FIRST LANGUAGE PHONOLOGICAL PROCESSES AND
MORPHOPHONOLOGICAL RULES IN SECOND LANGUAGE
ACQUISITION: KOREAN LEARNERS OF ENGLISH

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To my family
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ABSTRACT

This dissertation addresses two principal questions about the acquisition of English phonology by speakers of Korean. The first is: Do native speakers of Korean show a difference in transfer of Korean phonological processes and morphophonological rules in the acquisition of English? Morphologically conditioned morphophonological rules should be easy to suppress in L2 because speakers can pronounce their inputs easily, which indicates that such rules lack synchronic phonetic motivation. In contrast, phonological processes are expected to be difficult to suppress in L2 because, in L1, speakers are not required to pronounce their inputs. My second question is about the effect of phonological and phonetic factors in L1 transfer: How do word boundaries, voicing, and/or point of articulation (homorganicity) affect the application of transferred processes?

In order to answer these questions, I tested four Korean phonological processes—STOP NASALIZATION, CORONAL STOP LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION—and three morphophonological rules—T-PALATALIZATION and the DUIMA LAW (L-NASALIZATION and N-DELETION). An elicited production task was performed by thirty-two speakers of Standard South Korean.

The main findings from the production task are, first, that L1 phonological processes and morphophonological rules show different behavior in L2; that is, L1 phonological processes tend to transfer in L2 and morphophonological rules do not. Second, phonological factors that seem irrelevant in L1 may still affect the degree of difficulty of sequences in L2. Stop voicing affected STOP NASALIZATION and CORONAL...
STOP LATERALIZATION; STOP NASALIZATION and CORONAL STOP LATERALIZATION occurred more frequently with voiceless stops than with voiced stops. Homorganicity also affected STOP NASALIZATION, which occurred more frequently in homorganic sequences than in heterorganic sequences. Word boundaries affected N-LATERALIZATION and S-PALATALIZATION; these occurred more frequently within words than across word boundaries. And syllabicity (/i/ versus /j/) affected S-PALATALIZATION, which occurred more frequently before /j/ than /i/.
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CHAPTER 1
INTRODUCTION

1.1 Goal

Why does a speaker show a first language accent when learning a second or foreign language? Korean learners of English, for example, tend to show mispronunciations like ‘jackknife’ [dʒæknaiʃ], ‘potluck’ [pʰælk], and ‘wellness’ [weləs]. This is attributed to the transfer (or interference) of the first language (here, Korean) phonological system to the second (or foreign) language (here, English) pronunciations (Broselow 1987, Major 2001, among others). Such mispronunciations take place when the learner cannot produce second-language sounds correctly because of “constraints on a pre-trained articulatory system” (Hancin-Bhatt 1994:13). For example, Korean speakers often have difficulty accurately producing a voiceless stop, or even a glottalized stop or glottal stop, before a nasal. Certain sequences of sounds appear to be more difficult than others for them to produce.

There has been much research in second language phonology, especially regarding L1 transfer, within many theoretical frameworks, including the contrastive analysis hypothesis, the markedness differential hypothesis, etc. For example, contrastive analysis approaches have focused on identifying the differences between first language (L1) and second language (L2) phonological inventories and predicting difficulties in L2 speech based on these differences (Lado 1957 among others). The markedness differential hypothesis has attempted to explain how universal markedness constraints interact with L1 transfer (Eckman 1977, 1981).
Sound substitutions, the systematic change of one input segment to another in L1 productive synchronic alternations, are found in all languages. Not all the sound substitutions of one segment for another in L1 are transferred to L2. In the case of Korean learners of English, some L1 phonological substitutions are transferred to L2, in examples like ‘goodness’ [gunヌe] and ‘catnap’ [kʰæn,naep’], whereas other phonological substitutions are not. For example, word-initial /l/ and /ni/ are not allowed in Sino-Korean words, and word-initial /l/ and /ni/ become [n] and [i], respectively. Thus, one might expect ‘lion’ [la̞jɔn] and ‘neat’ [nɪt’] to be realized as [na̞jɔn] and [i̞t’], respectively, but this does not occur. This is illustrated in examples like ‘lion’ [la̞jɔn] and ‘neat’ [nɪt’]. The difference in transferability of sound substitutions requires us to distinguish them. As Singh and Ford (1987) point out, in standard Generative Phonology (Chomsky and Halle 1968) all phonological substitutions were dealt with homogeneously. Since then, theories have appeared in which the types of sound substitutions are not always treated identically (Singh and Ford 1987). Among others, Natural Phonology (Stampe 1979, Donegan and Stampe 1979, Donegan 1985), Lexical Phonology (Mohanan 1982, 1986, Kiparsky 1982, 1983) and Cyclic Phonology (Rubach 1984a) have attempted to classify phonological substitutions into two types based on a number of characteristics of the substitutions. Differences between the two types will be presented in section 2.1.1. In Natural Phonology, the types of phonological substitutions

1 Another variation [rajәn] is the result of an allophonic process tapping. In native Korean words, word-initial /l/ becomes a tap.
are divided into phonological processes and morphophonological rules; in Lexical Phonology, lexical rules and postlexical rules; in Cyclic Phonology, cyclic rules and postcyclic rules. This classification may help to give an account of phonological transfer (or interference) of L1 to L2 which standard Generative Phonology did not offer. Unlike these theories, however, Optimality Theory (Prince and Smolensky 1993) which is based on constraints, does not give a distinction of types of sound substitutions, even though Optimality Theory tries to account for phonological phenomena with different types of universal constraints (e.g., faithfulness and well-formedness constraints) and their rankings.

L1 substitutions, in general, are affected by phonological conditions. According to Carlisle (1991) and Park (2002b), phonological conditions also play a role in L1 transfer. Carlisle investigated the influence of environment on Vowel Epenthesis in Spanish-English interphonology. His study showed that Epenthesis occurred before the three onsets – /sp/, /st/, and /sk/\(^2\) more frequently after word-final consonants than after word-final vowels. Park also showed that phonological conditions play a role in L2 transfer. Stop Nasalization occurred more frequently in the sequence of a voiceless stop plus a nasal than in the sequence of a voiced stop plus a nasal, and Stop Nasalization occurred more frequently in homorganic sequences of a stop plus a nasal than in heterorganic sequences of a stop plus a nasal.

The main purposes of this study are a) to investigate the difference in L2 transferability of two types of sound substitutions and b) to assess the effects of certain

\(^2\) In Spanish, these sequences are not allowed within a syllable.
phonological conditions on the transfer of phonological substitutions.

1.2 Organization

The chapters are organized as follows: Chapter 2 provides a review of relevant literature and attempts to characterize the two types of substitution. Chapter 3 sketches the phonologies of Korean and English, and it includes my research questions. Chapter 4 presents the experimental studies of the first of the two types of sound substitutions, including design of the experiments, with descriptions of participants, stimuli, and procedures, results, data analyses, and some discussion. Chapter 5 presents the experimental studies of the other type of sound substitutions. In Chapter 6, the L2 effects of the various substitutions tested are compared. Finally, in the last chapter, the summary and general conclusions of this study are presented.
CHAPTER 2

LITERATURE REVIEW

Speakers show L1 accent in L2 learning, and this has been attributed to transfer of the L1 phonological system to L2. But the phonological system of an L1 is not homogeneous; there may be different types of phonological substitutions. Transfer may depend on the nature of L1 phonological substitutions. In this chapter, I will summarize the characteristics of two types of phonological substitutions, based on previous theories. I will also take a brief look at how phonotactic constraints may be relevant in L2 learning, and I will examine how this typology of phonological substitutions and constraints may predict transfer of L1 phonology to L2; that is, how the two types of substitutions transfer in L2 learning. This literature review will provide some evidence for a difference in transferability of phonological substitutions.

2.1 Typology of phonological substitutions

As Singh and Ford (1987) pointed out, all phonological substitutions were dealt with homogeneously in standard Generative Phonology (Chomsky and Halle 1968). If we take a look at the behavior of phonological substitutions, we can easily find a need for a typology of phonological substitutions. The evidence for two types of phonological substitutions is found in the characteristics of phonological substitutions which are first discussed in Natural Phonology (Stampe 1979, Donegan and Stampe 1979, Donegan 1985) and then taken up by Lexical Phonology (Mohanan 1982, 1986, Kiparsky 1982, 1989).
1983) and Cyclic Phonology (Rubach 1984a).

Table 2.1 summarizes the evidence for a difference between two types of phonological substitutions.

Table 2.1 Typological characteristics of phonological substitutions

<table>
<thead>
<tr>
<th>Sources</th>
<th>Type A</th>
<th>Type B</th>
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<tbody>
<tr>
<td>Donegan &amp; Stampe (1979), Kiparsky (1982, 1983), Rubach (1984a)</td>
<td>5. Apply in derived environments (not within a morpheme)</td>
<td>5. Apply across the board</td>
</tr>
<tr>
<td>Kiparsky (1982, 1983)</td>
<td>6. Disjunctively ordered with respect to other Type A</td>
<td>6. Conjunctively ordered with respect to Type A</td>
</tr>
<tr>
<td>Kiparsky (1982, 1983)</td>
<td>8. Apply to lexical categories only</td>
<td>8. Apply to all categories</td>
</tr>
<tr>
<td>Stampe (1979), Donegan &amp; Stampe (1979), Donegan 1985</td>
<td>10. Always obligatory – apply regardless of factors like tempo</td>
<td>10. May be optional (variable) or obligatory, depending on speech style, tempo, and attention</td>
</tr>
<tr>
<td>Stampe (1979), Donegan &amp; Stampe (1979), Mohanan (1982, 1986), Rubach (1984a)</td>
<td>13. Depend on morphological information</td>
<td>13. Do not depend on morphological information (However, morpheme boundaries may affect syllabification, and syllabification may affect the application of Type B.)</td>
</tr>
<tr>
<td>Stampe (1979), Donegan &amp; Stampe (1979), Donegan 1985</td>
<td>14. An input is felt to be no more difficult to pronounce than the substitute</td>
<td>14. An input is felt to be more difficult to pronounce than the substitute, even if the substitution is optional</td>
</tr>
</tbody>
</table>
As Table 2.1 indicates, Type A substitutions apply only within words, whereas Type B substitutions may apply across word boundaries (Stampe 1979, Mohanan 1982 and 1986, Kiparsky 1982 and 1983). For example, consider VELAR SOFTENING and TAPPING in English. VELAR SOFTENING changes /k/ to [s] before the suffix -ity only within words in cases like electricity [tˌlekˈtrɪsɪtɪ]; it belongs to Type A substitutions. TAPPING generally changes /t/ or /d/ to [r] in syllable-final position, sometimes within words like water ['wɔːtə] and sometimes across a word boundary in cases like get it [ˈɡɛtɪt]; it belongs to Type B substitutions.

Second, Type A substitutions have access to word-internal structure assigned at the same level only, whereas Type B substitutions have access to phrase structure only (Kiparsky 1982, 1983, Rubach 1984a). For example, in a word such as [[nation]al]ity, the Type A substitutions, TRISYLLABIC LAXING, which changes the vowel in the first syllable of a base nation when the suffix -al is added, and STRESS SHIFT, which moves the stress on a base national to the right when the suffix -ity added, apply at the same level (the first level here) (Kaisse and Shaw 1985:5). In contrast, Type B substitutions apply to words like [nationality] and phrases like [[hit] [him]] in structures that are characterized at the syntactic level (TAPPING which changes the t in nationality to a tap, and H-DELETION/TAPPING which delete the h from him and change the t in hit to a tap, respectively, in the post-lexical/syntactic level).

Third, all Type A substitutions precede all Type B substitutions (Stampe 1979, Donegan & Stampe 1979, Kiparsky 1982, 1983, Rubach 1984a, Donegan 1985). Stampe
1979, Donegan & Stampe (1979) and Donegan (1985) claim that Type A substitutions precede all Type B substitutions, because they find that Type B substitutions apply after slips of the tongue and secret-language rules, but Type A substitutions apply before them. Stampe (1979:44) and Donegan (1985:10) claim that one gets a phonetically well-formed output when a slip of the tongue applies before ASPIRATION, for example, if the slip exchanges the /k/ and /t/ in /skatʃ teɪp/ ‘Scotch tape,’ as shown in the following:

(1) /skatʃ teɪp/  ‘Scotch tape’

| Tongue-slip |  stətʃ kɛɪp | ASPIRATION | skatʃ tʰɛɪp |
| ASPIRATION |  stətʃ kʰɛɪp | Tongue-slip | stʰatʃ kɛɪp |
|            |  ['stətʃ,kʰɛɪp] |            | *['stʰatʃ,kɛɪp] |

In contrast, according to Stampe (1979:45), English shows that “the alternation of [k] with [s] and [ɡ] with [dʒ] before reflexes of front vowels in words of Romance origin, e.g., electric [k] beside electricity [s], pedagogue [ɡ] beside pedagogy [dʒ], is clearly learned.” He claims that these learned alternations “are utterly insensitive to slips: the spoonerism of cynical guys is not [tʃimk] 'kajz], as we would expect if this learned rule [i.e., Type A substitution] applied after slips occur, but simply [ɡmɪk] 'sajz].” (Stampe 1979:45)

Fourth, Type A substitutions apply cyclically, whereas Type B substitutions apply once, although some apply iteratively (Donegan & Stampe 1979, Kiparsky 1982,

---

1 Stampe (1979:45) refers to “the palatality of [ɡ]”, so I assume that [ɡ] is a fronted [g]. According to Stampe, it is readjusted by an innate Type B process after the spoonerism occurs.

2 With regard to cyclicity, Mohanan (1986:51) claims that “cyclicity is a property of the stratum, not of the rule in Lexical phonology” and “[t]hus a rule may apply cyclically in one domain and noncyclically in another” (For details, refer to section 2.5 in Mohanan (1986)).
According to Kiparsky (1982, 1983) and Rubach (1984a), Type A substitutions are cyclic because they reapply at each step (i.e., each cycle). For example, TRISYLLABIC LAXING and STRESS SHIFT apply iteratively in the same order at each cycle in the derivation of [[[national]ity] which takes place on a single level (the first level here) (Rubach 1984a:2–4). The noncyclic application of Type B substitutions means that they “apply in a single pass to the entire phonological phrase” after syntactic representation (Kiparsky 1983:6). On the other hand, Donegan and Stampe (1979) claim that Type B substitutions can apply once or iteratively, as illustrated in the following:

(2) Type B substitutions

\[
\begin{align*}
&{(TAPPING)}^6, \text{NASALIZATION, N-DELETION,} \\
&(\text{PROGRESSIVE NASALIZATION})] \\
&\text{A [\text{\texttt{\textbackslash w\textipa{\texttt{\textbackslash i\textipa{\textbackslash t}}}\textipa{\textbackslash o}]}]} \\
&[TAPPING, (\text{NASALIZATION, N-DELETION,} \\
&(\text{PROGRESSIVE NASALIZATION})] \\
&B [\text{\texttt{\textbackslash w\textipa{\texttt{\textbackslash i\textipa{\texttt{\textbackslash r}}}\textipa{\textbackslash o}]}]} \\
&[(TAPPING, \text{NASALIZATION, N-DELETION,} \\
&(\text{PROGRESSIVE NASALIZATION})] \\
&C [\text{\texttt{\textbackslash w\textipa{\texttt{\textbackslash i\textipa{\texttt{\textbackslash r}}}\textipa{\textbackslash i}}}]} \\
\end{align*}
\]

The first simultaneous application of four Type B substitutions – TAPPING, NASALIZATION, N-DELETION, and PROGRESSIVE NASALIZATION – to /\textipa{\textbackslash w\textipa{\textbackslash i\textipa{\textbackslash r\textipa{\textbackslash t}}}\textipa{\textbackslash o}]/winter derives variant A. The iterative application of the Type B substitutions together can result in two further variants B and C.

Fifth, Type A substitutions apply in derived environments (not within a morpheme), whereas Type B substitutions apply across the board (Donegan & Stampe

\[\text{\textsuperscript{6} Processes in the parentheses indicate their vacuous application.}\]
1979, Kiparsky 1982, 1983, Rubach 1984a). According to Kiparsky (1982a:152), a 'derived environment' is defined as follows:

"An environment E is derived with respect to a rule [Type A substitution] R if E satisfies the structural description of R crucially by virtue of a combination of morphemes or the application of a rule [Type A substitution]."

For example, consider the Korean words: /mati/ [madi] 'joint' and /mat-i/ [maji] 'oldest child' (first+person marker). /mati/ 'joint' does not include a derived environment (i.e., a derived [t]-[i] sequence), and thus T-PALATALIZATION does not apply to it, and it surfaces as [madi]. (Note that the voiced stop is a result of a ‘natural’ (Type B) substitution of VOICING.) On the contrary, /mat-i/ 'oldest child' has a derived environment (i.e., a derived [t]-[i] sequence) and thus T-PALATALIZATION applies, producing (intermediate) *[maci], and VOICING results in [maji].

