minute on the video demonstrating voicing by putting a hand over his larynx to feel for vibration, explaining the difference between pre-voiced and voiceless stops by bringing attention to the timing of the voicing. The video was made up of approximately three minutes of explicit instruction and about three minutes of exercises, after each of which there was a brief explicit explanation. No sound bites from the testing were used in the instruction video, but rather the video was conducted in a way similar to what might be done in a classroom environment. (See Appendix C for complete script of the experimental video.)

CHAPTER 4

CODING AND RESULTS

4.1 DATA ANALYSIS

The data was made up of the participants' responses. They were coded as a "1" if the answer was correct, a "0" if it was not, and a null "-" if the participant chose the "Not sure" option. It was found that, in addition to the voluntary choice of the "Not sure" option, response time was a significant indicator of "sureness." After seven seconds, the average percentage of correct responses fell below 60%, legitimating the decision to code these responses as part of the "Not sure" category. Any think-aloud protocols or oral productions of the tokens gathered from the recordings of the participants were used to determine the reliability of their responses in accurately reflecting their perceptive abilities. For example, if a participant chose many incorrect answers with a response time above seven seconds, and was also heard expressing confusion in their think-aloud protocols, this would confirm that these answers were in fact due to uncertainty rather than to a naturally methodical processing of phonological information.

4.2 RESULTS

The results for the Experimental pre-test and the Control immediate post-test (that is, both groups' first exposure to the tokens) were very similar (for raw scores, see Appendix D), as neither group had received phonetic instruction before the test (those who had were excluded from analysis, see footnote 1). The results of this first exposure

for both groups revealed an equivalent high aptitude for perceiving voiced stops (with an average accuracy of 95% for the experimental group versus 100% for Control), as well as a comparable lack of accuracy in perceiving voiceless stops (with an average accuracy of 35% for Experimental and 21% for Control). This result confirmed Hypothesis I, which stated that native Korean speakers would have the most difficulty with voiceless word-initial stops.

In the results from the immediate post-test, the experimental group showed an overall increase in correct answers compared with their answers on the pre-test, with the area of marked improvement being their perception of voiceless stops (see Table 4.1). This result seems to partially confirm Hypothesis II: that overall perception will improve with explicit instruction, especially in the area of highest complexity, that is, voiceless stops. Nevertheless, a non-significant ($p > .05$) drop in the experimental group's perception of voiced stops was also witnessed at the delayed post-test, possibly because the enhanced conscious awareness of a novel distinction made them question their original impressions, including their correct ones.

The delayed post-test for the control group (a second exposure comparable with the immediate post-test of the experimental group), also showed an average increase in perception accuracy concerning voiceless stops, but this increase was minimal, and was due exclusively to the results of a single participant (see participant 10 in Table 4.2). This could be due to a number of factors, including, but not limited to implicit exposure to the target forms and, most importantly, limited sample size.

As is to be expected, overall retention among the experimental group from the immediate post-test to the delayed post-test (conducted one week later) dropped slightly,

Table 4.1 Average Percentage % of Scores and Gains by Time, Treatment, and Variable

Treatment	Pre	Post	Pre-Post Gain	Dpost	Post-DP Gain
Voiceless					
Experimental	22.22	85.19	62.96	79.63	-5.56
Control	-	20.83	-	37.50	16.67
Voiced					
Experimental	96.30	79.63	-16.67	79.63	0.00
Control	-	100.00	-	100.00	0.00
Total					
Experimental	59.26	82.41	23.15	79.63	-2.78
Control	-	60.42	-	68.75	8.33

Table 4.2 Average Percentage of Scores by Participant, Time, and Variable

Parti-cipant	Treat-ment	Pre Total	Pre V+	Pre V-	Post Total	Post V+	Post V-	DPost Total	DP V+	DP V-
1	Control				50	100	0	58.3	100	16.7
3	Exp	91.7	100	83.3	58.3	33.3	83.3	75	83.3	66.7
4	Exp	58.3	100	16.7	91.7	100	83.3	75	50	100
5	Exp	33.3	66.7	0	58.3	66.7	50	66.7	50	83.3
6	Exp	58.3	100	16.7	100	100	100	100	100	100
7	Exp	50	100	0	66.7	33.3	100	91.7	83.3	100
8	Exp	50	100	0	91.7	100	83.3	50	66.7	33.3
9	Exp	50	100	0	83.3	83.3	83.3	91.7	100	83.3
10	Control				58.3	100	16.7	91.7	100	83.3
11	Control				58.3	100	16.7	50	100	0
13	Exp	58.3	100	16.7	91.7	100	83.3	66.7	83.3	50
15	Exp	83.3	100	66.7	100	100	100	100	100	100
16	Control				75	100	50	75	100	50

but was still strong at 91%. Curiously, though, there was no change in their perception of voiced stops between these times. In this way, although the drop in scores from the pre-test to the post-test was not statistically significant, when compared with the delayed post-test, the result was significant ($p < .05$). No such drop in perception of voiced stops had been witnessed in the pilot study, where voiced stops were consistently perceived with an accuracy of 100%, implying that the above-mentioned results for the current study may be due to individual learner differences or other factors outside the scope of this study.