Sixth, Type A substitutions are disjunctively ordered with respect to other Type A substitutions, whereas Type B substitutions are conjunctively ordered with respect to Type A substitutions (Kiparsky 1982, 1983). Kiparsky (1982b:8) presents the following modified formulation in order to block *oxens, which would result from applying another AFFIXATION (general substitution (Type A)) of the third level to the word oxen with a derived environment formed by an AFFIXATION (special substitution (Type A)) in the first level:

"[Type A substitutions] A, B in the same component apply disjunctively to a form Φ if and only if

(i) The structural description of A (the special [substitution]) properly includes the structural description of B (the general [substitution])."
The result of applying A to Φ is distinct from the result of applying B to Φ.
In this case, A is applied first, and if it takes effect, then B is not applied.”

Kiparsky (1982, 1983) claims that, unlike Type A substitutions, Type B substitutions are conjunctively ordered with respect to Type A substitutions, as illustrated in examples below.

(3) /aks/ ox /ilekturk+tti/ electricity
Type A: AFFIXATION (-en) /aks+on/ VELAR SOFTENING [ilekturositi]
  AFFIXATION (-s) —
Type B: NASALIZATION ['aksøn] TAPPING [ilektuursiri]

Seventh, Type A substitutions are structure preserving (never allophonic), whereas Type B substitutions are not; they can be allophonic or phonemic (Donegan & Stampe 1979, Kiparsky 1983). **VELAR SOFTENING** involves a phonemic (i.e., structure preserving) change of k to s, and it is said to belong to Type A substitutions. In contrast, **VOWEL NASALIZATION** (e.g., van /væn/ [væn]) is an allophonic substitution, which means that it is not structure preserving, since nasalized vowels are not phonemes in English, and it is said to belong to Type B substitutions. According to Natural Phonology, Type B substitutions may also have a morphophonemic effect, as in English **NASAL PLACE ASSIMILATION** (ten pounds /ten paundz/ may become [tʰɛm pʰɑʊndz]).

Eighth, Type A substitutions apply to lexical categories only, whereas Type B substitutions apply to all categories (Kiparsky 1982, 1983). Kiparsky claims that Type A substitutions apply to specified lexical categories only, like Noun, Verb, Adjective, Adverb, because such categories as Determiner, Pronoun, Auxiliary, Complementizer, Conjunction, and Interjection fail to enter into word-formation processes. But these
categories do undergo Type B substitutions in examples like *in /ɪn/ [ɪn] (VOWEL NAZALIZATION) and *in Boston /ɪn ˈbɒstn/ [ɪm ˈbɒstn] (VOWEL NAZALIZATION and NASAL PLACE ASSIMILATION).

Ninth, Type A substitutions may have exceptions, whereas Type B substitutions are automatic (Stampe 1979, Donegan and Stampe 1979, Kiparsky 1983, Rubach 1984a). Type A substitutions like English TRISYLLABIC LAXING allow exceptions like obesity in which TRISYLLABIC LAXING fails to apply to the second vowel. Type B substitutions do not have exceptional forms, that is, forms to which they may not apply. Donegan and Stampe (1979) point out that there are sometimes surface exceptions because Type B substitutions like NASAL PLACE ASSIMILATION may be optional, but this is not the same as having to specify forms to which Type B substitutions cannot apply. Thus, obesity is realized phonetically as only [ʊˈbɪsəri] (*[ʊˈbɛsəri]), whereas ten pounds is realized phonetically as [tʰɛn pʰaʊndз] ~ [tʰɛm pʰaʊndз].

Tenth, Type A substitutions are always obligatory, that is, they apply regardless of factors like tempo, whereas Type B substitutions may be optional (variable) or obligatory, depending on speech style, tempo, and attention (Stampe 1979, Donegan & Stampe 1979, Donegan 1985). For example, Type A substitutions like VELAR SOFTENING, TRISYLLABIC LAXING and T-DELETION apply obligatorily to the relevant words (except for exceptions, in which case they obligatorily do not apply), as illustrated in *opaque+ity [oˈpæsəri] (*[oˈpeɪkəri]) and *soft+en [sɒfən] (*[sɒfən]). On the other hand, some Type B substitutions like English NASAL PLACE ASSIMILATION and PALATALIZATION
are affected by factors like tempo and are optional, as illustrated in *miss you* [mɪsju] ~ [mɪʃju] (the phrase is more susceptible to the assimilation in fast or non-emphatic speech). Other Type B substitutions like Korean *STOP NASALIZATION* are of course obligatory, as illustrated in */kok-mul/ [koŋmul] (*[kökmul]) ‘grain.’

Eleventh, Type A substitutions often involve a radical substitution, as illustrated in *electricity* /ɪlektrɪk+tɪ/ [ɪlktrɪsɪrɪ] (VELAR SOFTENING: [−cont, −ant] → [+cont, +cor, +ant] / ____+[+syl, +high, −back]), whereas Type B substitutions involve only a minimal substitution, as illustrated in *van* /væn/ [vaːn] (VOWEL NASALIZATION: [+son] → [+nas] / ____ [+nas]) (Stampe 1979). In other words, Type A substitutions can change more features than Type B substitutions. Type B substitutions typically change one feature.

Twelfth, Type A substitutions are occasionally borrowed when a lot of vocabulary is borrowed (e.g., the English *k/s* alternation (VELAR SOFTENING) from French), whereas Type B substitutions cannot be borrowed (Donegan & Stampe 1979, Donegan 1985). For example, Type B substitutions like WORD-FINAL DEVOICING are not borrowed from German when German words are borrowed into English. Donegan & Stampe (1979:144–145) claim that “if a process [Type B substitution] in the loaning language produces frequent alternations in vocabulary which is borrowed into another language, and if certain morphological conditions are satisfied, the borrowers may formulate a rule [Type A substitution] corresponding roughly to the process [Type B substitution] in the loaning language.” Since, within Donegan & Stampe’s framework, a Type B substitution in the
loaning language is a universal substitution (Type B) which has been suppressed in the borrowing language, in fact it may be revived, even though it is formulated as a learned substitution (Type A).

Thirteenth, Type A substitutions depend on morphological information, whereas Type B substitutions do not (Stampe 1979, Donegan & Stampe 1979, Rubach 1984a). For example, VELAR SOFTENING applies across a morpheme boundary and only in Romance vocabulary, whereas TAPPING applies regardless of morphological information (such as a morpheme boundary).

Lastly, the inputs to Type A substitutions are felt to be no more difficult to pronounce by L1 speakers than the substitutes, whereas the inputs to Type B substitutions are more difficult to pronounce by L1 speakers than the substitutes, even if the substitution is optional (Stampe 1979, Donegan & Stampe 1979, Donegan 1985). For example, [k] is felt to be no more difficult to pronounce rather than [s] in electricity, while [t] is felt to be more difficult to pronounce than a tap in water and letter; [a] is felt to be more difficult to pronounce (in some dialects) than [a:] in life and time; [æ] is felt to be more difficult to pronounce (in some dialects) than [æ] in down and out; and non-nasalized vowels are felt to be more difficult to pronounce than nasalized vowels in dean and hand (Stampe 1979, Donegan 1985).

In Natural Phonology, Type A substitutions are called (morphophonological) rules and Type B substitutions are called (phonological) processes. In Lexical Phonology, the former are called lexical rules and the latter are called post-lexical rules.
In Cyclic Phonology, the former are called *cyclic rules* and the latter are called *post-cyclic rules*. These terms are not quite equivalent. For example, the term *processes* is not equivalent to the term *post-lexical rules or post-cyclic rules*, even though these terms share some similar characteristics in Table 2.1. Processes are natural (phonetically motivated) responses to speech difficulties. Because they are dependent on the nature of the vocal tract, processes are innate. They do not just apply post-lexically but constrain the system, applying in perception as well as in production, and interacting to create the phoneme inventory of the language (Stampe 1987, Donegan 1995). In this study, I will use the terms of Natural Phonology.

So far I have presented a brief description of the characteristics of two types of substitutions. I will not focus on more details of each theory. The point is that various authors working in different theories have recognized a difference between these two types of sound substitutions. On the other hand, more recent work—Optimality Theory—does not give a distinction of types of sound substitutions. It distinguishes two types of universal constraints, that is, faithfulness and well-formedness constraints, but this is an entirely different matter.

### 2.2 Phonotactic constraints

In addition to phonological substitutions, phonotactic constraints relevant in L2 learning, which are the results of phonological processes in Natural Phonology, also need to be considered. Phonotactic constraints are constraints that govern the possible combinations of sounds in a language. There seem to be two types of phonotactic constraints. For example, English has phonotactic constraints such as constraints that forbid sequences of (a) labial stop plus labial glide (*pw-, *bw-), (b) labio-dental
fricative plus labial glide (*fw-, vv-), (c) diphthong (aᴜ) plus labial stop/nasal (*-aᴜp, -aᴜm), (d) diphthong (aᴜ) plus velar stop (*-aᴜk, -aᴜg), (e) diphthong (-a̯j) plus alveo-palatal (e.g., *-aируют, *-aїдорь, *-айя, *-айы), (f) diphthong (oɪ) plus labial stop/nasal (e.g., *-oїр, *-oїм), (g) diphthong (oɪ) plus velar stop (*-oїк, *-oїг) (vs. -ɪk, -ʊk, -ɒk, -æk, -айк, -oўк), etc. Consider the following words:

(4) a. Puerto Rico [ˈpweɾoɾiko]  
   b. bwana [ˈbwaŋo]  
   c. foie gras [ˌfwaˈɡʁɛ]  
   d. voyeur [ˈvwaˈjʊər]  

(5) a. trauma [ˈtraʊmə]  
   b. lebensraum [ˈbɛnʃˌʁaʊm]  

The words above are unlike native English words in that examples in (4) and (5) violate constraints *[−son, +lab][−syl, −cons, +lab] and *[a̯C][+lab] respectively. The only examples of such words are obvious loanwords – not native words. But they are pronounceable to native speakers of English, and they do not require repair\(^7\) or phonological substitutions. However, English also lacks certain other syllable-initial sequences such as sequences of (a) labial obstruent plus nasal (*pn-, *bn-, etc.),

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\(^7\) The notion of ‘repair’ is from Paradis (1995)’s Theory of Constraints and Repair Strategies. A repair strategy is defined as “a universal, context-free phonological operation that is triggered by the violation of a phonological constraint, and which inserts or deletes content or structure to ensure conformity to the violated constraint.” (Paradis 1995:76) According to her claim, French loanwords in Fula like /karda/ ‘card (comb)’ and /fɔɾɔs/ ‘force’ are from carde [kard] and force [fɔɾs] respectively, in which vowel insertion occurs through this phonological operation (Repair strategy) because of a phonological constraint that a final CC or an internal CCC cluster is not allowed in the phonetic form in Fula.
(b) coronal stop plus lateral (*tl-), (c) stop plus obstruent (*tb-, *ts-, *tp, *tk, *pt, *ps, *dh-, etc., (d) labio-dental fricative plus obstruent (*fp, *ft, *fk, *fs, etc.), (e) nasal plus liquid (*ml/r-, *nl/r-, etc.), (f) alveolar fricative plus non-lateral liquid (*sr-), etc.

These gaps seem to represent phonotactic constraints which are difficult for native speakers of English to violate. These sequences require repair with epenthesis, deletion, or substitution, as illustrated in the following:

\[(6)\]

a. Sri Lanka \[*sril\'n\k]\(\rightarrow\) [\'sril\'n\k]\n
b. pneumonia \[*pn\m\n\j]\(\rightarrow\) [\'n\m\n\j]\n
c. Tbilisi \[*tb\l\s\i]\(\rightarrow\) [\’t\b\l\s\i]\n
d. tsunami \[*ts\n\m\i]\(\rightarrow\) [\'s\n\m\i] (~ [\ts\n\m\i])
e. Tsongas \[*ts\n\g\s\s]\(\rightarrow\) [\’ts\n\g\s\s] (~ [\ts\n\g\s\s])

Examples in (6d) and (6e) have variants. The relevant constraint *ts- is more easily violated than the constraints related to examples in (6a)-(6c). This constraint seems to be moving toward the type of constraint without any phonetic difficulty like the constraints mentioned with regard to examples in (4) and (5). That is, more and more speakers are learning to overcome this constraint and pronounce the input to the processes which would eliminate the configuration.

(South) Korean also seems to have two types of phonotactic constraints. One type is represented by word-initial phonotactic constraints such as *ni- and *nj-.

Diachronically, word-initial /n/ was deleted before high front vocoids /i, j/ (Hwang 1979, Park 1996, among others), as illustrated below:

\[(7)\] Native Korean

a. ni > i ‘tooth’; nj\r\i m > j\r\i m ‘summer’ (Hwang 1979:303)
b. nipta > ipta ‘put on’; nirida > irida ‘tell’; nikta > ikta ‘ripe’

(8) Sino-Korean

a. njæca > jœca ‘woman’
b. njœmjœ > jœmjœ ‘concern.’

Nowadays word-initial /ni/ does not exist in Sino-Korean words in South Korean. From this, it can be inferred that Korean has phonotactic constraints *#ni- and *#nj-. But consider the following Korean loanwords:

(9) a. nickel [nikbɔl] (*[ikbɔl])
b. news [njusi] (*[jusi])
c. Nissan [nis’an] (*[is’an])
d. knit [nitʰi] (*[itʰi])

The words above are unlike native Korean words in that they violate these constraints. The only examples of such words are obvious loanwords. These words are pronounceable to native speakers of Korean and do not require repair. There are also a few native words—not Sino-Korean words—which violate this constraint. For example, there are /ni/ [ni] (derived recently from /ne/; used in informal/casual speech) ‘you,’ /nim/ [nim] ~ [im] (obsolete) ‘lord, sweetheart,’ /njœsök/ [njœsök] (~ [jœsök]) ‘fellow, chap’ (noted in Sohn 1999:169), and also /niklkœlita/ [nigilqœrida] ‘feel nauseous,’ /njamnjam/ [njamnjam] ~ [jamnjam] ‘yum-yum,’ and /nijllila/8 [nillirija] ‘refrain used in a song.’

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8 Some Korean speakers have the different phonemic representation (/nillilija/).
The other type of phonotactic constraint does require repair. An example is the Syllable Contact Constraint that was originally proposed by Vennemann (1988) and discussed further by Davis and Shin (1999). This constraint does not allow a sequence of rising sonority over a syllable boundary. This requires, for example, that VCV be syllabified V.CV, not *VC.V. In Korean (including loanwords), sequences of a stop and a nasal, like -p.m-, -t.m-, -k.m-, etc., are inadmissible. They are difficult for native speakers of Korean to pronounce and are repaired with STOP NASALIZATION, as illustrated in the following:

(10) a. /kjəp+mun/ [kjəmmun] ‘double door’
b. /path+noŋsa/ [pannoŋsa] ‘field farming’
c. /kuk+mul/ [kuŋmul] ‘broth’
d. /kok-mul/ [koŋmul] ‘grain’
e. /sahöcak#munce/ [sahöŋ munje] ‘social issue or matter’

(11) a. /puk+maki/ [puŋmakʰi] ‘bookmark’ (from English)
b. /has+meil/ [hanmeil] ‘the name of an email service’ (from ‘hot mail’)

(Note that NEUTRALIZATION changes /has+meil/ to [hafmeil] and then STOP NASALIZATION changes *[hafmeil] to [hanmeil].)

Thus, it may be concluded that phonotactic constraints, like phonological substitutions, can be divided into two types. These are constraints which require repair, and those that do not.

2.3 Predictions in L2

In the previous sections, I have sketched a typology of phonological substitutions and a typology of phonotactic constraints. We may ask here why some phonological substitutions will transfer and others will not.
In second language phonology, it is predicted that phonological processes will transfer, whereas morphophonological rules will not. As argued by Natural Phonology, the fundamental difference between Type A and B substitutions is synchronic phonetic motivation. The substitutions that are morphologically conditioned and have some exceptions are easy not to apply in L2. This is attributed to lack of synchronic phonetic motivation; that is, speakers have learned to pronounce the relevant sequence, so they find no difficulty in L2 pronunciation. Morphologically conditioned substitutions lack phonetic motivation because they are learned and “do not represent real constraints on pronunciation, but only on ‘correctness’” (Donegan 1985:8). An alternative explanation might be that L1 morphological conditions are missing in L2 or that the target lexicon of L1 is different from that of L2. For example, in Korean, constraints *ni- and *nj- or their relevant substitutions involve the Sino-Korean lexicon only, but not Korean native lexicon nor any L2 lexicon.

In contrast, the substitutions that are phonetically motivated and automatic are not easy to suppress. As noted, Natural Phonology calls Type A and Type B (morphophonological) rules and (phonological) processes, respectively. A phonological process is “a mental operation that applies in speech to substitute, for a class of sounds or sound sequences presenting a specific common difficulty to the speech capacity of the individual, an alternative class identical but lacking the difficult property” (Stampe 1979:1), and that is “performed on behalf of the physical system involved in speech perception and production” (Stampe 1979:9). Natural phonology claims that phonetic motivation is a critical fundamental criterion for distinguishing the two types of
phonological substitutions. This claim implies that phonological processes will transfer since they are difficult to suppress in L2 due to their phonetic motivation. Speakers have not learned to pronounce their inputs in learning L1.

Similarly, in the case of phonotactic constraints, it can be proposed that phonetically motivated phonotactic constraints will affect L2 phonology, whereas phonotactic constraints lacking synchronic phonetic motivation do not. One may assume that phonological processes control L1 and phonetically motivated phonotactic constraints as well as phonological processes may control L2 acquisition.

2.4 Evidence for the difference in transferability of phonological substitutions

We see that some phonological processes and constraints transfer and some rules do not. Evidence for the difference in transferability of phonological substitutions has been found in many interlanguages: Hindustani-English, Malayalam-English, Arabic-English, Polish-English, Korean-Swedish, German-Swedish, and German-English.

Singh and Ford (1987) discuss differences of transfer in Hindustani English. Hindustani has the sound substitutions of N-INSERTION, VOWEL SHORTENING, and SCHWA EPENTHESIS, as illustrated in the following (Singh and Ford 1987:165):

(12) a. N-INSERTION
   ek  [ek] ‘one’  anek  [ənek] ‘several, many’

b. VOWEL SHORTENING
   jagna  [jaːɡna] ‘wake up’  jagana  [jəɡaːna] ‘waken’ (causative)

c. SCHWA INSERTION
   jiv  [jiv] ‘life’  sajiv  [səjiv] ‘living’
The insertion of *n* seems unnatural. Usually when **CONSONANT EPENTHESIS**\(^9\) occurs between two vowels a glide is inserted, as illustrated as follows:

(13) a. English

\[
\text{[endʒɒjɛskrɪ:m] } \quad \text{enjoy ice cream (Spencer 1996:234),}
\]

\[
\text{[goʊwərɛt] } \quad \text{go away (Spencer 1996:235)}
\]

\[
\text{[aj jo kajnd əv 'noʊ] } \quad \text{I, uh, kind of know...}
\]

b. Korean

\[
/kæki-ɛ/ \quad \text{[kægiɛ] there-locative ‘there’}
\]

\[
/kio kata/ \quad \text{[kijɔɡada] crawl-go ‘crawl’}
\]

c. the Bizcayan dialect of Basque (Kenstowicz 1994:23)

\[
\text{errije ‘village’ (definite of erri)}
\]

\[
\text{buruwe ‘head’ (definite of buru)}
\]

These insertions seem natural because intensification of labial or palatal quality of adjacent vowels occurs in order to prevent hiatus which may result in assimilation. **N-INSERTION**, however, seems to be conventional in Hindustani and has the characteristics of a morphophonological rule ((5) and (11) of Type A in Table 1: It applies in derived environments; it makes radical substitutions, as in \(a+ek \ [ənɛk]\)). **VOWEL SHORTENING** also does not appear to have any phonetic motivation in Hindustani, and it occurs only in the case of causative formation. Singh and Ford (1987) and Singh (1995) therefore consider these two substitutions to be different from **SCHWA INSERTION**.

Native speakers of Hindustani do not show transfer of **N-INSERTION** or **VOWEL SHORTENING** in L2 acquisition. Words like *re-invent* and *teacher* do not become

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\(^9\) In the case of English hiatus, unusual **r-INSERTION** occurs — but only in accents which show **r-DELETION** (Wells 1982, Spencer 1996). Donegan (1993) proposes that postvocalic *r*’s (including “inserted” *r*’s) are present in the underlying representation (For details, refer to section 5.2 in Donegan (1993)).
*[reinvent] and *[tʃə] respectively, in Hindustani-accented English, although native Hindustani words *adhi*kar and *ja:g*na become *anadhi*kar and *[jəɡaːna] respectively, as shown in the following (Singh 1995:72):

(14) a. $\theta \rightarrow n / _\_ V$; *adhi*kar/*anadhi*kar vs. *dharma*/adharma

b. $V \rightarrow V / _\_ C_0 V$; (12b) *jagna* *[jaːɡna]* jagina *[jəɡaːna]¹²

SCHWA EPENTHESIS, on the other hand, has the characteristics of a phonological process (for example, it does not depend on morphological information). Native speakers of Hindustani do show transfer of SCHWA EPENTHESIS in numerous borrowings from English where the original word displays an illegal onset cluster, as shown in the following (Singh and Ford 1987, Singh 1995):

(15) a. *istʃən* (from station)

b. *kirast* (from Christ)¹³

An unacceptable word-initial consonant cluster is broken up by the insertion of a vowel before the more sonorous segment. Native speakers of Hindustani also tend to insert schwa to break up complex codas when learning English, in exactly the same environments as in the borrowings above (Singh and Ford 1987).

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¹⁰ Singh and Ford (1987) and Singh (1995) use [ɛ] for [ʃ]. They also use [ɔ] for [ʃ]. In this dissertation, [ʃ] and [ʃ] will be used throughout.

¹¹ Singh (1995:72) seems to have to include morpheme boundaries in his rule, N-INSERTION, because it is related to a derived environment.

¹² Singh (1995:72) seems to have to include morpheme boundaries in his rule, VOWEL SHORTENING, because it is related to causative formation.

¹³ As in these examples, a high front lax vowel, [ɪ], is inserted in L2 acquisition, but Singh and Ford (1987) and Singh (1995) still use the term SCHWA INSERTION.
Singh and Ford (1987) have pointed out that native speakers of English also show a tendency to insert an epenthetic vowel in the case of illegal consonant clusters when they are in the process of learning languages. We assume that phonotactic constraints transfer when they are phonetically motivated. On the other hand, the English morphophonological rule, \textit{velar softening}, which shows characteristics of morphophonological rules (for example, it is morphologically conditioned), does not transfer. As Singh and Ford mention, native speakers of English do not make errors like *\textit{sanasi} for \textit{sanaki} (‘whimsical’: \textit{sanak} ‘whim’ + \textit{i} (denominal suffix)) when learning Hindustani, or *\textit{kandasita} for \textit{kandakita} (\textit{kandak} + \textit{ita}) when learning Malayalam despite the English morphophonological rule of \textit{velar softening}. When learning English, native speakers of Malayalam also do not show transfer of a morphophonological rule that applies regularly in Malayalam compounds: The English word \textit{suitcase} does not become *\textit{sulkes}, although the native Malayalam word \textit{jarat} + \textit{ka:lam} becomes \textit{jaralka:lam}, as shown in the following (Singh 1995:73):

\begin{equation}
\begin{array}{c}
t \rightarrow 1 / \underline{____} +k; \textit{jarat} + \textit{ka:lam} \rightarrow \textit{jaralka:lam} \\
\text{‘winter’ ‘time’ ‘wintertime’}
\end{array}
\end{equation}

It thus appears that these rules are not phonetically motivated synchronically.

Broselow (1987) examines consistent patterns of errors in the speech of Arabic learners of English, especially native speakers of two dialects of Arabic: Iraqi Arabic and Egyptian Arabic. Typical errors by speakers of Egyptian Arabic and Iraqi Arabic are illustrated below.
(17) Errors by speakers of Egyptian Arabic

a. [filoor] ‘floor’
b. [bilastik] ‘plastic’
c. [θirii] ‘three’
d. [tiransilet] ‘translate’
e. [silayd] ‘slide’
f. [fired] ‘Fred’

(18) Errors by speakers of Iraqi Arabic

a. [ifloor] ‘floor’
b. [ibleen] ‘plane’
c. [isnoo] ‘snow’
d. [iθrii] ‘three’
e. [istadi] ‘study’
f. [ifred] ‘Fred’

Speakers of Egyptian Arabic show a tendency to insert an [i] between two initial consonants (except in three-consonant clusters), while speakers of Iraqi Arabic tend to make fewer errors involving initial two-consonant clusters, but when such errors occur, they tend to insert [i] before the initial cluster, as shown above.

Iraqi Arabic and Egyptian Arabic have syllable structures as follows:

(19) a. Iraqi Arabic: CV, CVC, occasionally CCV(C) (only phrase-initially)

b. Egyptian Arabic: CV, CVC, CVCC (only phrase-finally)

Both dialects allow only syllables consisting of consonant-vowel or consonant-vowel-consonant, except at the beginning or end of an utterance: Egyptian Arabic allows syllables ending in two consonants phrase-finally, while Iraqi Arabic optionally allows syllables beginning in two consonants phrase-initially, as illustrated in the following:
EPENTHESIS in Iraqi Arabic has characteristics of a phonological process, for example, (6), (10), and (13) in Table 1. EPENTHESIS inserts a vowel before stray consonant(s), yielding iC (or CiC) syllable structure, as illustrated in the data in (20) above and in (21a) below. The phonological process transfers, as illustrated in the data in (18) above and in (21b) below.

(21) a. Iraqi Arabic EPENTHESIS: A vowel \( i \) is inserted before a stray consonant or between two stray consonants.

\[
\begin{align*}
\text{ki.tab.t.Ia} & \rightarrow \text{ki.ta.bit.la} \ ('I \ wrote \ to \ itlhim') \\
\text{ki.tab.tI.ha} & \rightarrow \text{ki.ta.tab.til.ha} \ ('I \ wrote \ to \ her')
\end{align*}
\]

b. Errors by Iraqi Arabic learners of English

\[\text{tfil.d.ren} \rightarrow \text{tji.lid.ren}\]

Egyptian Arabic, on the other hand, has two types of EPENTHESIS for avoiding consonant clusters; one gives stray consonant(s) a CV (or CVC) syllable structure, and the other gives a word-initial stray consonant a VC syllable structure, as illustrated in (22a) and (22b) respectively.

(22) a. Egyptian Arabic EPENTHESIS I: A vowel \( i \) is inserted after a stray consonant or between two stray consonants.

\[
\begin{align*}
\text{ka.tab.t.lu} / & \rightarrow \text{ka.tab.tI.lu} \ ('I \ wrote \ to \ it/him') \\
\text{ka.tab.tI.ha} / & \rightarrow \text{ka.tab.til.ha} \ ('I \ wrote \ to \ her')
\end{align*}
\]

b. Egyptian Arabic EPENTHESIS II: A vowel \( i \) is inserted before a stray consonant in imperative forms.

\[\text{k.tib} \rightarrow \text{ik.tib} \ ('write!')\]
According to Broselow, Egyptian Arabic _Epenthesis_ I in (22a) is a general and productive process of _Epenthesis_, whereas Egyptian Arabic _Epenthesis_ II in (22b) is morphologically restricted, affecting only imperative forms. Broselow points out that the latter “affects only a small class of morphemes,” while the former (_Epenthesis_ I) “applies to any cluster of three consonants, regardless of the morphological or syntactic environment”, as shown in the following (Broselow 1987:299):

(23) a. bint ‘girl’
    b. nabiiha ‘intelligent’
    c. bint i nabiiha ‘an intelligent girl’

_Epenthesis_ I, which would group with Type B substitutions, transfers, as illustrated in the data in (17) and _tʃil.d.ren_ → _tʃil.di.ren_, while _Epenthesis_ II, which would group with Type A substitutions, does not.

Dziubalska-Kołaczyk (1997:251) says that “Polish [morphophonological] rules do not interfere since Polish and English do not match morphologically.” According to Rubach (1984b:37–38), Polish learners of English do not show transfer of Polish morphophonological rules like _Second Velar Palatalization_ when learning English, as illustrated in _hockey_ [haki] (*[hatsi]) and _keep_ [ki?p] (*[tsi?p]). This rule changes _k_ to _c_ [ts] before certain suffixes usually beginning with front vowels. In addition, Dressler (1985:102) points out that Polish learners of English do not show transfer of the rule even in examples like _electricity_, and he claims that “the identical condition of a morpheme boundary (i.e., similar domain of application) and similar phonological properties of the first morpheme of the suffix do not suffice, nor does partial overlap of the structural
description of the respective rules.” But phonological processes such as \textsc{word-final obstruent devoicing} (e.g., [ɛnɛk] ~ [ɛnɛg] \textit{snow}) do transfer in the English of native Polish speakers, as illustrated in \textit{dig} [dik], \textit{digs} [diks] but \textit{digger} [dɪɡə] (Dziubalska-Kołaczyk 1997:251). \textsc{word-final obstruent devoicing} has the characteristics of a phonological process ((9) and (13) of Type B in Table 1: (9) it is automatic; (13) it does not depend on morphological information).

Pyun (1987) investigated the L2 phonology of Korean speakers of Swedish. He shows the interference in Swedish of many substitutions of Korean. Two of these are \textsc{s-palatalization} and the phonotactic constraint that consonant clusters are not allowed within a syllable at the phonetic level (*c[C(C) or *C(C)]). This usually results in \textsc{vowel insertion}. Pyun (1987) points out that native Korean speakers show a tendency to insert a vowel to break up complex onsets or codas when learning Swedish, and that the least marked vowel,\textsuperscript{14} /i/, is usually inserted, as illustrated in (24).

\begin{table}
\begin{tabular}{lll}
Target language (Swedish) & L2 pronunciation by Korean speakers \\
\textit{dagmamma} & [dɑːɡmɑːma] & ‘child-minder’ & [dɑːɡimama] \\
\textit{film} & [fil:m] & ‘film’ & [filim] \\
\textit{molin} & [mo:ln] & ‘floor’ & [molin] \\
\end{tabular}
\end{table}

\textsuperscript{14} ‘The least marked vowel’ is an ambiguous and controversial notion, because it also means /a/ cross-linguistically or in terms of language universal. Therefore, instead, ‘the most deletable vowel’ seems to be a more desirable characterization. This will be discussed later, in section 4.2.4.
The examples in (25) show transfer of Korean S-PALATALIZATION, which changes /s/ to [ʃ] before the high palatal vowels /i/, /y/, and /j/. This substitution has some characteristics of a phonological process, like (6) and (13) of Type B substitutions in Table 1.

(25) S-PALATALIZATION (Pyun 1987:122)

<table>
<thead>
<tr>
<th>Target language (Swedish)</th>
<th>L2 pronunciation by Korean speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>sida [si:da]</td>
<td>‘side’ [ʃi:da]</td>
</tr>
<tr>
<td>sy [sy:]</td>
<td>‘sew’ [ʃy:]</td>
</tr>
<tr>
<td>cykel [syk:ɔ]</td>
<td>‘bicycle’ [ʃykɔ]</td>
</tr>
</tbody>
</table>

According to Hammarberg (1997), not all phonological substitutions in L1 have an equally strong tendency to be transferred by L2 learners. With some phenomena, transfer occurs in a virtually compulsory way, whereas in other cases, transfer takes place less consistently, and in others, it does not occur at all. Hammarberg also claims that this seems to be related to the way the phonological substitutions function in the learner’s L1, in that the learner cannot easily suppress those substitutions that effectively constrain him/her as a speaker of L1, i.e. those that have synchronic phonetic motivation. He (1997:167) raises the following question: if phonetically motivated substitutions are susceptible to transfer and the morphologically conditioned substitutions without phonetic motivation are not, what will happen in cases with partial phonetic motivation?

Hammarberg investigated the difference of transferability of four phonological phenomena in German learners of Swedish. The four phonological phenomena in German (L1) are as follows:
(26) a. **FINAL DEVOICING OF OBSTRUENTS**: [-son] → [-voiced] /____#

   b. *#sC

   c. *#sV

   d. **INTERVOCALIC VOICING**: *'V: s V, *'V Son s V, *'V z V

German **FINAL DEVOICING OF OBSTRUENTS** (e.g., in *Hund* [hunt] ‘dog’ and *Tag* [tak] ‘day’) is a well-known phonological process that is generally thought to have phonetic motivation.

In the initial preconsonantal position #_C, /s/ is not used in native words or in older loans, and for these words the pattern can be described as a neutralization in favor of /ʃ/, as illustrated in words like *schneiden* [ʃnajdɐn] ‘cut’ and *Stelle* [ʃtɛlɐ] ‘place.’ The phonotactic constraint *#sC does not seem to have phonetic motivation which would bring forth /ʃ/ rather than /s/ (Hammarberg 1997). According to Hammarberg, in general, /s/ is a more favored segment than /ʃ/ in the languages of the world. He also points out that in the initial prevocalic position #_V, /s/ is not used in native German words or in older loans, and instead /z/ appears, as illustrated in words like *sagen* [zaːɡən] ‘say’ and *Satz* [zats] ‘sentence.’ Hammarberg regards this phonotactic constraint as being partially phonetically motivated, in that the voiced sibilant would seem more motivated in anticipation of the vowel, even though /s/ occurs/ in recent loanwords, as in *Sex* [ʃɛks] vs. *sechs* [ʃɛks], which shows that there is not a fully productive constraint against /s/ here.
In some types of intervocalic position, such as 'V: _ V (e.g., diesig [diːzɪɡ] ‘misty’) and 'V Son _ V (e.g., Sense ['zenzə] ‘scythe’), /z/ is more common than /s/, even though a contrast between /s/ and /z/ is maintained. Hammarberg points out that this has historical reasons, /z/ deriving diachronically from the voicing of a simple /s/, and /s/ from a geminate /ss/. Voicing is supported phonetically by the voiced environment; on the other hand, other voiceless obstruents occur freely in this position (Hammarberg 1997). And /z/ is not permissible in the position immediately following a stressed short vowel ('V _ V, as in essen ['esən] ‘eat’), where /s/ originates from a geminate. Thus, Hammarberg claims that INTERVOCALIC VOICING is not a widely applied process in German, although he regards it as being partially phonetically motivated.