In order to test the hypothesis (H_1: $\mu_{pre} < \mu_{post}$ and $\mu_{post} \leq \mu_{delayed}$ and $\mu_{pre} > \mu_{delayed}$) of the overall effectiveness of the instruction within the experimental group against the null hypothesis (H_0: $\mu_{pre} = \mu_{post} = \mu_{delayed}$), a repeated-measures ANOVA showed an effect for time as a within-groups factor (see Table 4.4), revealing a significant ($p < .05$) difference between the pre- and post-tests, as well as between the pre- and delayed post-tests. The result of a Wilks' Lambda multivariate test also proved significant ($p < .05$, $F = 5.008$). The expected drop in scores between the post- and delayed post-tests, however, was not significant ($p > .05$). As both Hypotheses I and II focus on voiceless stops as the area of highest complexity, a repeated-measures ANOVA was conducted again comparing only the voiceless stops (see Table 4.6), and an even more significant difference was found between the pre- and post-tests ($p < .001$) and the pre- and delayed post-tests ($p < .005$). The Wilks' Lambda multivariate test also showed greater significance ($p < .005$, $F = 16.334$).

Table 4.3 Descriptive Statistics of Total Results for Experimental Group

Time	Mean	Std. Deviation
Pre-test	59.259	17.8946
Post-test	82.407	16.8966
Delayed Post-test	79.63	17.2357

Table 4.4 Pairwise Comparisons of Total Results for Experimental Group

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-23.148*	7.705	.017	-40.9160	-5.1938
	3	-20.370*	6.960	.019	-36.4200	-4.3210
2	1	23.148*	7.705	.017	5.3800	40.9160
	3	3	7.082	.705	-13.5530	19.1090
3	1	20.370*	6.960	.019	4.3210	36.4200
	2	-3	7.082	.705	-19.1090	13.5530

Note: "1" = Pre-test; "2" = Post-test; "3" = Delayed Post-test

* The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.5 Descriptive Statistics of Voiceless Results for Experimental Group

Time	Mean	Std. Deviation
Pre-test	22.222	31.1805
Post-test	85.185	15.466
Delayed Post-test	79.63	24.6894

Table 4.6 Pairwise Comparisons of Voiceless Results for Experimental Group

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-62.963*	10.311	0.000	-86.7390	-39.1870
	3	-57.407*	12.763	0.002	-86.8390	-27.9760
2	1	62.963*	10.311	0.000	39.1870	86.7390
	3	6	8.333	0.524	-13.6610	24.7720
3	1	57.407*	12.763	0.002	27.9760	86.8390
	2	-6	8.333	0.524	-24.7720	13.6610

Note: "1" = Pre-test; "2" = Post-test; "3" = Delayed Post-test

* The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

For comparing the overall effectiveness of instruction to that of non-instruction, a repeated-measures ANOVA test was done between the post-test results and delayed post-test of the experimental group and of the control group. The test results did not prove to be significant both for time as a within-groups factor and a time × treatment interaction ($p > .05$). As before, the test was conducted again, this time excluding the results from the voiced stops. These results were also not significant ($p > .05$). The reason for this is the change between the post- and delayed post-tests for both groups was slight, and there was also no interaction (see Figure 4.1).

Nevertheless, there was a significant improvement overall for the experimental group, and especially for the voiceless stops (see Figure 4.2). A full statistical comparison could not be performed between the two groups, however, and therefore the contrast is lost, since the control group did not receive a pre-test (as the reader may remember, this was done to guard against contamination from implicit exposure to the target forms). Therefore, in order to more accurately present the difference between the two groups, these were compared again based on their first exposure to the tokens (Experimental pre-test, Control post-test) and last exposure (delayed post-test for both groups). The results for the total score showed a significant change for time ($p < .05$, $F = 5.627$), as did the voiceless only results ($p < .01$, $F = 10.702$), but there was still no significant time × treatment interaction. Nonetheless, this lack of significance in interaction may be due to the miniscule sample size of the Control, for, as seen in Figures 4.3 and 4.4, the two groups show very different outcomes.