Now, consider the following results of Hammarberg’s (1997) study on German-Swedish interlanguage.

Table 2.2 Error percentages for some consonant structures in an imitation test and in free conversational speech with German learners of Swedish (Hammarberg 1997:170)

<table>
<thead>
<tr>
<th>Swedish structure</th>
<th>Imitation test</th>
<th>Conversation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Error (%)</td>
<td>Error (%)</td>
</tr>
<tr>
<td>Word-final voiced Obstruent</td>
<td>58</td>
<td>91</td>
</tr>
<tr>
<td>[s] in crucial intervocalic position</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Initial prevocalic [s]</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Initial preconsonantal [s]</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
The two tasks—an imitation test and a conversation—show different results for the voiced final obstruents, and for the initial preconsonantal /s/, as seen in the above table. The above result shows that German learners of Swedish do have difficulty in producing voiced final obstruents. According to Hammarberg, the substituted error was almost invariably a devoiced obstruent. Initial preconsonantal /s/ was learned without problems, and the participants did not show a tendency to carry over the German /ʃ/ pattern. As predicted, German Final Devoicing of Obstruents tends to transfer. According to Hammarberg, however, for /s/ in those initial prevocalic and intervocalic positions where /z/ is dominant in German, learners showed occasional use of the [z] pattern in conversational speech, even though they did not show any difficulty at all in the imitation task. Hammarberg's interpretation of these results is that there is a scale of transferability, ranging from the cases showing transfer of a phonetically natural L1 regularity in a productive and compelling way to the cases showing nontransfer of a less natural L1 regularity. Hammarberg (1997:170) claims that there are intermediate cases between these two extreme cases, where an L1 phonological pattern that is to some extent “natural but not compelling” for L1 speakers is transferred in a less productive way. He continues to claim that such a pattern will be easier for the learner not to apply and more open to alternation with the target pattern. As Hammarberg points out, the data suggest that in the intermediate cases transferability is particularly sensitive to attention or control (Hammarberg 1997:170). Thus, he hypothesizes that L1 phonological substitutions with partial naturalness show a tendency to transfer in a noncompelling way, and attention and control have greater effect in this transfer (Hammarberg 1997).
He does not say, but he implies that a voicing rule with partial phonetic motivation is applied in L2 as a result of L1 phonotactic constraints against /s/ in both positions. A second possible interpretation might be that speakers substitute lexical forms from L1 for forms in L2 because of lexical similarity. This can be inferred from Hammarberg's (1997) citation of his previous research (1988) on the perception and production of German learners of Swedish. He attributes the variants of a vowel in production to lexical equivalency (e.g., the German learners’ [a:] variant of Swedish /a:/ r[a:]dio ‘radio’ and bl[a:]d ‘leaf’ vs. German form-equivalent words R[a:]dio and B[ə]l[ə]d, and he claims that “[t]he learners’ pronunciations tended to reflect the form of L1 lexical equivalents if these were similar enough, but the weaker the formal similarity, the more often did a phonetically based solution occur” (Hammarberg 1997:166).

From Wode (1978), we also see that children who are native speakers of German tend to devoice final consonants in English, as illustrated in examples like [kʰwek] ~ [kʰeik] Craig, [fɾɛnt] friend.

In summary, although there are many characteristics that distinguish the two types of substitutions, these characteristics do not give a fundamental explanation, as opposed to a description, for why one is transferable and why the other is not. As illustrated in the evidence mentioned so far, it appears that the two types of substitutions are treated differently in second language acquisition. The difference between the two types of substitutions should be accounted for, based on phonetic motivation and/or morphological conditions. Natural Phonology (Donegan and Stampe 1979, Dziubalska-
KOŁACZYK 1997, among others) claims that the transferable phonological substitutions—phonological processes—can be characterized as phonetically motivated; that is, synchronically motivated by articulatory economy (ease of articulation) or perceptual audibility (ease of perception) in the L1, and that this motivation is not limited by morphological conditions and operates in an unconscious way in normal speech. Natural Phonology also claims that, in contrast, the nontransferable substitutions—morphophonological rules—can be characterized as lacking synchronic phonetic motivation and as being conditioned morphologically in the language.
CHAPTER 3

MOTIVATING THE PRESENT RESEARCH

The previous chapter cited evidence from the literature on L2 phonological acquisition which indicates that there are two types of sound substitutions, which are treated differently in languages, particularly with respect to transfer. In order to support this and to explore the application conditions for several Korean phonological processes in the learning of General American English\(^{15}\) (English, hereafter), the L2 English production of native speakers of Korean will be investigated. This chapter will give a brief description of the phonologies of Korean and English. I will focus on some differences between Korean and English in the treatment of the following sequences: a stop plus a nasal, a stop plus a lateral, a lateral plus a nasal, /s, t/ before /i/ or /j/, word-initial /l/, and word-initial /n/ before /i/. In addition, I will give a phonetic explanation of some phonological processes. A comparison of the phonologies of Korean and English will then point to some research questions.

3.1 The consonant and vowel systems of Korean and English

3.1.1 Consonants and vowels in Korean

The Korean consonant system is shown in Table 3.1. Stops and affricates in Korean are categorized into three types (Kim 1965, Ahn 1985, Sohn 1999, Lee and Ramsey 2000, among others): a) aspirated stops and affricates /pʰ, tʰ, kʰ, cʰ/; b)
unaspirated tense stops and affricates /p’, t’, k’, c’/; c) weakly aspirated lax stops and affricates /p, t, k, c/.

Table 3.1. The Korean consonant system

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Alveo-palatal</th>
<th>Palatal</th>
<th>Velar</th>
<th>Labio-velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stop</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirated</td>
<td></td>
<td>pʰ</td>
<td>tʰ</td>
<td></td>
<td>kʰ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td></td>
<td>p’</td>
<td>t’</td>
<td></td>
<td>k’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lax</td>
<td></td>
<td>p</td>
<td>t</td>
<td></td>
<td>k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Affricate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>eʰ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lax</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fricative</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>s’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lax</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nasal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>m</td>
<td>n</td>
<td>η</td>
<td>h</td>
</tr>
<tr>
<td><strong>Lateral approximant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Central approximant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>w</td>
</tr>
</tbody>
</table>

Only the weakly aspirated lax stops and the lax affricate, /p, t, k, c/, become voiced between voiced segments. /s/ does not become voiced in any environment.

According to much of the literature on Korean (Kim-Renaud 1974, Ahn 1985, Sohn 1999, Lee and Ramsey 2000, among others), the dentals and alveolars in Table 3 were together categorized as dentals, alveolars, or alveo-dentals (denti-alveolars) (Kim-Renaud 1974 (dentals), Lee and Ramsey 2000 (dentals); Ahn 1985 (alveolars), Park 1990 (alveolars); Sohn 1999 (alveo-dentals), Choo and O’Grady 2003 (denti-alveolars), Anderson et al. 2004 (denti-alveolars for coronal obstruents), among others). However, /tʰ, t’, t/, /n/, and /s, s’/ are better categorized as dentals, and the lateral is better.

---

16 Anderson et al. (2004) categorize Korean coronal obstruents (especially, coronal stops and fricatives) as denti-alveolars. They found gender differences for contact patterns on the tongue: female speakers used laminal articulations; male speakers used apico-laminal articulations.
categorized as alveolar, based upon my own observations and an informal survey of native speakers of Korean.

Consonant clusters are not allowed within a syllable at the phonetic level, as in /kaps/ [kap] ‘price’ and /salm/ [sam] ‘life.’

The vowel system of standard Korean is provided in Table 3.2.

Table 3.2 Korean vowel system (Sohn 1999)

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unrounded</td>
<td>Rounded</td>
</tr>
<tr>
<td>High</td>
<td>i</td>
<td>ι</td>
</tr>
<tr>
<td>Mid</td>
<td>e</td>
<td>τ</td>
</tr>
<tr>
<td>Low</td>
<td>ε</td>
<td>ί</td>
</tr>
</tbody>
</table>

Korean /y/ and /ø/ (or /ü/ and /ð/ in Ahn 1985 and Park 1990) are sometimes realized phonetically as rising (on-glide) diphthongs [yi]~[ui] and [ge]~[ge], respectively. I will not further focus on vowel quality here because it is not relevant to my study.

3.1.2 The consonant and vowel systems of English

The English consonant system is shown in Table 3.3 below.

Table 3.3 English consonant system (cf. Ladefoged 1982, Wells 1982, Hammond 1999)

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labio-dental</th>
<th>Inter-dental</th>
<th>Alveolar</th>
<th>Alveo-palatal</th>
<th>Palatal</th>
<th>Velar</th>
<th>Labio-velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stops</td>
<td>Voiceless</td>
<td>p</td>
<td>t</td>
<td></td>
<td>k</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Voiced</td>
<td>b</td>
<td>d</td>
<td></td>
<td>g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affricate</td>
<td>Voiceless</td>
<td>f</td>
<td>s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>h</td>
</tr>
<tr>
<td>Affricate</td>
<td>Voiced</td>
<td>v</td>
<td>z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricative</td>
<td>Voiceless</td>
<td>m</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal</td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximant</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
English obstruents have two categories—voiceless and voiced. The English alveolar stops /t/, /d/, and /n/ usually become a tap [ɾ] or [ɹ] in syllable-final position when followed by an unstressed vowel. The lateral /l/ becomes velarized ([ɭ]), which is called dark l. From my own observation, English /s/ seems to have two allophones—lax [s] and tense [s’]—which are phonemes in Korean. Lax [s] seems to occur before a consonant (e.g., [wasp’] wasp, [lisp’] lisp, [kʰəst] cast, [ste?p’] step, [ɔ.ˈgənst] against, [tʰəkst] text, [kʰæs’kʰəd] cascade, [sləpi] sloppy, [snəg] snug, [swən] swan, etc.), and tense [s’] seems to occur elsewhere (e.g., [s’et] set, [s’ʌn] sum, [dæs’ɪn] dressing, [fəs’] fuss, [ləs’] less, etc.). Consonant clusters are allowed within a syllable in English.

The vowel system of English is provided in Table 3.4.

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unrounded</td>
<td>Unrounded</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>Lax</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>Mid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td>èi</td>
<td>o/ʌ</td>
</tr>
<tr>
<td>Lax</td>
<td>è</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td>æ</td>
<td></td>
</tr>
<tr>
<td>Lax</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One notable characteristic of English vowels is that there is a tense-lax distinction, in general. English has a number of phonemic diphthongs. In addition to /èi/ and /ðu/,

17 /t/ and /d/ become a tap [ɾ] and /n/ becomes a nasalized tap [ɭ].
English has /ai/, /au/, and /ɔi/. An important difference between English and Korean vowels is that the former have a tense-lax distinction, but the latter do not. Another difference is that English vowels tend to diphthongize as falling diphthongs, whereas the Korean vowels are monophthongal, or they tend to diphthongize as rising diphthongs.

English unstressed vowels reduce, whereas Korean vowels do not. The Korean vowel /i/ and the English schwa, /ə/, tend to devoice and drop in voiceless environments,\(^{18}\) as illustrated in /pasilak/ [pası̝rak'] ~ [pasrak'] ‘rustling, crumbly’ and /pitʰirəpwa/ [pitʰəɾəbwa] ~ [pitʰɾəβa] ‘Try to twist it!’ in Korean (Kim-Renaud 1987:347), and in [kʰəɛkt] ~ [kʰɛkt] correct and [pʰəɾʰɛɾʊu] ~ [pʰɾʰɛɾʊu] potato in English (Spencer 1996:226).

### 3.2 Target sequences in Korean and English

This section will investigate how the phonologies of Korean and English treat certain sound sequences or segments differently. These include a stop plus a nasal, a coronal stop plus a lateral, a lateral plus a nasal, /s/, /ʃ/, /ti/, word-initial /l/, and word-initial /ni/.

#### 3.2.1 Stop-nasal sequences

In Korean, STOP NASALIZATION\(^{19}\) occurs in sequences of a stop and a nasal (Kim-Renaud 1974; Park 1990; Ahn 1998; Sohn 1999). Examples are given in (1).

---

\(^{18}\) English /ə/ does not need to devoice to delete, as in [ˈblɪv] believe, [ˈɡaɾɑʒ] garage, [ˈmɛmˌbɪŋ] remembering, etc.

\(^{19}\) In voiceless stop plus nasal sequences, VOICING ASSIMILATION is also involved in STOP NASALIZATION.
(1) STOP NASALIZATION: A stop becomes a nasal before a nasal.

\[-son, -cont, -release\] \(\to\) \([+\text{nas}] /\_\_\_\_\_\_\_\_\_\_\_\_\_[+\text{nas}]\]

(2) \(/\text{ip+mat}/\) [immat] mouth+taste ‘appetite’
\(/\text{nat+mal}/\) [nanmal] individual+word ‘a word’
\(/\text{uk-nulita}/\) [\(\text{ø}\text{nurida}\)] emphatic prefix-press ‘suppress’
\(/\text{kot/} \# /\text{naota/}\) [kon naoda] soon come out ‘come out soon’

STOP NASALIZATION is a phonological process in that it has characteristics (1), (9), (13), and (14) of Type B in Table 1: (1) it may apply across word boundary; (9) it is automatic; (13) it does not depend on morphological information like morpheme boundary; and (14) the sequence of a stop and a nasal \([t\text{'n}]\) is felt to be more difficult to pronounce by native speakers of Korean than the substitute \([n\text{.n}]\).

STOP NASALIZATION is found in other languages, for example, Latin, Greek, German, French, Faroese, and Norwegian, as illustrated in the following:


\(*p\text{.m} > *b\text{.m} > m\text{.m}: *\text{sup-mos} > \text{summus} ‘\text{highest}’\)
\(*p\text{.n} > *b\text{.n} > m\text{.n}: *\text{spep-nos} > \text{somnus} ‘\text{sleep}’\)
\(*k\text{.m} > *g\text{.m} > n\text{.m}: *\text{sek.mentom} > \text{segmentum} [n\text{.m}] ‘\text{section}’\)
\(*k\text{.n} > *g\text{.n} > n\text{.n}: *\text{dek-nos} > \text{dignus} [n\text{.n}] ‘\text{dignified}’\)
\(*t\text{.n} > *d\text{.n} > n\text{.n}: *\text{atmos} > *\text{annus} ‘\text{year}’\)
\(*d\text{.m} > m\text{.m}: *\text{räd-mos} > *\text{râmmos} > \text{râmus} ‘\text{branch}’\)
\text{agnus} [\text{an\text{nus}}] ‘\text{lamb}’
\text{ignum} [\text{i\text{nnum}}], \text{magnum} [\text{ma\text{nnum}}], \text{ignominia} [\text{ı\text{nnonimia}}]


\(/-\text{pm}-/ [-\text{mm}-], /-\text{bm}-/ [-\text{mm}-], /-\text{bn}-/ [-\text{mn}-]\)
\(/-\text{km}-/ [-\text{m}-], /-\text{gm}-/ [-\text{m}-] \text{in perfect and aorist middle forms.}\)

\(^{20}\) \(+\) indicates a compound boundary, and - indicates a morpheme boundary (like affixes and case markers).
\(#\) indicates a word boundary (as in Sohn 1999, Davis and Shin 1999).
c. German (Vennemann: Personal communication 2003, via email)

Agnes [aŋnɛs] ‘Agnes’
Wagen [ˈvaŋŋɛ] ‘car’

d. French (in sloppy speech: Dell 1981)

admirer [admire] ~ [anmire] ‘to admire’
obnubile [ɔnɪbile] ~ [ɔmɪbile] ‘obsessed’
le diagnostique [lɔdʒɑ̃nostik] ~ [lɔdʒɑ̃nostik] ‘the diagnosis’
des demis [dedɔmi] ~ [dedmi] ~ [denmi] ~ ‘half-pints (beer)’

e. Southernmost dialect of Faroese (Thomsen: Personal communication 2003, via email)

regna /ˈʁeŋna/ [rɛŋna] ‘to rain’
vognur /ˈvɔŋnur/ [voŋnur] ‘wagon’

f. Norwegian (Sivertsen 1967)

Sogne Fjord /ˈsɔŋe fjœrd/ [-ŋ-]
rogn /ˈɾoŋn/ /ɾøŋn/

In English, (PRE)GLOTTALIZATION (sometimes called “GLOTTAL REINFORCEMENT”) occurs in syllable-final unreleased voiceless stops preceded by a vowel, a glide, a liquid, or a nasal (but not by a fricative, as in best man, left many, etc.) (Wells 198221, Selkirk 1982, Giegerich 1992, Jensen 1993). For voiceless stops, the bilabial, alveolar, or velar closure is usually accompanied by glottal closure, so that a glottal stop is simultaneously articulated with the supralaryngeal stop, as illustrated in the following:

---

21 Wells (1982:261) says that there is “no systematic investigation of Preglottalization and Glottalling in American speech; but T Glottalling is clearly to be observed in the speech of some Americans in [the following] environments”: ___ #true C (e.g., quite good); ___ #non-syllabic liquids or glides (e.g., quite likely); ___ syllabic nasals (e.g., button) (Wells 1982:260).
(4) **GLOTTALIZATION:** An unreleased voiceless stop becomes glottalized in syllable-final position when it is preceded by a sonorant.

\[-\text{cont}, -\text{voice}, -\text{release}] \rightarrow [+\text{constr}] / \ldots [+\text{son}] \ldots \r

(5) a. Syllable-final voiceless stops
   
   - cup [kʰʌʔpʼ]
   - beat [biʔtʼ]
   - buck [baʔkʼ]

b. Syllable-final voiced stops
   
   - cub [kʰʌb]
   - bead [bid]
   - bug [bʌg]

c. Word-internal voiceless stop-nasal
   
   - topmost [taʔpʼmoust]
   - catnap [kaʔtʼnæʔpʼ]
   - quickness [kwɪʔkʼnes]

d. Word-internal voiced stop-nasal
   
   - crabmeat [kraebmiʔtʼ]
   - good-natured [gudnæjtsed]
   - ignore [igkær]

e. Word-external voiceless stop-nasal
   
   - drip mat [druptʼmeʔtʼ]
   - pot marigold [paʔtʼmæŋgould]
   - folk music [faʔkʼmjuzikʼ]

f. Word-external voiced stop-nasal
   
   - tub mat [tub maʔtʼ]
   - good men [gud men]
   - Big Mac [big maʔkʼ]

This implies that glottal reinforcement often occurs with voiceless stop-nasal sequences across a syllable boundary, as in (5c) and (5e) above. In most dialects, **GLOTTALIZATION** does not occur in syllable-final voiced stops or voiced stop-nasal sequences, as in (5b), (5d), and (5f) above.