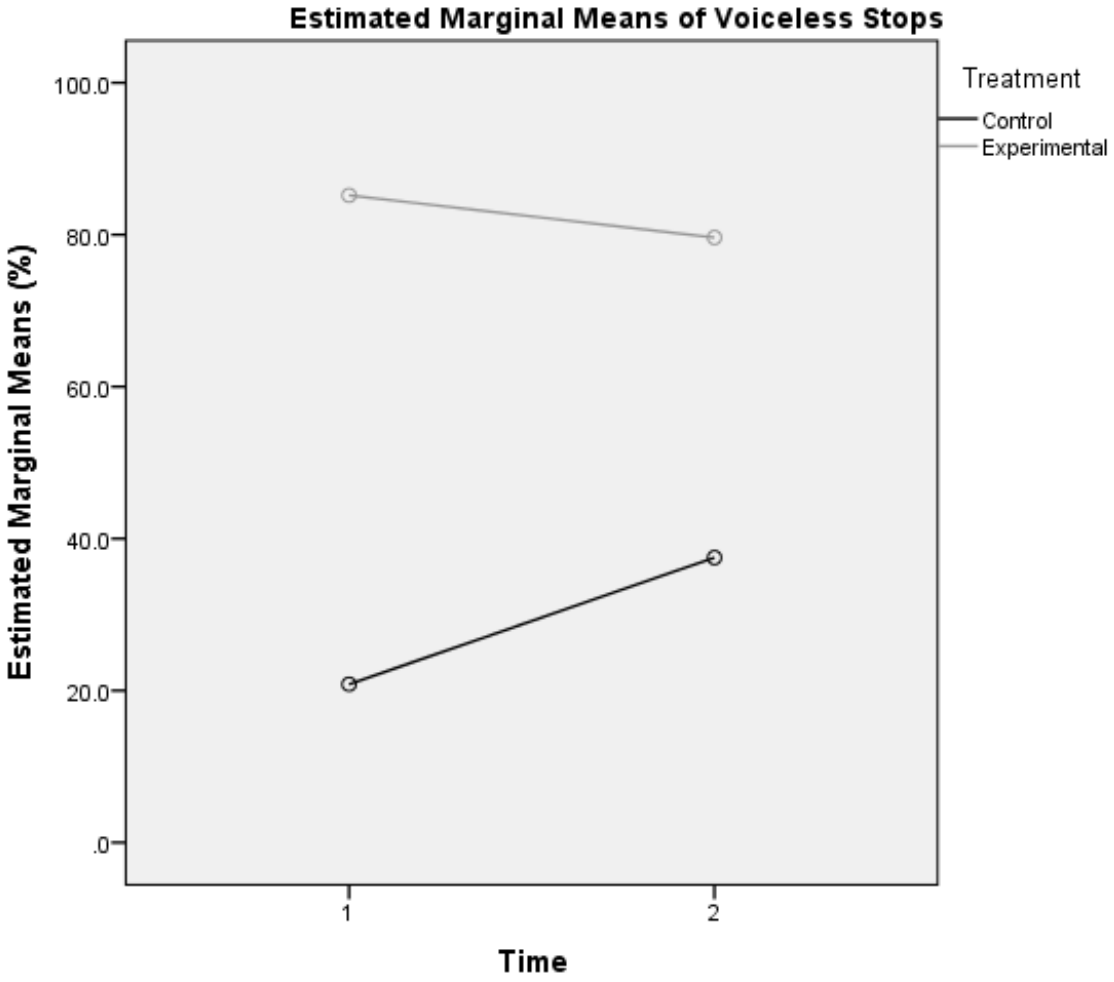

Figure 4.1 Plot of the results of both groups for voiceless stops between the post-test (1) and the delayed post-test (2).

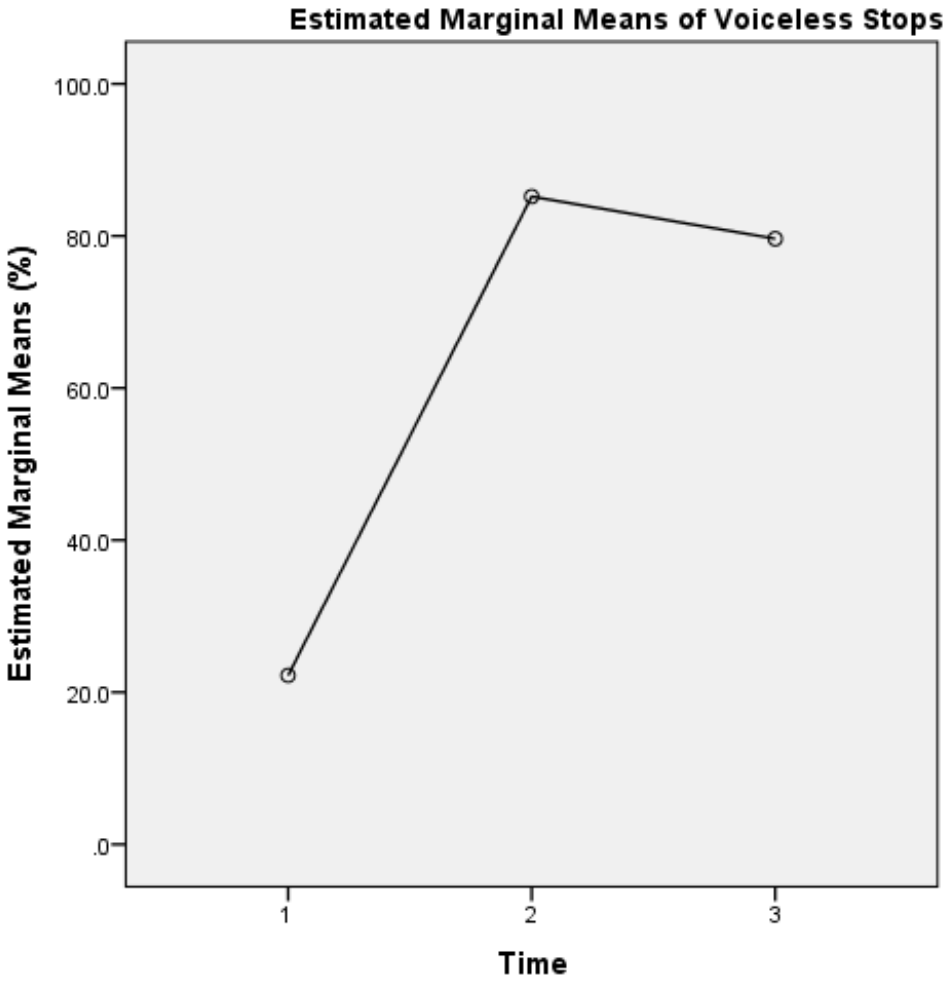

Figure 4.2 Plot of the Experimental results for voiceless stops between the pre-test (1), post-test (2), and the delayed post-test (3).

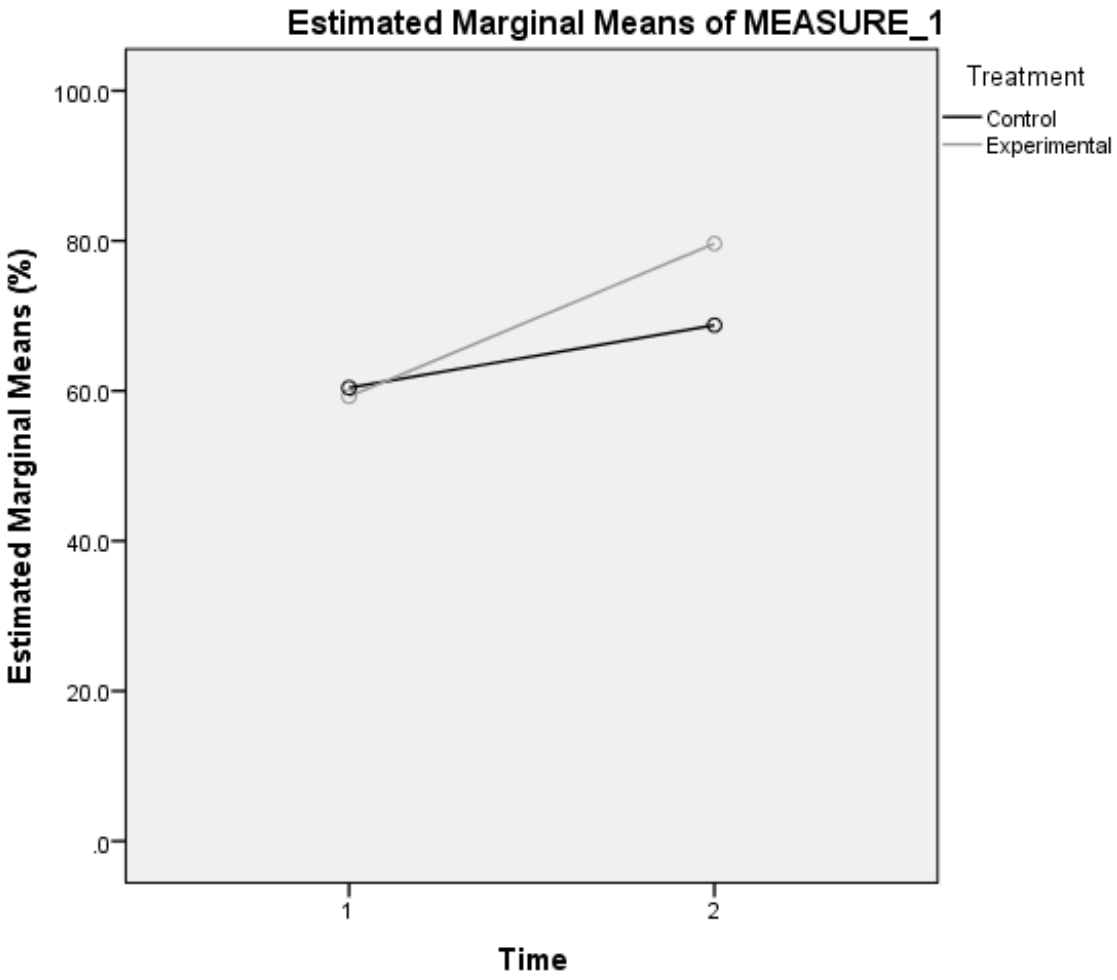

Figure 4.3 Plot of the results from both groups for total score between the First Exposure (1) and the Last Exposure (2).