Both Korean and English avoid sequences of an unreleased plain voiceless stop and a nasal like [pʼ.m], [pʼ.n], [tʼ.m], [tʼ.n], [kʼ.m], and [kʼ.n] at the phonetic level. We assume that the sequence of a voiceless stop and a nasal presents a relative phonetic difficulty of some kind. The Korean phonological process **STOP NASALIZATION** and the English phonological process **GLOTTALIZATION** have phonetic motivation—the former, an assimilation, seems to ease articulation, and the latter may ease both articulation and perception. In English, **GLOTTALIZATION** may ease perception in that it resists voicing...
and reinforces voicelessness and may ease articulation in that it lowers higher oral air pressure and otherwise, higher oral air pressure may cause released allophones.

3.2.2 Coronal stop-lateral sequences

In Korean, CORONAL STOP LATERALIZATION changes a coronal stop to a lateral before a lateral, as in the following:

(6) **CORONAL STOP LATERALIZATION**: A coronal stop becomes a lateral before a lateral.

\[-\text{son, cont, cor, constr, spread, rel}\] \(\rightarrow\) \([+\text{lat}] / \ldots [+\text{lat}]\)

(7) /tikit/ # /liil/ \(\rightarrow\) [tigilliil]\(^{22}\) ‘names of two Korean letters’

**CORONAL STOP LATERALIZATION** is a phonological process in that it has characteristics like (1), (9), (13), and (14) of Type B in Table 1: (1) it may apply across a word boundary; (9) it is automatic; (13) it does not depend on morphological information like morpheme boundary; (14) the sequence \([t^*l]\) is felt to be more difficult to pronounce by native speakers of Korean than the substitute \([l.l]\).

As mentioned in section 3.2.1, in English, **(PRE)GLOTTALIZATION** occurs in syllable-final unreleased voiceless stops preceded by a vowel, a glide, a liquid, or a nasal (Refer to (4) for this phonological process). The behavior of stops before nasals in (5c) and (5e) implies similar behavior for stops before laterals. In most dialects it does not occur in syllable-final voiced stops. Examples are given in the following:

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\(^{22}\) This is virtually the only example with the \(/t/\) and \(/l/\) sequence in Korean (Davis and Shin 1999). There is another variation \([tigin niil]\) for /tikit#liil/. That undergoes two substitutions—the DU-im LAW (INITIAL SOUND LAW) and NASALIZATION. The DU-im LAW is a morphophonological rule, and NASALIZATION is a phonological process.
(8) a. Word-internal voiceless stop-lateral  b. Word-internal voiced stop-lateral

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<tbody>
<tr>
<td>potluck</td>
<td>[pəˈtʌkl]</td>
<td>padlock</td>
</tr>
<tr>
<td>reckless</td>
<td>[ˈrɛksl]</td>
<td>piglet</td>
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<tr>
<td></td>
<td>[ˈpa?dlo?k]</td>
<td>[ˈpiɡleɪt]</td>
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</table>

c. Word-external voiceless stop-lateral  d. Word-external voiced stop-lateral

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<tbody>
<tr>
<td>tot lot</td>
<td>[tɒtˈloʊt]</td>
<td>wood lily</td>
</tr>
<tr>
<td></td>
<td>[ˈwʊdlɪlɪ]</td>
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</table>

We assume that the sequence of a coronal stop and a lateral, like the sequence of a stop and a nasal, presents a relative phonetic difficulty and/or complexity. Some languages resolve this by assimilation, and some by VOWEL EPENTHESIS. For example, Choctaw inserts a vowel in stop-sonorant clusters (but not in all CCs) (/toklo/ [tokˈlo] ‘two’ (cf. /pakna/ [pakna] ‘top’ and /hokmi/ [hokˈmi] ‘to burn up’) (Nicklas 1974:15). Other languages also show diachronic changes that eliminate those clusters (e.g., Latin *duplus > Italian doppio ‘double,’ Latin oc(u)lus > Italian occhio ‘eye,’ ON eple vs. OE æppel ‘apple’ (Vennemann 1988:43–46).

In Korean, the substitution of [l.l] for the sequence of [t’.l] is motivated by ease of articulation. Recall that in Korean, which is that in Korean, the place of articulation of the unreleased coronal stop [t’] is different from that of a lateral [l]: [t’] is dental and [l] is alveolar. The assimilation of both place and manner in the substitution of the geminate [l.l] for [t’.l] eliminates this relatively complex sequence.

3.2.3 Lateral-coronal nasal sequence

In Korean, N-LATERALIZATION changes a coronal (dental) nasal to a lateral after a lateral, as illustrated in the following:
(9) **N-LATERALIZATION:** A coronal nasal becomes a lateral after a lateral.

\[ [+nas, +cor] \rightarrow [+lat, -nas] / [+lat, -nas] \]

(10) \( /\text{sol+nal}/ \rightarrow /\text{solal} \)  ‘New Year’s Day’

\( /\text{pjal-nan}/ \rightarrow /\text{pjal-lan} \)  ‘weird’

\( /\text{simil/ # /namu}/ \rightarrow /\text{simillamu} \)  ‘a tree to plant’

**N-LATERALIZATION** applies in Korean regardless of morphological information, as illustrated in examples of (6).

**N-LATERALIZATION** is a phonological process in that it has characteristics (1), (9), (13), and (14) of Type B in Table 1: (1) it may apply across word boundary; (9) it is automatic; (13) it does not depend on morphological information like morpheme boundary; (14) the sequence \( [ln] \) is felt to be more difficult to pronounce by native speakers of Korean than the substitute \( [l] \).

In English, **VELARIZATION** velarizes a lateral /l/ in the coda (which includes the /l/s in /ln/ sequences), as shown in the following:

(11) **VELARIZATION:** \( l \rightarrow \dagger / \quad \text{C}_0\sigma \) (nasals)

\[ [+lat] \rightarrow [+back] / \quad \text{C}_0\sigma \) ([+nas])

(12) a. Syllable-final lateral

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<tbody>
<tr>
<td>seal</td>
<td>[sɪl]</td>
<td>milk</td>
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b. Word-internal lateral-nasal

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<tbody>
<tr>
<td>walnut</td>
<td>[wʊlnæt]</td>
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</table>

c. Word-external lateral-nasal

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<tbody>
<tr>
<td>till now</td>
<td>[tɪl nɔʊ]</td>
</tr>
</tbody>
</table>
We assume that the sequence of a lateral and a coronal nasal may present a relative phonetic difficulty and/or complexity, as it is eliminated in diachronic changes, for example, *kolnis > collis ‘hill’ in the pre-history of Latin (Vennemann 1988:36), and it is also eliminated in synchronic change in a number of languages. Here are some examples:

(13) **N-LATERALIZATION in /ln/**

a. Leti (Hume et al. 1997:375)

/vulan/ [vulla]²³ ‘moon’
/elə+nə/ [əlle] ‘sister (possessive)’

b. Teralfene dialect of Flemish (Blevins 1994:341)

/specə:l-n/ [spe:lj] ‘to play’

c. Rendille (Sim 1981)

/yeel-n-e/ [yeelle] ‘we carved’
/dəl+n+e/ [delle] ‘we gave birth’

d. Somali (Zorc and Osman 1993)

/di:l+nay/ [dillay] ‘(we) killed’

e. Udi (Schulze 2001)

/k’alnexa/ [k’allexa] ‘(s)he calls’

The sequence [ln] is avoided in other languages by nasalizing the /l/.

(14) **L-NASALIZATION in /ln/**

a. Choctaw (Nicklas 1974:130)

/tal.nə/ [tanna] ‘to be woven’ (the passive of /tana/) 
/ənəwə/ [annowa] ‘to be told’ (the passive of /ənəli/)

---

²³ According to Hume (1998:147), the Austronesian language Leti has two types of METATHESIS: “The first is motivated by a requirement that all phrases end in a vowel, and the second, by syllable well-formedness conditions: syllables have onsets and tautosyllabic consonant clusters are avoided.” In the above example (‘moon’), N-LATERALIZATION applies after METATHESIS: /vulan/ → *[vulna] → [vulla].
b. Moroccan Arabic (Amakhmakh 1997:43)

/qt\+n\a/ [qt\+n\a] ‘we killed’
/mal+n\a/ [m\a+n\a] ‘what’s the matter with us’
/dyal+n\a/ [d\a+y\a+n\a] ‘ours’

In Korean, the substitution of [1.1] for the sequence /1.n/ seems to be based on ease of articulation and maybe ease of perception. N-LATERALIZATION seems to make pronunciation easier on the part of native speakers of Korean by changing the following nasal /n/ to a lateral [1] and maintaining the same manner of articulation. In other words, one tongue position (instead of two tongue positions) and one velum position (instead of two velum positions) are involved in N-LATERALIZATION. The substitution of [1.1] for the sequence /1.n/ might be based on ease of perception in that [1] and [n] are auditorily confusable.

One interesting point is that English weakens the consonantal strength of the coda segment (/l/ \rightarrow [l]) and Korean weakens the consonantal strength of the onset segment (/n/ \rightarrow [l]). The Korean change goes against the general view that consonantal strengthening tends to occur in the onset while consonantal weakening tends to occur in the coda, but it complies with the PROGRESSIVE/STRENGTH ASSIMILATION LAW originally proposed by Murray (1982) and developed by Vennemann (1988). Vennemann defines the STRENGTH ASSIMILATION LAW as follows:

“If Consonantal Strength is assimilated in a syllable contact, the Consonantal Strength of the stronger speech sound decreases.” (Vennemann 1988:35)
3.2.4 Si/j sequences

There are three types of Palatalization in Korean (Ahn 1985, Sohn 1999, among others) – N/L-Palatalization, S-Palatalization, and T-Palatalization. T-Palatalization will be described in the following section. In N/L-Palatalization, /n/ and /l/ change to [p] and [ʌ], respectively, before the high palatal vocoids /i, j/, as in the following:

(15) N/L-Palatalization (cf. Ahn (1985:94) separates it to N-Palatalization and L-Palatalization): A coronal nasal and a coronal lateral become a palatal nasal and a palatal lateral respectively before /i/ and /j/.

\[ [+ \text{son}, + \text{cor}, - \text{cont}] \rightarrow [+ \text{pal}] / \_ \rightarrow [+ \text{son}, + \text{high}, + \text{pal}] \]

(16) /kani/ [kʌɲi] ‘(Are you) going?’
/nj/ [ɲi] ‘who’
/can+jɔ/ [caɲjɔ] ‘the remainder’
/p’alli/ [p’aʌʎi] ‘quickly’
/jɔl+jjan/ [jɔʎʎjan] ‘calorie’

In the experiments to follow, N/L-Palatalization will not be considered since the degree of palatalization in the relevant palatalized segments is very weak and younger speakers do not palatalize /n/ and /l/. More important, if it applies in L2 English, it does not cause a change that is perceptible to English speakers, so it does not seem to be part of a Korean ‘accent.’ The palatalized variants are difficult to distinguish from the original segments. Thus it seems that N/L-Palatalization cannot usefully be studied by the methods used here.
S-PALATALIZATION palatalizes /s/ before the high palatal vocoids /i, y, j/\(^{24}\), as shown in the following (cf. Kim-Renaud 1974, Ahn 1985, Sohn 1999 among others):

(17) S-PALATALIZATION: A dental fricative becomes an alveo-palatal before a high palatal vocoid.

\[-\text{son}, +\text{cont}] \rightarrow [+\text{pal}] / \quad [+\text{son}, +\text{high}, +\text{pal}]\]

(18) /kasi/ \quad [kaʃi]\(^{25}\) ‘thorn’

/os-i/ \quad [ofi] ‘clothes-subject marker’

/syn/ \quad [ʃin] \sim [ʃin] ‘husky’

/syun/ \quad [ʃiun] \sim [ʃiun] ‘easy’

/mul masjọ/ [mulmaʃjo] \sim [mulmaʃa] ‘Drink water.’

S-PALATALIZATION is a phonological process in that it has characteristics (9), (13), and (14) of Type B in Table 1: (9) it is automatic; (13) it does not depend on morphological information like morpheme boundary; (14) /s/ before a high front vocoid is felt to be more difficult to pronounce by native speakers of Korean than the substitute /ʃ/.

In English, a phonological process of PALATALIZATION changes alveolar obstruents to alveo-palatals, but only before only the palatal glide /j/ glide.\(^{26}\) This usually occurs in connected speech (Jensen 1993). Some examples are shown in the following:

\(^{24}\) The high front rounded vowel, /y/, was not considered in the relevant experiment, because English does not have /y/.

\(^{25}\) The Korean alveo-palatal /ʃ/ generally does not have lip-rounding.

\(^{26}\) In Lexical Phonology, PALATALIZATION also occurs both within words and across a word boundary, as shown in examples like //paʊtʃ-oʃ// /paʊʃə/ ‘partial’ and //diskɔʃ-ʃən// /dɪskɔʃən/ ‘discussion,’ and in (20) above. The lexical representations of such words are /paʊʃə/, /dɪskɔʃən/, etc. The usual explanation is addition of transitional sounds ([ʃ] and [ʒ]) between /t/ and /j/, and between /d/ and /j/, respectively. An alternative explanation for the post-lexical, or processual PALATALIZATION is that the change of /tʃ/ to /ʃ/ results from FRICTION whereby the /j/ becomes ʒ after /t/ and DEVOICING whereby ʒ becomes [ʃ]; the change of /dʃ/ to [dʒ] results from just FRICTION of /j/ after /d/.
(19) **PALATALIZATION:** An alveolar obstruent becomes an alveo-palatal obstruent before a palatal glide. 
[-son, +cor] → [+pal] / ______ [-syl, -cons, -back]

(20) got you ['gat(j)u]→['gatʃa] put you ['putʃju] → ['putʃu]
made you [mɛdʒ(j)u] would you [wodʒju] → [wodʒu]
miss you [mɛʃu] → [mɛʃu] kiss you [kɪʃu] → [kɪʃu]
ease yourself [iʃ(j)uəself] amaze yourself [œmɛjʒjuəself] → [œmɛjʒuəself]

3.2.5 **Ti/j sequences**

In Korean, T-PALATALIZATION changes /t/ and /tʰ/ to [c] and [cʰ], respectively, before a morpheme boundary followed by /i, j/.

(21) **T-PALATALIZATION:** A dental stop becomes a palatal stop before a morpheme boundary followed by a high palatal vocoid. 
[-son, -cont, +cor, -constr] → [+pal] / ______ - [+son, +high, +pal]

(22) /kut-i/ [kuji] firm-adverbial marker ‘firmly’
/mat-i/ [maji] first+person marker ‘oldest child’
/hæ+tot-i/ [hætɔjı] sun+rise-nominalizer ‘sunrise’
/kat-hjə-sa/ [kæcʰasə] lock up-passive-suffix ‘because (I was) locked up’
/katʰ-i/ [kæcʰi] same-adverbial marker ‘together’
/k’otʰ-i/ [k’ɔtʃi] flower-nominalizer marker ‘(The) flower (is... )’
/mul+pat-i/ [mʌlbai] water+receive-thing ‘a gutter at the eaves’

cf. /titi-ta/ [tidida] step on-declarative ‘step on’
/mati/ [madi] ‘joint’
/pati/ [padi] ‘a reed; a yarn guide’
/tʰi/ [tʰi] ‘mote’
/tʰicəkkəli-ta/ [tʰiʃəkkərida] keep teasing-declarative ‘keep teasing’

As illustrated in examples like /mati/ [madi] ‘joint’ and /tʰi/ [tʰi] ‘mote’ above, T-PALATALIZATION does not apply within morphemes.
T-PALATALIZATION in Korean is a morphophonological rule in that it has characteristics (1), (13), and (14) of Type (A) in Table 1: (1) it applies only within words; (13) it depends on morphological information like morpheme boundary; (14) [t] before a high front vocoid is felt to be no more difficult to pronounce by native speakers of Korean than the substitute [c].