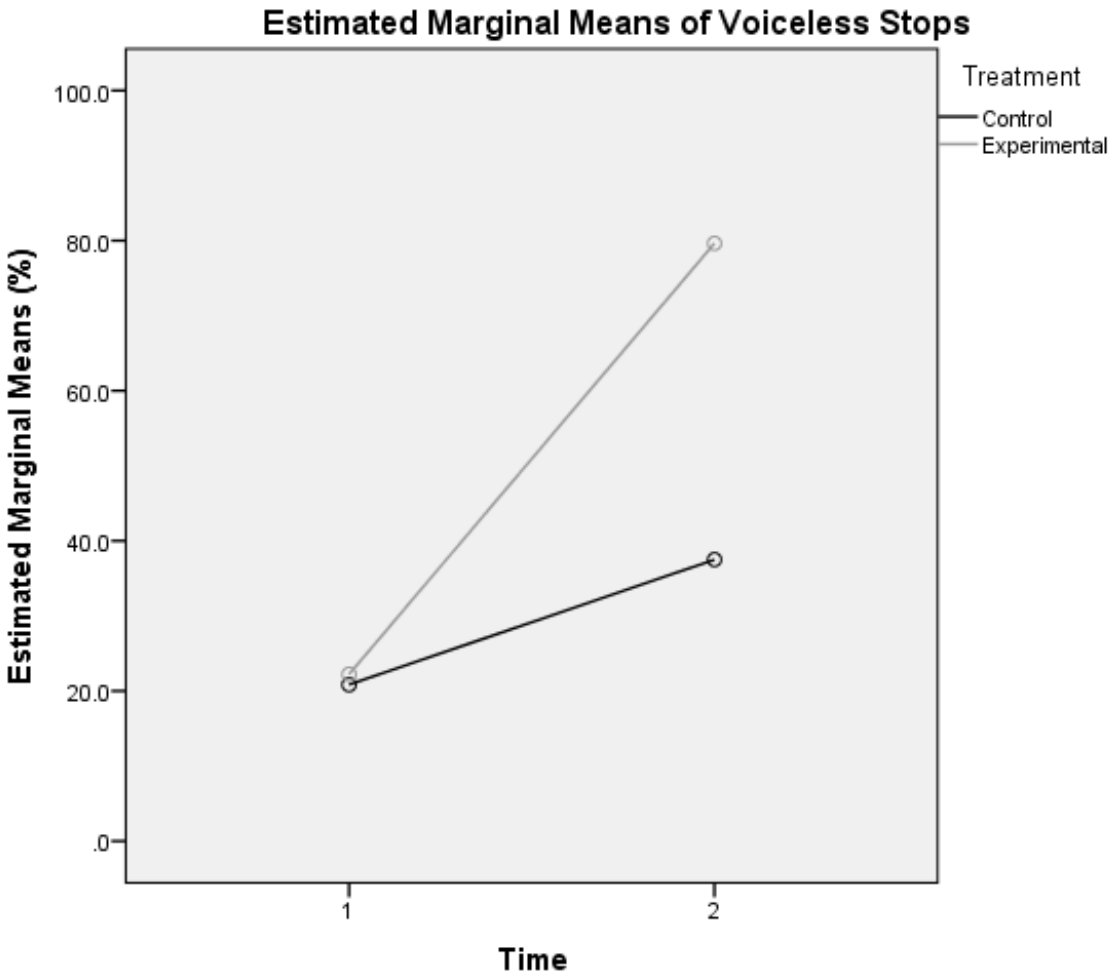

Figure 4.4 Plot of the results from both groups for voiceless stops between the First Exposure (1) and the Last Exposure (2).

CHAPTER 5

DISCUSSION & CONCLUSION

5.1 DISCUSSION

Here will be discussed the reason for the underlying complexities native Korean speakers face when confronted with the voicing system in English and Spanish, as well as probable causes for its lack of salience. Another important issue that has been only briefly mentioned earlier in this study is that of learning an L3. Of the numerous theories concerning this topic, several have surfaced in recent studies concerning how having phonological knowledge of an L2 can uniquely affect one's acquisition of the phonology in additional languages. These will also be considered in light of the results found in this study.

5.1.1 THE UNDERLYING PROBLEM

Returning to the original hypotheses of this study, we saw that the first of these was indeed supported by the results, showing that voiceless stops were far more difficult for the participants to perceive than the voiced stops. This was due in part to the fact that the voiced stops in Spanish have the lowest *f*0 and correspond nicely with the lax stops in Korean. However, the voiceless Spanish stops are more complex because, in the absence of aspiration, Korean speakers only have the *f*0 to go on, and in Spanish, this feature is in free variation (Kim, M., *et al*, 2002).

Although, in the introduction of this study, it was mentioned that this perceptive handicap of Korean speakers goes unnoticed due to their seeming ability to hear the

voicing distinction in English, just because they can perceive a difference between the stops in English does not mean that they have conscious knowledge of the voicing feature. They have both aspirated and the lax stops (perceived correlates to English /p, t, k/ and /b, d, g/, respectively), so they have no need to distinguish voicing (this classification of voiceless stops as their aspirated version is evident in how they pronounce words like "stop" as [sɨt^{h}op] and producing voiced word-initial stops as lax by aspirating words such as "be" as [b^{h}i]) (Ha, *et al*., 2009). In this way, L1 Korean students may "pass under the radar" in their L2 English, having never consciously learned to distinguish voicing, but with little consequence other than a slightly accented pronunciation. However, when they begin to learn Spanish, there is no aspiration to rely on, and so, these students are at a loss. They may produce the sounds adequately by simply pronouncing the voiced stops as lax and the voiceless stops as tense, but native speakers of Spanish do not always produce the voiceless stops with tenseness, leading to a perceptual dilemma for the native Korean students.

5.1.2 THE ISSUE OF L3 ACQUISITION

As Gut (2010) succinctly puts it, "[t]he specific characteristics of L3 acquisition are caused by the fact that L3 learners have already acquired an L2 and thereby have gained conscious linguistic knowledge and language-learning experience on which they can potentially rely when learning a further language" (p. 19). Many researchers have found evidence to support this in many different areas of language, including phonology, but this is not always the case for every situation (hence Gut's use of the word "potentially"). As this study has pointed out, Korean speakers with proficiency in L2 English have not necessarily gained anything which could help them in learning the stops

in Spanish any better than a monolingual Korean speaker (if we take "Years in U.S." data from Table 3.1 as an indicator of proficiency, there are very disparate levels represented).

As indicated, there are many theories of possible sources of influence in the acquisition of L3 phonology. The one which most often comes to mind as a logical source and as one of the most prevalent in L2 acquisition research is phonological influence stemming from the L1 (Ringborn, 1987). Having been rehashed so often in SLA literature, it has been less popular in the burgeoning field of TLA, although some have found evidence for L1 precedence in learning a L3 (Llisterri & Poch, 1987; Mado, Roberta & Alberto, 2007).

Another influence is, as Gut (2010) mentioned, the L2. Beyond simply having a larger repertoire of language tools and experiences gained during L2 acquisition, it has been theorized that a cognitive process, named the "association of foreignness," may also be at work (De Angelis, 2005). According to De Angelis (2005), a cognitive association forms between all non-native languages learned by a given individual, implying that the L2 would retain some influence over all proceeding languages, it having been the first to establish a standard for "foreignness."

An additional factor in TLA is typology, or "the degree of similarity or distance among a given set of languages" (Llama, Cardoso & Collins, 2008, p. 314). For example, Llama, *et al*. (2010) found typology to be the primary factor in determining acquisition of VOT distinction for voicing in Spanish in comparison with the factors mentioned earlier. This is because participants who had French (typologically similar to Spanish, especially concerning VOT length) as one of their spoken languages, whether as and L1 or L2, did similar on their production of Spanish stops.

In the present study, however, the participants perception of Spanish stops were not influenced by English, which is both a "foreign" L2 and typologically similar to Spanish in that it shares the category of voicing to distinguish between word-initial stops. Therefore there was no affect seen due to an "association of foreignness" or simply knowledge of an L2, nor was there an influence of typology, as had been observed by Llama, Cardoso & Collins (2008, 2010) and Tremblay (2007). Instead, there was a prevailing influence from the participants' L1 which dictated their perception by acting as a phonological "sieve" (Martin, *et al*., 2011).

5.1.3 PEDAGOGICAL IMPLICATIONS

The broader goal of this study was to provide a framework in which others can discover and analyze specific difficulties non-native English speakers are having in the American FL classroom, the purpose being the development of explicit phonetic lessons for addressing these areas in an efficient and effective manner. Additionally, as all of the participants in the present study had either never before been exposed to Spanish, or had only a brief exposure to it classroom, the results support the hypothesis of Lord (2005) who claimed that phonetic instruction can indeed be taught even at the earliest stages of language learning.

5.2 CONCLUSION

This study has attempted to answer the questions:

1. Do word-initial, voiceless Spanish stops pose a greater challenge to L1 Korean speakers than voiced ones?

2. Does explicit, phonetic instruction improve perception of these stops and, if so, are these effects maintained in a delayed post-test administered one week after the experimental session?

As has been shown, there is a theoretical basis for affirming the first question which has been further supported by the empirical data in this and previous studies by the author. Concerning the second question, there is a valid argument to be made for explicit phonetic instruction based on the results of this study alone, which support the claims of others who have either hypothesized on this matter or who have conducted their own research in this area based on the practical application of theoretical concerns (e.g. Arteaga, 2000; Derwing, et al. 1998; Elliot, 1997).