In English, as shown in the previous section, /t/ is palatalized before only the high palatal glide /j/ (e.g., /gat ju/ [gatʃ(j)u] ~ [gatʃa] got you and /did ju/ [didʒ(j)u] did you). This usually occurs in connected speech (Jensen 1993). It occurred historically in certain environments within words (e.g., fortune, future, nature).

Although PALATALIZATION, as a cross-linguistic phenomenon, is often phonetically motivated and is phonetically motivated in English, it does not retain its phonetic motivation in synchronic Korean (i.e., the phonetic motivation is resisted for phonological or lexical reasons). One major difference between Korean and English PALATALIZATION is that morphological information is involved in Korean T-PALATALIZATION but not in English PALATALIZATION.

3.2.6 #l and #ni sequence

In Korean, the DU-iM LAW (INITIAL SOUND LAW) represents a sound change which occurred frequently in the cases of both native Korean and Sino-Korean words diachronically (from the 18\textsuperscript{th} century to the mid-20\textsuperscript{th} century) (Hwang 1979, Park 1996). It applies only to Sino-Korean words synchronically as a morphophonological rule. The law currently does not apply to loanwords.
It is divided into two rules; one changes word-initial /l/\(^{27}\) to /n/, which is called L-NASALIZATION, and the other deletes word-initial /n/ before high palatal vocoids /i, j/, which is called N-DELETION, as shown in the following (Kang and Lee 1997):

(23) L-NASALIZATION: A word-initial lateral becomes a coronal nasal.

\[ [+\text{lat}] \rightarrow [+\text{nas}, -\text{lat}] \]

(24) /lakwɔn/ [nagwɔn] ‘paradise’ (cf. /kolak/ [korak] ‘pain and pleasure’)

/lotoŋ/ [nodoŋ] ‘labor’ (cf. /kwalo/ [kwaro] ‘overwork’)

(25) N-DELETION: A word-initial dental nasal is deleted before a high palatal vocoid.

\[ [+\text{nas}, +\text{cor}] \rightarrow \emptyset / \]

(26) /njɔca/ [jɔja] ‘woman’ (cf. /canja/ [caŋja] ‘children’)

/njɔnto/ [jɔndo] ‘year’ (cf. /sonjɔn/ [soŋjɔn] ‘a boy’)

/nikmjɔŋ/ [inimjɔŋ] ‘anonymity’ (cf. /innik/ [innik] ‘hiding’)

Although the Du-iM LAW applies mainly to Sino-Korean words, there are some native Korean words that still retain word-initial /l, n/, as shown in the examples below:

(27) Native Korean words

/liil/ [riil] ‘the name of a Korean letter’

/njɔsɔk/ [njɔsɔk] (≈ [jasak]) ‘fellow, chap’

/njamnjam/ [njamnjam] ≈ [jammjam] ‘yum-yum’

/ni/ [ni] ‘you’

/nikikolita/ [nigilgərida] ‘feel nauseous,’

/nim/ [nim] ≈ [im] ‘lord, sweetheart’

/niin/ [niin] ‘the name of a Korean letter’

/nijillija/ [nillirija] ‘refrain used in a song.’

\(^{27}\)/l/ undergoes a phonological process TAPPING and thus becomes [ɾ] in the word-initial position of native Korean words.
The DU-iM LAW (INITIAL SOUND LAW) is a morphophonological process in that it has characteristics (1), (9), (13), and (14) of Type (A) in Table 1: (1) it applies only within words; (9) it may have exceptions; (13) it depends on morphological information like a word boundary or a word class (vocabulary stratum); (14) a sequence of sounds [ni] in word-initial position is felt to be no more difficult to pronounce by native speakers of Korean than the substitute [i].

The word-initial /l/ in English loanwords in Korean does not undergo the DU-iM LAW (INITIAL SOUND LAW), which has become a conventionalized rule; it undergoes the phonological process TAPPING instead and thus becomes a tap, as in the examples of (28a). The word-initial /ni/ sequence in English loanwords in Korean does not undergo any rule or process, as shown in the examples of (28b).

(28) a) /leis’i/ [reis’i] lace /laundʒi/ [raundʒi] lounge  
   b) /nit’i/ [nit’h] knit /nikʰot’in/ [nikʰot’in] nicotine

The Word-initial /l/ and /ni/ in English do not undergo any phonological substitution, as in [leis] lace and [nikʰo’tʰin] nicotine.

I have so far investigated how the phonologies of Korean and English deal differently with certain sound sequences (or segments), such as a stop plus a nasal, a coronal stop plus a lateral, a lateral plus a nasal, /si, sj/, /ti, tj/, word-initial /l/, and word-initial /ni/, and I have indicated which type of substitution the Korean substitutions belong to.
3.3 Research questions

The transfer of some of these substitutions in L2 speech can be affected by phonological conditions. As mentioned earlier in section 1, according to Carlisle (1991) and Park (2002b), phonological conditions play a role in L1 transfer.\(^{28}\) Carlisle investigated the influence of environment on Vowel Epenthesis in Spanish-English interphonology. His study showed that Epenthesis occurred significantly more frequently after word-final consonants than after word-final vowels before the three onsets — /sp/, /st/, and /sk/. Park also showed that phonological conditions play a role in L2 speech. Stop nasalization occurred more frequently in the sequence of a voiceless stop plus a nasal than in the sequence of a voiced stop plus a nasal. Stop nasalization also occurred more frequently in homorganic stop-nasal sequences than in heterorganic stop-nasal sequences, and it also occurred more frequently across word boundary than within a word.

The phonological processes I deal with in this study are assimilations. Phonological conditions like voicing, word boundary, point of articulation, and the syllabic orth of high front vocoids often play a role in assimilations. These phonological conditioning factors are irrelevant in the Korean assimilations described above, but they may affect Korean learners’ L2.

In summary, based on the division of sound substitutions into ‘morphophonological rules’ and ‘phonological processes’ described in section 2.1, the

\(^{28}\) In fact, Stampe (1969) predicted this long ago, pointing out that obstruents will devoice in final position in L2 English, even when the speaker’s L1 has no final obstruents.
Korean substitutions described here, and the phonological conditioning factors mentioned above, the following research questions can be posed:

(29) Research Questions
   (a) Do native speakers of Korean tend to transfer phonological processes in speaking English?
   (b) Do native speakers of Korean tend to transfer morphophonological rules in speaking English?
   (c) Does voicing affect the transfer of L1 phonological substitutions when native speakers of Korean speak English?
   (d) Does word boundary affect the transfer of L1 phonological substitutions when native speakers of Korean speak English?
   (e) Does place of articulation affect the transfer of L1 phonological substitutions when native speakers of Korean speak English?
   (f) Do high front vocoids ([i] vs. [j]) affect the transfer of L1 phonological substitutions when native speakers of Korean speak English?
CHAPTER 4

EXPERIMENTS: PHONOLOGICAL PROCESSES

In this chapter, I will consider the application in L2 English of the Korean phonological processes discussed in sections 3.2 and 3.3. A series of experiments will test whether and how STOP NASALIZATION, CORONAL STOP LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION apply in the L2 speech of Korean learners of English. These experiments will evaluate the roles that various phonological conditions play in L2.

4.1 General comments

4.1.1 Participants

The speakers who participated in the experimental study were sixteen female and sixteen male Korean learners of English. Most of them were students at the University of Hawai‘i at Mānoa or Hawaii Pacific University, or they were the spouses of students. They were non-advanced learners who spoke Korean with a standard South Korean accent; their ages ranged from 20 to 43. The investigator and a native speaker of English rated the pronunciation level of the participants, which is based on the recordings of their reading some English passages. A native speaker of English who has a California accent was also recorded in order to provide a typical production of American English as a reference tool for transcribing the Korean English-learners’ productions. They all participated in each experiment.
4.1.2 Statistics

For the statistical analysis of speaker errors, the GLM (General Linear Model) procedure in SAS was used, which provided ANOVA (analysis of variance) with repeated measures on one or more independent variables.

4.1.3 Data elicitation and procedures

Material used as stimuli will be discussed for each experiment. In order to elicit data as naturally as possible, reasonable sentences that included the target sequences were constructed. Some distracter sentences were also used in the set of stimuli, which are shown in Appendix C. The speakers were asked to choose their preference in each sentence with two choices (e.g., They took a catnap [in/during] the daytime) and to read the sentence twice as if they were speaking to a native speaker of English. The order of sentences was randomized. It took around forty minutes per subject. Recordings were made in a sound-attenuated recording studio at the University of Hawai‘i at Mānoa and in other quiet places. The speakers were compensated with a small gift.

Elicited segments were transcribed and categorized by the investigator and 640 out of 6080 target segments/sequences of segments of all the target utterances of this study were tested for inter-transcriber agreement, and of these, there was 94% agreement, showing reliable transcription on the investigators part. Transcription and checking were done with the aid of waveforms and spectrograms in the case of unclear segments and/or disagreements.
4.2 Phonological processes tested

Four phonological processes—STOP NASALIZATION, T-LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION—were tested.

4.2.1 Stop nasalization

As mentioned earlier in Section 3.2.1, the Korean process of STOP NASALIZATION is automatic and does not depend on morphological information like a morpheme boundary or a particular morphological class. It may apply across word boundaries, and a stop is felt to be more difficult to pronounce in a stop plus nasal sequence by native speakers of Korean than the substitute (nasal).

We expect that this phonetically motivated process, STOP NASALIZATION, will apply in second language phonology and we suspect that phonological conditions such as input stop voicing, a word boundary, and homorganicity may affect its application in L2, even though these conditions do not affect the process application at all in L1. According to the Similarity Principle, which means that more-similar sequences are more susceptible to assimilation than less-similar sequences (Hutcheson 1973), we would expect that voiced stops will be more susceptible to STOP NASALIZATION than voiceless stops and that homorganic sequences will be more susceptible to STOP NASALIZATION than heterorganic sequences. However, Park (2002b) found that, as far as voicing is concerned, STOP NASALIZATION went against the Similarity Principle: Voiceless stops were more inclined to nasalize before nasals than voiced stops. A possible explanation for voicing as a factor is that voiced stops occur only in syllable initial position in
Korean, and \textit{Vowel insertion} is likely to occur more frequently between a voiced stop and a nasal in L2 (Park 2002a). This may be why \textit{Stop nasalization} occurs more often with voiceless stops than with voiced stops. Park also found that homorganic sequences like /tn/ and /pm/ were more inclined to nasalize than heterorganic sequences like /tm/ and /pn/, which complies with the Similarity Principle. As for pronunciations with inserted vowels, they occurred more frequently in heterorganic sequences than in homorganic sequences. This is because two points of articulation are involved in the articulation of heterorganic sequences, and thus a stop is more likely to be released, and thus susceptible to \textit{Vowel insertion}, before a following heterorganic nasal than before a following homorganic nasal.

Word-internal sequences, on the other hand, are expected to be more susceptible generally to \textit{Stop nasalization} than word-external sequences, but this was not the case in Park (2002b).\textsuperscript{30} Word-external sequences (that is, sequences across a word boundary) were more inclined to nasalize than word-internal sequences (that is, sequences within a word). Nevertheless, I will here hypothesize that \textit{Stop nasalization} will occur in word-internal sequences more frequently than in word-external sequences, based on the more general hypothesis that word-internal sequences are likely to be more susceptible

\textsuperscript{29} Korean does not have a voicing distinction in its stop phonemes. It has only voiceless stops at the phonemic level.

\textsuperscript{30} As mentioned in Park (2002a), a possible explanation for this is that unreleasing of a stop in Korean marks a boundary (syllable or word boundary) and is stronger at a strong boundary. Therefore, unreleasing is stronger at word boundary. \textit{Vowel insertion} would thus be expected less often in word-external sequences.
generally to assimilation than word-external sequences (Donegan and Stampe 1978).\textsuperscript{31}

Note that a word boundary does not affect STOP NASALIZATION in Korean.

\textbf{4.2.1.1 Hypotheses}

Based on the above, the following hypotheses are made:

(1) Hypothesis 1-1

Korean learners of English will nasalize stops before nasals.

(2) Hypothesis 1-2

A voiceless stop will nasalize more frequently before a nasal than a voiced stop will.

(3) Hypothesis 1-3

A homorganic sequence of a stop plus a nasal will undergo STOP NASALIZATION more frequently than a heterorganic sequence of a stop and a nasal.

(4) Hypothesis 1-4

STOP NASALIZATION will occur within a word more frequently than across a word boundary.

It will be interesting to note any interactions that occur among phonological conditioning factors, but no hypotheses are made regarding such interactions. Although gender was considered in the analysis, no hypotheses were made regarding this potential factor.

\textbf{4.2.1.2 Materials}

The experiment focused on sequences of a dental or labial stop (/t, d, p, b/) and a nasal (/m, n/), excluding the velar place of stop and nasal articulation. Place of

\textsuperscript{31} Donegan and Stampe (1978:28) point out that the obligatory domain of REGRESSIVE NASALIZATION is the syllable and the optional domain is the measure (foot) and the obligatory domain of PROGRESSIVE NASALIZATION is the measure, which means a measure unit implies a syllable unit with regard to the application of the phonological process. It may be inferred that smaller units are more susceptible to assimilation.
articulation (homorganic vs. heterorganic) and stop voicing (voiced vs. voiceless) were considered. The stress pattern of stressed vowel-stop-nasal-stressed vowel was used in the target sequences (e.g., 'cat,nap, 'nut,meats). Boundary patterns (word-internal vs. word-external) were also taken into consideration. Thus, three factors (stop voicing, word boundary, and point of articulation) were take into consideration in order to test the above hypotheses. Some examples are shown below in Table 4.1.

Table 4.1 Sample experimental material for STOP NASALIZATION (reproduced in full in Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>b#m</td>
<td>She can bob Martha’s hair to keep [her/it] in style.</td>
</tr>
<tr>
<td>d#n</td>
<td>[Fifteen/sixteen] is an odd number.</td>
</tr>
<tr>
<td>bm</td>
<td>Davis eats seaweed and crabmeat every [evening/morning].</td>
</tr>
<tr>
<td>dn</td>
<td>Today’s headline news is [the/a] story of a kidnapping</td>
</tr>
<tr>
<td>b#n</td>
<td>Bob noticed the nice eagle on [the/a] coin.</td>
</tr>
<tr>
<td>d#m</td>
<td>I need seed money [for/in] my new business.</td>
</tr>
<tr>
<td>bn</td>
<td>The tube-maker is [wearing/trying] a rib-knit sweater.</td>
</tr>
<tr>
<td>dm</td>
<td>Two guys are [loading/shipping] a treadmill.</td>
</tr>
<tr>
<td>p#m</td>
<td>The second footnote gives [the/a] definition of ‘group marriage.’</td>
</tr>
<tr>
<td>t#n</td>
<td>The secretary put nice pictures [on/at] the desk.</td>
</tr>
<tr>
<td>pm</td>
<td>The topmast was broken [at/around] midnight.</td>
</tr>
<tr>
<td>tn</td>
<td>They took a catnap [in/during] the daytime.</td>
</tr>
<tr>
<td>p#n</td>
<td>Could you keep nice topknots [on/in] a shelf?</td>
</tr>
<tr>
<td>t#m</td>
<td>The coach got mad [at/of] the players on his baseball team.</td>
</tr>
<tr>
<td>pn</td>
<td>Can you [show/demonstrate] me how to make a slipknot?</td>
</tr>
<tr>
<td>tm</td>
<td>When making cookies, I usually put nutmeats in [them/it].</td>
</tr>
</tbody>
</table>

The number of the sequences was 48: 4 stops (p, b, t, and d) x 2 nasals (m and n) x 2 word boundary patterns (word-internal vs. word-external) x 3 sets (i.e., 3 examples per target sequence), which are shown in Appendix C. Thirty-two speakers were asked to choose their preference in each sentence with two choices and then to read the sentence
twice. Thus, the total number of target sequences collected and investigated was 3,072
(48 stimuli x 32 speakers x 2 repetitions).

4.2.1.3 Data analysis

The target segments were transcribed/categorized by the investigator and 10% of
all target segments were checked by a phonetically trained native speaker of English
(with a result of 94% intertranscriber agreement). Transcription and checking were done
with the aid of waveforms and spectrograms in the case of unclear segments and/or
disagreements. In such cases, stop sounds were differentiated from nasals by using
spectrograms. Nasals showed formant structures and/or obvious voicing on the spectrogram.

When I transcribed target sequences of a stop plus a nasal within words and
across word boundary, I categorized them as ‘nasalized,’ ‘vowel-inserted,’ ‘correct,’ and
‘others,’32 which I expected to encounter as L2 variants. ‘Nasalized’ means that a stop is
nasalized. ‘Vowel-inserted’ means that a stop is followed by an inserted vowel, usually
[i], or that it is given a very short vowel-like release. ‘Correct’ means English native-like
production. Some native speakers of Korean sometimes put a pause between a stop and a
nasal, especially when two segments in the target sequences occur across a word
boundary. When they put long pauses between those segments, they were asked to re-
read the relevant sentences including the target sequences in order to avoid the influence
of pauses. Also, beginning learners of English who read very slowly (and could

32 This category includes AFFRICATION (/t.m/-/tms/-]: e.g., /natmits/ [natsmits] nutmeats),
DENASALIZATION (/b.n/-/b.d/-]: e.g., /bub natst/ [budetst] Bob noticed...), FRICATION (/p.m/-/f.m/-]:
e.g., /dmp mst/ [dmp mst] drip mat), etc., which occurred less than 1% of the time.
be expected to pause frequently) were excluded from this study.