5.3 LIMITATIONS & FUTURE RESEARCH

From the data collected in this study, it was found that future replications will be better served if all groups (including the control group) receive a pre-test that is given well in advance to the experimental group's first exposure to the explicit instruction (e.g. 3-4 weeks). In this way, we will have a more even comparison between the two groups while correcting for any incidental contamination of the control group due to implicit exposure to the target forms. Additionally, the results would be stronger if the delayed post-test were repeated again at a later date (e.g. 3-4 weeks after the experimental session) in addition to the original delayed post-test.

Concerning the participants, there was no formal testing of L2 English or L3 Spanish proficiency, nor was their exposure to Spanish equal among all participants, which may have been two important but untested factors. And, as is always the case in studies such as these, the population size was quite limited, resulting in skewed statistical

results when the data from the control group (4 participants in total) were included. Therefore, more research, with more participants, will be needed before these results can be verified. Indeed, this is just one of many areas in need of research in order to inform instructors as to how they may effectively and efficiently teach their non-native English students, and before any general prescriptions may be made for groups of language learners, much more must be done.

It is for this purpose that the overarching goal of this study is to open doors to future research which may proceed by utilizing the same design to test other phonemes; replicating the study with a different L3 variable; or studying the same population but with a different combination of L1 and L2, to name just a few possibilities. Additionally, just as this study found results for perception which correlated with production results from various other authors (Bradlow, *et al*., 1997; Derwing, *et al*., 1998; Elliot, 1997; Lord, 2005), further research may also be done using this framework to test for perception of phonemes among other populations studied previously for their production. Ultimately, it is hoped that the results of this study, and of future studies based on this one, will provide instructors with empirical data to help them develop effective and efficient ways of teaching problematic areas of phonology to their non-native English speaking students.

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APENDIX A – SOCIOLINGUISTIC BACKGROUND QUESTIONNAIRE

Name: Age:

1. As a child, what was your first language?

2. Right now, what is your dominant language (우성 언어)?

    What language(s) do your parents speak at home?

3. What other languages do you speak fluently **or** understand well?

    How long have you studied/spoken them?

4. How long have you lived outside of Korea?

5. How long have you lived in the U.S.?

6. Have you ever studied Spanish before?

    When and for how long?

    Were your instructors native Spanish-speakers?

7. Have you ever lived in a Spanish-speaking country before?

    When, and for how long?

8. What other **recent** exposure (노출) have you had to Spanish?

(Examples: Spanish-speaking friends or roommates, watching Spanish-language TV, etc.)

APENDIX B – CONTROL GROUP ACTIVITY

Los cognados (Cognates)

Objetivo: Identify all of the cognates in a paragraph in order to understand its main ideas.

Recapitulación: A cognate is a word in one language (Spanish) that looks the same and/or sounds the same as a word in another language (English).

Instrucciones: Working with a partner, read the following paragraph and complete the following steps:

1. Scan the passage to *identify* all of the cognates you can find by *circling* them.
2. Make a *list* of all the cognates you circled.
3. Write the *meaning* in English of the cognates you have listed.
4. Read the passage again and *say* what you think the passage is talking about.

¡Hola! Me llamo Javier y soy estudiante en la Universidad de Carolina del Sur en los Estados Unidos. Ayer *(yesterday)* hubo un accidente de automóvil terrible en la intersección de las calles Gervais y Assembly. Un chico que manejaba su carro negro perdió el control del vehículo y colisionó con un poste de luz eléctrica. Por suerte *(luckily)* llegaron la policía y la ambulancia rápidamente y condujeron al chico al hospital inmediatamente. Las personas que observaron el accidente estaban muy sorprendido y preocupados por el chico. Unas horas después *(later)* yo recibí una llamada por teléfono. ¡Era *(it was)* un doctor del hospital que me informó que el chico del accidente era *(was)* mi compañero de apartamento! ¡Qué horrible! ¡Gracias a Dios que está en condición estable!

List of Spanish cognates	**Meaning in English**

APENDIX C – EXPERIMENTAL VIDEO SCRIPT

¡Hola! 안녕하세요! Thank you for participating in my study! In this mini-lesson, I will be teaching you how to hear the difference between these Spanish sounds... Pe, be…

Do these sound the same? What about de, te? How about ga, ka?

These sounds are similar to the ones in English. In English and Spanish, we have two groups, on the top, the voiced group, and on the bottom, the voiceless group.

The difference between these two groups is whether they use the vocal cords or not. You can feel them vibrate when you put your hand over your throat like this for the group on the top…bdg…but the group on the bottom does not make any vibration…ptk. Now you try!

(Together)

Now, notice how the voiced sound starts right when you let the air out? B, d, g. That is how English does it. In Spanish, the voice sound starts *before* you release the air. B, d, g.

(Demonstrate)

Now you try!

(Together, slowly)

Now let's look at the group of voiceless sounds on the bottom. For these, there is no vibration of the vocal cords.

(Demonstrate)

Spanish does not have [p^h, t^h, k^h], but only has something similar to ㄲ (sang gi-eok). See?

(Demonstrate)

Now you try!