I evaluated L1 transfer, based on the frequency of STOP NASALIZATION. I considered only nasalized segments statistically, in order to examine whether factors such as word boundary (vs. its absence), stop voicing, and homorganicity significantly affected STOP NASALIZATION. In addition, I conducted a statistical analysis of vowel-inserted pronunciations, based on the frequency of those pronunciations, in order to give a better account for the transfer of STOP NASALIZATION.

4.2.1.4 Results

4.2.1.4.1 General results

Table 4.2 below shows the results of the experiment. Mean frequencies of correct pronunciation ranged from 26% to 59.3% (total mean: 47%), depending on the sequence. The speakers showed a lot of nasalized pronunciations, compared to the other errors (42.4% vs. 10.8%). Nasalized pronunciations (e.g., /kʰætnæp/ [kʰætnæp'] catnap) ranged between 16.1% and 71.7% (total mean: 42.4%), depending on the sequence. Vowel-inserted (V-inserted) pronunciations (e.g., /tʰædmil/ [tʰædmil] treadmill) ranged from 0% to 30.5% (total mean: 10.3%), and other errors were between 0% and 1.2% (total mean: 0.5%), depending on the sequence.
Table 4.2 Mean (%) of each category with regard to target sequences*

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>Nasalized</th>
<th>Correct</th>
<th>V-inserted</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>d#n, b#m</td>
<td>F</td>
<td>42.5</td>
<td>44.8</td>
<td>12.2</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>38.7</td>
<td>56.1</td>
<td>5.2</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>40.6</td>
<td>50.5</td>
<td>8.7</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>39.4</td>
<td>42.9</td>
<td>17.7</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>46.4</td>
<td>39.1</td>
<td>13.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>42.9</td>
<td>41.0</td>
<td>15.6</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>22.8</td>
<td>53.4</td>
<td>22.6</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>20.0</td>
<td>65.2</td>
<td>14.8</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>21.4</td>
<td>59.3</td>
<td>18.7</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16.8</td>
<td>48.5</td>
<td>34.2</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>15.3</td>
<td>57.9</td>
<td>26.8</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>16.1</td>
<td>53.2</td>
<td>30.5</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>59.1</td>
<td>39.8</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>58.9</td>
<td>41.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>59.0</td>
<td>40.5</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>70.2</td>
<td>27.5</td>
<td>1.7</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>72.6</td>
<td>24.5</td>
<td>2.2</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>71.4</td>
<td>26.0</td>
<td>2.0</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>46.5</td>
<td>52.5</td>
<td>0.0</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>36.4</td>
<td>60.4</td>
<td>3.3</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>41.5</td>
<td>56.5</td>
<td>1.7</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>43.8</td>
<td>47.9</td>
<td>6.7</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>47.1</td>
<td>48.9</td>
<td>3.3</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>45.5</td>
<td>48.4</td>
<td>5.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Stop-Nasal</td>
<td>F</td>
<td>42.6</td>
<td>44.7</td>
<td>11.9</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>41.9</td>
<td>49.2</td>
<td>8.6</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>42.3</td>
<td>47.0</td>
<td>10.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

* ‘F,’ ‘M,’ and ‘Mn’ indicate ‘female,’ ‘male,’ and ‘mean,’ respectively.

### 4.2.1.4.2 Results for nasalized pronunciation in stop-nasal sequences

To determine whether the frequency of nasalized pronunciations (the dependent variable) differs depending on stop voicing (voiceless vs. voiced input), place of articulation (homorganic vs. heterorganic sequences), the presence/absence of a word boundary (word-internal vs. word-external sequences), or gender (male vs. female speakers), a 4-way ANOVA with repeated measures on three independent variables was
conducted. For this statistical analysis, I computed the means of nasalized cases for every subject in each condition with stop voicing, place of articulation, and word boundary. Table 4.3 displays descriptive results arranged according to the conditions on STOP NASALIZATION, and Table 4.4 shows a summary of the results of ANOVA on STOP NASALIZATION.

Table 4.3 Descriptive Statistics (Mean (%) for STOP NASALIZATION in different stop plus nasal conditions)*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Voiced</th>
<th>Voiceless</th>
<th>Row Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Homorganic</td>
<td>Heterorganic</td>
<td>Homorganic</td>
</tr>
<tr>
<td></td>
<td>W-E</td>
<td>W-I</td>
<td>W-E</td>
</tr>
<tr>
<td>d#n,</td>
<td>42.5</td>
<td>39.4</td>
<td>22.8</td>
</tr>
<tr>
<td>b#m</td>
<td>18.0</td>
<td>18.0</td>
<td>15.0</td>
</tr>
<tr>
<td>d#m,</td>
<td>38.7</td>
<td>46.4</td>
<td>20.0</td>
</tr>
<tr>
<td>b#n</td>
<td>20.0</td>
<td>19.0</td>
<td>13.0</td>
</tr>
</tbody>
</table>

* ‘W-E’ and ‘W-I’ indicates ‘word-external’ and ‘word-internal,’ respectively. ‘SD’ indicates ‘standard deviation.’

33 Three repeated independent variables are stop voicing, place of articulation, and word boundary, and one non-repeated independent variable is gender.
Table 4.4 Summary of the results of ANOVA on STOP NASALIZATION in stop plus nasal sequences (The factors marked with bold face were significant at $p < .05$.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$F$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>0.01</td>
<td>0.9047</td>
</tr>
<tr>
<td><strong>Voicing</strong></td>
<td>1, 30</td>
<td>158.69</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Voicing x Gender</td>
<td>1, 30</td>
<td>0.05</td>
<td>0.8200</td>
</tr>
<tr>
<td><strong>POA (Place of articulation)</strong></td>
<td>1, 30</td>
<td>171.53</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>POA x Gender</td>
<td>1, 30</td>
<td>1.45</td>
<td>0.2381</td>
</tr>
<tr>
<td>Boundary</td>
<td>1, 30</td>
<td>3.62</td>
<td>0.0667</td>
</tr>
<tr>
<td>Boundary x Gender</td>
<td>1, 30</td>
<td>4.04</td>
<td>0.0536</td>
</tr>
<tr>
<td>Voicing x POA</td>
<td>1, 30</td>
<td>0.26</td>
<td>0.6120</td>
</tr>
<tr>
<td>Voicing x POA x Gender</td>
<td>1, 30</td>
<td>0.02</td>
<td>0.8843</td>
</tr>
<tr>
<td><strong>Voicing x Boundary</strong></td>
<td>1, 30</td>
<td>10.83</td>
<td>0.0026</td>
</tr>
<tr>
<td>Voicing x Boundary x Gender</td>
<td>1, 30</td>
<td>0.12</td>
<td>0.7311</td>
</tr>
<tr>
<td><strong>POA x Boundary</strong></td>
<td>1, 30</td>
<td>8.62</td>
<td>0.0063</td>
</tr>
<tr>
<td>POA x Boundary x Gender</td>
<td>1, 30</td>
<td>0.01</td>
<td>0.9083</td>
</tr>
<tr>
<td>Voicing x POA x Boundary</td>
<td>1, 30</td>
<td>0.02</td>
<td>0.8867</td>
</tr>
<tr>
<td>Voicing x POA x Boundary x Gender</td>
<td>1, 30</td>
<td>4.15</td>
<td>0.0505</td>
</tr>
</tbody>
</table>

Of the 15 effects, only two main effects (stop voicing and place of articulation) and two 2-way interaction effects (voicing x word boundary and place of articulation x word boundary) were significant, as shown in Table 4.4.

Stop voicing did play a role in nasalized pronunciation. As predicted, STOP NASALIZATION occurred more frequently in the case of voiceless stops (54.4%) than in the case of voiced stops (30.3%). Place of articulation also played a role in nasalized pronunciation. STOP NASALIZATION occurred more frequently in homorganic sequences (that is, in coronal-coronal and labial-labial sequences: 53.5%) than in heterorganic sequences (that is, in coronal-labial and labial-coronal sequences: 31.1%).

Let us turn to interaction effects. A 2-way interaction effect of voicing x word boundary was significant, which suggests that the word boundary effect depends on stop voicing. As shown in Figure 4.1, for voiceless stops, STOP NASALIZATION is more
frequent within a word (58.5%) than across a word boundary (50.3%). However, for voiced stops, the opposite is true, that is, STOP NASALIZATION is marginally more frequent within a word (29.5%) than across a word boundary (31%). It should also be noted that for voiced stops, the frequency of STOP NASALIZATION is almost the same within a word or across a word boundary, whereas the difference in STOP NASALIZATION frequency is more drastic for voiceless stops. That means that the effect of a word boundary on STOP NASALIZATION depends on whether the stop is voiced or voiceless.

![Figure 4.1 Interaction of voicing x word boundary in nasalized pronunciation](image)

A 2-way interaction effect of place of articulation x word boundary was significant, which suggests that the word boundary effect also depends on place of articulation. As shown in Figure 4.2, in a homorganic sequence (that is, in a coronal-coronal or labial-labial sequence), STOP NASALIZATION is more frequent within a word (57.2%) than across a word boundary (49.8%). However, in a heterorganic sequence (that is, in a coronal-labial or labial-coronal sequence), the opposite is true, that is, STOP NASALIZATION is a bit more frequent across a word boundary (31.5%) than within a word (30.8%). It should also be noted that in a heterorganic sequence, the frequency of STOP NASALIZATION is almost the same within a word or across a word boundary, whereas the
difference in STOP NASALIZATION frequency is more drastic in the homorganic sequence. That means that the effect of a word boundary on STOP NASALIZATION depends on whether the sequence is homorganic or heterorganic.

<table>
<thead>
<tr>
<th></th>
<th>Word-external</th>
<th>Word-internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homorganic</td>
<td>49.8</td>
<td>57.2</td>
</tr>
<tr>
<td>Heterorganic</td>
<td>31.5</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Figure 4.2 Interaction of place of articulation x word boundary in nasalized pronunciation

4.2.1.4.3 Results for vowel-inserted pronunciation in stop-nasal sequences

To determine whether the frequency of vowel-inserted pronunciations (dependent variable) differs depending on stop voicing (voiceless vs. voiced input), place of articulation (homorganic vs. heterorganic sequences), the presence/absence of a word boundary (word-internal vs. word-external sequences), or gender (male vs. female speakers), a 4-way ANOVA with repeated measures on three independent variables was conducted. For this statistical analysis, I computed means of vowel-inserted cases for every subject in each condition with stop voicing, place of articulation, and word boundary. Table 4.5 displays descriptive results arranged according to the conditions on VOWEL INSERTION, and Table 4.6 shows a summary of the results of ANOVA on VOWEL INSERTION.
Table 4.5 Descriptive Statistics (Mean (%) for VOWEL INSERTION in different stop plus nasal conditions)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Voiced</th>
<th>Voiceless</th>
<th>Row Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Homorganic</td>
<td>Heterorganic</td>
<td>Homorganic</td>
</tr>
<tr>
<td></td>
<td>W-E</td>
<td>W-I</td>
<td>W-E</td>
</tr>
<tr>
<td>d#n, b#m</td>
<td>12.2</td>
<td>17.7</td>
<td>22.6</td>
</tr>
<tr>
<td>dn, bm</td>
<td>14.0</td>
<td>18.0</td>
<td>10.0</td>
</tr>
<tr>
<td>t#m, p#m</td>
<td>5.2</td>
<td>13.5</td>
<td>14.8</td>
</tr>
<tr>
<td>t#n, pn</td>
<td>10.0</td>
<td>14.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Column Mn</td>
<td>8.7</td>
<td>15.6</td>
<td>18.7</td>
</tr>
</tbody>
</table>

Table 4.6 Summary of the results of ANOVA on VOWEL INSERTION between a stop and a nasal (The factors marked with bold face were significant at p <.05.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>1.98</td>
<td>0.1702</td>
</tr>
<tr>
<td>Voicing</td>
<td>1, 30</td>
<td>71.66</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Voicing x Gender</td>
<td>1, 30</td>
<td>3.05</td>
<td>0.0909</td>
</tr>
<tr>
<td>POA (Place of articulation)</td>
<td>1, 30</td>
<td>40.36</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>POA x Gender</td>
<td>1, 30</td>
<td>0.25</td>
<td>0.6173</td>
</tr>
<tr>
<td>Boundary</td>
<td>1, 30</td>
<td>21.66</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Boundary x Gender</td>
<td>1, 30</td>
<td>0.07</td>
<td>0.7926</td>
</tr>
<tr>
<td>Voicing x POA</td>
<td>1, 30</td>
<td>15.82</td>
<td>0.0004</td>
</tr>
<tr>
<td>Voicing x POA x Gender</td>
<td>1, 30</td>
<td>0.12</td>
<td>0.7349</td>
</tr>
<tr>
<td>Voicing x Boundary</td>
<td>1, 30</td>
<td>7.08</td>
<td>0.0124</td>
</tr>
<tr>
<td>Voicing x Boundary x Gender</td>
<td>1, 30</td>
<td>0.90</td>
<td>0.3498</td>
</tr>
<tr>
<td>POA x Boundary</td>
<td>1, 30</td>
<td>2.89</td>
<td>0.0994</td>
</tr>
<tr>
<td>POA x Boundary x Gender</td>
<td>1, 30</td>
<td>1.63</td>
<td>0.2112</td>
</tr>
<tr>
<td>Voicing x POA x Boundary</td>
<td>1, 30</td>
<td>0.79</td>
<td>0.3813</td>
</tr>
<tr>
<td>Voicing x POA x Boundary x Gender</td>
<td>1, 30</td>
<td>0.42</td>
<td>0.5216</td>
</tr>
</tbody>
</table>

Of the 15 effects, only three main effects (stop voicing, place of articulation, and word boundary) and two 2-way interaction effects (voicing x place of articulation and voicing x word boundary) were significant, as shown in Table 4.6. Although there was no significant effect of gender on VOWEL INSERTION, VOWEL INSERTION occurred arithmetically more frequently in female speakers (11.9%) than in male speakers (8.6%).
Stop voicing did play a role in vowel-inserted pronunciation. VOWEL INSERTION occurred more frequently in the case of voiced stops (18.4%) than in the case of voiceless stops (2.2%). Place of articulation also played a role in vowel-inserted pronunciation. VOWEL INSERTION occurred more frequently in heterorganic sequences (that is, in coronal-labial and labial-coronal sequences: 14%) than in homorganic sequences (that is, in coronal-coronal and labial-labial sequences: 6.6%). As predicted, word boundary did play a role in vowel-inserted pronunciation. VOWEL INSERTION occurred more frequently in word-internal sequences (that is, within a word: 13.3%) than in word-external sequences (that is, across a word boundary: 7.3%).

Let us turn to interaction effects. A 2-way interaction effect of voicing x place of articulation was significant, which suggests that the place of articulation effect depends on stop voicing. As shown in Figure 4.3, for voiced stops, VOWEL INSERTION is more frequent in heterorganic sequences (24.6%) than in homorganic sequences (12.2%). However, for voiceless stops, VOWEL INSERTION is only a little bit more frequent in heterorganic sequences (3.4%) than in homorganic sequences (1.0%). It should also be noted that for voiceless stops, the frequency of VOWEL INSERTION is almost the same in homorganic sequences or heterorganic sequences, whereas the difference in VOWEL INSERTION frequency is much more drastic for voiced stops. That means that the effect of place of articulation on VOWEL INSERTION depends on whether the stop is voiced or voiceless.
A 2-way interaction effect of voicing x word boundary was significant, which suggests that the word boundary effect depends on stop voicing. As shown in Figure 4.4, with voiced stops, VOWEL INSERTION is more frequent within a word (23.1%) than across a word boundary (13.7%). However, with voiceless stops, VOWEL INSERTION is only a little bit more frequent within a word (3.5%) than across a word boundary (0.9%). It should also be noted that for voiceless stops, the frequency of VOWEL INSERTION is almost the same within a word or across a word boundary, whereas the difference in VOWEL INSERTION frequency is much more drastic with voiced stops. That means that the effect of a word boundary on VOWEL INSERTION depends on whether the stop is voiced or voiceless.
4.2.1.4.4 Summary and discussion

As mentioned in Section 4.2.1.4.2, out of the 15 effects on nasalized pronunciation, only two main effects (stop voicing and place of articulation) and two 2-way interaction effects (voicing x word boundary and place of articulation x word boundary) were significant. The 4-way ANOVA with repeated measures on three independent variables showed no significant effect of gender on STOP NASALIZATION overall (F (1, 30)= 0.01, p=0.9047). There were no significant effects of word boundary and the interaction of voicing x place of articulation, and gender did not show any significant interaction with other factors in STOP NASALIZATION, as shown in Table 4.4.