(Together, slowly)

Let's take a look at some examples…

(Goes through all series of stops in the pair form ba/be, bringing attention to voicing characteristics for each)

Ok, now let's play a listening game. I'm going to say a syllable, and you choose the one that you think you are hearing. Let's see if you can figure out which one it is!

/pe/ x2

Did you get it right? ... Remember, you can tell it's a /p/ because you can hear the voicing begin *immediately* when I release it. Hear the difference between one and two…

(Demonstrate again, exaggeratingly)

Let's try another. Listen carefully:

/ga/ x2

Did you get it right? ... Remember, you can tell it's a /g/ because you can hear the voicing *before* I release it. Hear the difference between one and two…

(Demonstrate again, exaggeratingly)

Let's try one more. Listen carefully:

/te/ x2

Did you get it right? ... Remember, you can tell it's a /t/ because you can hear the voicing begin *immediately* when I release it. Hear the difference between one and two…

(Demonstrate again, exaggeratedly)

Do you think you're ready now? Let's test it!

APENDIX D – RAW SCORES

Table D.1 Raw Scores of Experimental Group by Participant and Token

Pre	ba	be	da	de	ga	ge	pa	pe	ta	te	ka	ke	Sum	%
3E	1	1	1	1	1	1	1	1	-	1	1	1	11	91.7
4E	1	1	1	1	1	1	1*12	0	1	0	1*8	0	7	58.3
5E	1	1	1	-*11	-*14	1	0*7	-*20	-*14	-*15	0	0	4	33.3
6E	1	1	1	1	1	1	0	0	1*9	1	0	0	7	58.3
7E	1	1	1	1	1	1	-	-	-	-	-	0*7	6	50.0
8E	1	1	1	1	1	1	0	-	0	0	0	0	6	50.0
9E	1	1	1	1	1	1	0	-	0	0	0	0	6	50.0
13E	1	1	1	1	1	1	-*9	-*11	-*8	-*9	0	1	7	58.3
15E	1	1	1	1	1	1	1	1	1	1	0	0	10	83.3
Total Avrg													7.1	59.3
Post	ba	be	da	de	ga	ge	pa	pe	ta	te	ka	ke	Sum	%
3E	0	1	0	0*9	0	1	1	1	1	1	0	1	7	58.3
4E	1	1	1	1	1	1	1	1	1	1	1	0	11	91.7
5E	1	1	0*22	0	1	1	1	1*7	1	1	1*7	1*9	7	58.3
6E	1	1	1	1	1	1	1	1	1	1	1	1	12	100.0
7E	1	1*10	0*9	0	0	1	1	1	1	1	1	1	8	66.7
8E	1	1	1	1	1	1	1	1	1	1	1	0*7	11	91.7
9E	1	1	1	1	-	1	1	1	1	1	1	0	10	83.3
13E	1	1	1	1	1	1	1	1	1	1	0	1	11	91.7
15E	1	1	1	1	1	1	1	1	1	1	1	1	12	100.0
Total Avrg													9.9	82.4
DP	ba	be	da	de	ga	ge	pa	pe	ta	te	ka	ke	Sum	%
3E	0	1	1	1	1	1	0	1	0	1	1	1	9	75.0
4E	0	0	1	0	1	1	1	1	1	1	1	1	9	75.0
5E	0	1	0	0	1	1	1	1	1	1	1	0	8	66.7
6E	1	1	1	1	1	1	1	1	1	1	1	1	12	100.0
7E	1	1	1	1*7	1	1	1	1	1	1	1	1	11	91.7
8E	1	1	1	0	1	0	1	1	0	0	0	0	6	50.0
9E	1	1	1	1	1	1	0	1	1	1	1	1	11	91.7
13E	1	1	1	1	1*11	1	1	1	0	0	0	1	8	66.7
15E	1	1	1	1	1	1	1	1	1	1	1	1	12	100.0
Total Avrg													9.6	79.6

* Indicates that the participant's response time was at or beyond seven seconds, followed by the reaction time.

Table D.2 Raw Scores of Control Group by Participant and Token

Post	ba	be	da	de	ga	ge	pa	pe	ta	te	ka	ke	Sum	%
1C	1	1	1	1	1	1	0	0	0	0	0	0	6	50.0
10C	1	1	1	1	1	1	0	1	-	0	0	0	7	58.3
11C	1	1	1	1	1	1	0	0	0	1	0	0	7	58.3
16C	1	1	1	1	1	1	1	0*14	1	0	0	1	9	75.0
Total Avrg													7.3	60.4
DP	ba	be	da	de	ga	ge	pa	pe	ta	te	ka	ke	Sum	%
1C	1	1	1	1	1	1	0	0	1	0	0	0	7	58.3
10C	1	1	1	1	1	1	1	1	-	1	1	1	11	91.7
11C	1	1	1	1	1	1	0	0	0	0	0	0	6	50.0
16C	1	1	1	1	1	1	1	0	0	1	1	0*11	9	75.0
Total Avrg													8.3	68.8

* Indicates that the participant's response time was at or beyond seven seconds, followed by the reaction time.