Figure 4.5 shows the effect of voiced/voiceless stops on the production of stop-nasal clusters. The effect of voicing on STOP NASALIZATION was significant (F (1, 30)=158.69, p<.0001).

![Figure 4.5 Effect of stop voicing on production of stop-nasal sequences](image)

As hypothesized, STOP NASALIZATION occurred more frequently in the case of voiceless stops than in the case of voiced stops (54.4% vs. 30.3%); this agrees with the results in Park (2002b). This actually violates the Similarity Principle, according to which more-similar sequences are more susceptible to assimilation than less-similar sequences.
(Hutcheson 1973). Thus, if the sequence /tn/ becomes [nn], then we expect that, ceteris paribus, the sequence /dn/ will become [nn], so this principle predicts that the substitution of [nn] for /dn/ will occur more frequently than the substitution of [nn] for /tn/.

We assume that the sequence of an unreleased voiceless stop and a nasal presents a relative difficulty of some kind. We might speculate about why the sequence of an unreleased oral stop plus a nasal is amended to a nasal-nasal sequence.

According to Cho, Jun and Ladefoged (2002:210), there are four factors which affect the oral air pressure: a) the subglottal air pressure, which the oral air pressure comes from originally; b) the glottal impedance, which may make the oral air pressure less than the subglottal air pressure; c) the tension of the walls of the vocal tract, which, if it is weak, will lower the oral air pressure; d) the duration of the stop closure—stops with a long closure will get a higher oral air pressure. Based on the second and fourth factors, we may infer that voiceless stops in the coda have higher oral air pressure than voiced ones because the former have less glottal impedance and longer closure than the latter.

These implications may explain why voiceless stop-nasal sequences are less preferred than voiced stop-nasal sequences. When an oral stop is articulated, air pressure builds up, and there may be some muscular tension of all the relevant articulators including velum and tongue. It may be harder to lower the velum under higher oral air pressure than under lower oral air pressure. For example, suppose that there is a flat tire that has a puncture. A mechanic will try to glue a patch inside the tire so that the high air pressure will push the patch against the hole and no air will go out. Likewise, the elevated
oral air pressure formed in the oropharyngeal cavity during a stop may push against the raised velum and it may be more difficult to lower the velum. Thus, the oral air pressure may need to be reduced for the articulation of the following nasal. **STOP NASALIZATION** and **VOICING** in Korean avoid the problem by lowering the velum before the oral air pressure builds up and by allowing the vocal folds to continue to vibrate. These assimilate an oral stop to the following nasal by changing two features \([-\text{nas}, -\text{voiced}\)] of a voiceless stop to \([+\text{nas}, +\text{voiced}\)] or spreading two features \([+\text{nas}, +\text{voiced}\)] of a nasal (i.e., nasal and voicing assimilation).\(^{34}\)

**VOWEL INSERTION** was the opposite of **STOP NASALIZATION**, in that vowels were inserted far more frequently after voiced stops than after voiceless stops (18.3% vs. 2.2%). This may be a result of the priority of the phonetic patterning in Korean, where, if a stop is phonetically voiced, it is assumed to be in syllable-initial position. In Park (2002a),\(^{35}\) voiceless stops were more often perceived as syllable-final and voiced stops

\(^{34}\) In Korean, manner assimilation complies with Vennemann's Contact Law because it reduces the consonantal strength of the coda by substituting \([n]\) for \([t]\), but English **GLOTTALIZATION** violates it. Vennemann defines the Contact Law as follows:

> "A syllable contact \(AB\) is the more preferred, the less the Consonantal Strength of the offset \(A\) and the greater the Consonantal Strength of the onset \(B\); more precisely — the greater the characteristic difference \(\text{CS}(B) - \text{CS}(A)\) between the Consonantal Strength of \(B\) and that of \(A\)." (Vennemann 1988:40)

\(^{35}\) Park (2002a) examined how Korean learners of English perceive stop-nasal sequences in English. Nonsense words involving sequences of a stop and a nasal (\(ep\)ma, \(ep\)na, \(eb\)ma, \(eb\)na, \(et\)ma, \(et\)na, \(ed\)ma, \(ed\)na, \(ek\)ma, \(ek\)na, \(eg\)ma, \(eg\)na) were recorded by two native English speakers. Words were placed in the carrier sentence 'I said ___ today/yesterday.' The task of the listeners was to choose from forms that represented the word they heard from a list. For instance, in response to the stimulus \(ep\)ma, listeners could choose one of the following: **EPENTHESIS** (\(epj\)ma), **DENASALIZATION** (\(epp\)a), **NASALIZATION** (\(emma\)), **correct pronunciation** (\(ep\)ma), **NASAL DELETION** (\(ep\)a), **STOP DELETION** (\(em\)a), and **METATHESIS** (\(emp\)a). Overall, Korean listeners significantly showed perception of an epenthetic vowel, which was affected primarily by the release and/or voicing of stops: perception of an epenthetic vowel occurred more frequently in released stop-nasal sequences than in unreleased stop-nasal sequences, and in voiced stop-nasal sequences than voiceless stop-nasal sequences. Their perception of an epenthetic vowel correlates to
were more often perceived as syllable-initial. Because voiced stops are produced in Korean only in syllable-initial position, Korean speakers may aim at a following vowel in order to produce a voiced stop. As a result, voiceless stops were nasalized more often in production (Park 2002b). It might be proposed that VOWEL INSERTION takes away potential inputs for STOP NASALIZATION, but correct pronunciation occurred less frequently with voiceless stops (42.8%) than with voiced stops (51%). From a comparison of nasalized pronunciation and correct pronunciation, it seems that voiceless stop-nasal sequences may be more difficult to pronounce than voiced stop-nasal sequences.

Among cases of pronunciations judged to be English-like, spectrogram analysis showed two contrasting alternatives: (1) partial voicing of voiceless stops before nasals, which could be attributable to spreading of the voicing feature of a nasal; and (2) partial devoicing of voiced stops before nasals, which may occur if the learners follow the phonological patterning of Korean in which syllable-final stops at the phonetic level are voiceless. Also, the speakers frequently tended to put a pause between a stop and a nasal, which suggests that they find sequences of a stop and a nasal difficult to pronounce.

Figure 4.6 shows the significant effect of place of articulation on production as a factor in STOP NASALIZATION (F (1, 30)= 171.53, p<.0001).

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36 As Table 4.4 shows, gender did not play an important role in STOP NASALIZATION in the case of place of articulation.
STOP NASALIZATION occurred more frequently in homorganic sequences (that is, in coronal-coronal and labial-labial sequences) than in heterorganic sequences (that is, in coronal-labial and labial-coronal sequences) (53.5% vs. 31.1%). This complies with the Similarity Principle (Hutcheson 1973). Vowel insertion, on the other hand, took place more frequently in heterorganic sequences than in homorganic sequences (14% vs. 6.6%), as in Figure 4.6.

Figure 4.7 shows the effect of a word boundary on production. There was no significant effect of word boundary (F (1, 30)=3.62, p=0.0667).37

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37 As Table 4.4 shows, the interaction effect of word boundary x gender also was not significant in STOP NASALIZATION.
STOP NASALIZATION occurred more frequently in the case of word-internal sequences (i.e., when no word boundary separated a stop from a nasal) than in the case of word-external sequences (i.e., when word boundary separated a stop from a nasal) (44% vs. 40.6%), as in Figure 4.7. This is contrary to the results of Park (2002b). But although this verifies Hypothesis 1-4 in (4) arithmetically, the hypothesis is not confirmed statistically. Note that the expectation that word-internal assimilation will be more frequent does not correspond to the way STOP NASALIZATION applies in Korean, where it applies equally within words and across word boundaries. VOWEL INSERTION occurred more frequently in the case of word-internal sequences than in the case of word-external sequences (13.3% vs. 7.3%), as shown in Figure 4.7.

Let us turn to interaction effects. The interaction of stop voicing x word boundary showed significant results ($F(1, 30)=10.83, p=0.0026$). The significance of 2-way interaction here reflects the fact that the absence of word boundary has a positive effect

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38 Park (2002b) may have been due to frequency difference of target sequences among speakers. Stop-nasal sequences within words are not very common in English.
on the frequency of nasalized pronunciation in voiceless stop-nasal sequences, and the absence of a word boundary has a negative effect (or near zero effect) on the frequency of nasalized pronunciation in voiced stop-nasal sequences, as in Figure 4.1. With regard to voiceless stop-nasal sequences, STOP NASALIZATION occurred more frequently within a word (58.5%) than across a word boundary (50.3%), so the difference of the two mean scores (58.5% - 50.3% = 8.2%) was positive. In contrast, with regard to voiced stop-nasal sequences, STOP NASALIZATION occurred more frequently across a word boundary (31%) than within a word (29.5%), so the difference of the two mean scores (29.5% - 31% = -1.5%) was negative (or showed a near zero effect). That is, the effect of a word boundary on STOP NASALIZATION showed opposite tendencies, depending on whether the stop was voiceless or voiced, as shown in Figure 4.1. It may be that NASALIZATION of a voiceless stop may be suppressed more easily across a word boundary than within a word because pause is more likely at a word boundary, rather than within a word.

Also, the interaction of place of articulation x word boundary showed significant results (F (1, 30)=8.62, p=0.0063). The significance of the 2-way interaction here reflects the fact that the absence of word boundary has a positive effect on the frequency of nasalized pronunciation in homorganic sequences, and the absence of a word boundary has a negative effect (or near zero effect) on the frequency of nasalized pronunciation in heterorganic sequences, as shown in Figure 4.2. With respect to homorganic sequences, STOP NASALIZATION occurred more frequently within a word (57.2%) than across a word boundary (49.8%), showing that the difference of the two mean scores (57.2% - 49.8% = 7.4%) was positive. In contrast, with respect to heterorganic sequences, STOP
NASALIZATION occurred more frequently across a word boundary (31.5%) than within a word (30.8%), showing that the difference of the two mean scores (30.8% - 31.5% = -0.7%) was negative. That is, the effect of a word boundary on STOP NASALIZATION showed opposite tendencies, depending on whether sequences were homorganic or heterorganic, as shown in Figure 4.2. This may be explained by the assumption that nasalized pronunciations occur in homorganic sequences more frequently than in heterorganic sequences, based on Hutcheson’s Similarity Principle, and within a word more frequently than across a word boundary due to the lower probability of a pause within a word than of a pause across a word boundary.

Gender did not interact with voicing x word boundary or place of articulation x word boundary in STOP NASALIZATION, as shown in Table 4.4.

With respect to VOWEL INSERTION and gender, there is one thing to note. VOWEL INSERTION arithmetically occurred more frequently in female speakers than in male speakers, even though there was no significant effect of gender. This may suggest that female speakers tend to show the fortitive process (VOWEL INSERTION) for clarity of their pronunciation in L2.

In summary, Hypothesis 1-1 in (1) was supported, because Korean learners of English tended to transfer their phonological process of STOP NASALIZATION (42.3% of their productions or 79.5% of their errors) and Hypotheses 1-2 in (2) and 1-3 in (3) were also supported: The main effects of two phonological conditioning factors—stop voicing and homorganicity—were significant. STOP NASALIZATION occurred more frequently in voiceless stop-nasal sequences (54.4%) than voiced stop-nasal sequences (30.3%), and in homorganic sequences (53.5%) than in heterorganic sequences (31.1%). Hypothesis 1-4
in (4) was not supported: There was no significant effect of word boundary on STOP NASALIZATION. STOP NASALIZATION occurred more frequently in the case of word-internal sequences (i.e., when no word boundary separated a stop from a nasal) than in the case of word-external sequences (i.e., when word boundary separated a stop from a nasal) (44% vs. 40.6%). However, word boundary interacted significantly with stop voicing and place of articulation, as shown in 4.4. The word boundary effect depends on stop voicing. With a voiceless stop, STOP NASALIZATION is more likely to occur within a word (58.5%) than across a word boundary (50.3%), whereas, with a voiced stop, STOP NASALIZATION is likely to occur almost equally in word-internal and word-external sequences (29.5% vs. 31.0%).

4.2.2 CORONAL STOP LATERALIZATION

Like STOP NASALIZATION, the Korean process of CORONAL STOP LATERALIZATION is a phonetically motivated process. As mentioned earlier in Section 3.2.2, it is automatic and does not depend on morphological information like a morpheme boundary. It may apply across a word boundary, and a stop is felt to be more difficult to pronounce in a /t.l/ sequence than its substitute (lateral).

We expect that this phonetically motivated process, CORONAL STOP LATERALIZATION, will transfer in second language phonology and that factors such as voicing and word boundary will affect L1 transfer to L2. We have only one native Korean case (e.g., /tikit/ /# /liil/ [tigilliil] ‘the names of two Korean letters’). Korean does not have a voiceless-voiced distinction of stops and its obstruent phonemes are all voiceless. Therefore, we cannot say that these factors affect the application of CORONAL
STOP LATERALIZATION in L1. There is also one loanword composed of a Korean word and a foreign word (e.g., /os/+/lopi/ [ollobi]\(^{39}\) ‘clothes+lobby’) where an input occurs for this process, in which /s/ undergoes NEUTRALIZATION before CORONAL STOP LATERALIZATION and becomes [t] (/os/+/lopi/ → *[ot lobi] → [ollobi] ‘clothes+lobby’).

As with STOP NASALIZATION, in the case of CORONAL STOP LATERALIZATION, we expect that a coronal voiceless stop /t/ will lateralize before a lateral more frequently than a coronal voiced stop /d/, even though this is contrary to the prediction of the Similarity Principle, because a coronal voiced stop /d/ occurs only in syllable initial position in Korean and it is likely to condition VOWEL INSERTION more frequently in Korean learners of English (cf. Park 2002b).

Word-internal sequences are likely to be more susceptible generally to assimilation than word-external sequences. Thus, it is expected that CORONAL STOP LATERALIZATION, which affects only unreleased stops, will occur within words more frequently.

4.2.2.1 Hypotheses

Based on the above, the following hypotheses are made:

(6) Hypothesis 2-1
Korean learners of English will lateralize coronal stops before a lateral.

(7) Hypothesis 2-2
A coronal voiceless stop will lateralize more frequently before a lateral than a voiced stop will.

\(^{39}\) We have another variant [onnobi] for /os/+/lopi/.
(8) Hypothesis 2-3

CORONAL STOP LATERALIZATION will occur more frequently within a word than across a word boundary.

4.2.2.2 Materials

Sequences of a coronal stop plus a lateral were elicited. Two factors, stop voicing and word boundary, were considered in order to test the above hypotheses. Stops were voiced and voiceless, and the sequences were within words or across word boundaries. The stress pattern of stressed vowel-stop-nasal-stressed vowel was used in the target sequences (e.g., 'pot,luck, 'head,line). The number of the sequences was 12: 2 voicing values (t, d) x 2 word boundary patterns (word-internal vs. word-external) x 3 sets (i.e., 3 examples per target sequence), which are shown in Appendix C. Some examples are shown in Table 4.7. Thirty-two speakers were asked to choose their preference in each sentence with two choices and then to read the sentence twice. Thus, the total number of target sequences collected and investigated was 768 (12 stimuli x 32 speakers x 2 repetitions).

Table 4.7 Sample experimental material for CORONAL STOP LATERALIZATION (reproduced in full in Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>tl</td>
<td>Jeb made a nice dish for the potluck [party/dinner].</td>
</tr>
<tr>
<td>dl</td>
<td>Today’s headline news is [the/a] story of a kidnapping.</td>
</tr>
<tr>
<td>t#l</td>
<td>Mr. Scot-Young got lost [in/on] the woods.</td>
</tr>
<tr>
<td>d#l</td>
<td>This is [the/a] dead letter.</td>
</tr>
</tbody>
</table>
4.2.2.3 Data analysis

Like the sequences of a stop and a nasal, the sequences of a coronal stop and a lateral were also transcribed/categorized by the investigator and 10% of all target segments were checked by a phonetically trained native speaker of English. Transcription and checking were done with the aid of waveforms and spectrograms in the case of unclear segments and/or disagreements. In such cases, stop sounds were differentiated from laterals, using spectrograms. Lateral sounds showed formant structures on the spectrogram.

When I transcribed target sequences of a coronal stop plus a lateral within words and across word boundary, I categorized them as 'lateralized,' 'correct,' 'vowel-inserted plus [l],' 'V-inserted plus [r/ω],’ ‘[t/d]-[r/ω],’ and 'other,'40 most of which one can expect to encounter as L2 variants. ‘Lateralized’ means that a coronal stop becomes a lateral. ‘Correct’ means English native-like production. ‘Vowel-inserted plus l’ means that a stop is followed by an inserted vowel, usually [i], or that it is given a very short vowel-like release before a lateral. ‘V-inserted plus [r/ω]’ means that, additionally, the lateral becomes a tap or an English r-like sound. ‘[t/d]-[r/ω]’ means that [t] or [d] is followed by a tap or an English r-like sound. Some native speakers of Korean sometimes put a pause between a coronal stop and a lateral, especially when two segments in the target

---

40 This category includes STOP NASALIZATION (/t,l/- [-nl-]: e.g., /potlak/ [pønlak] potluck), NASALIZATION and TAPPING (/t,l/- [nr]: e.g., /hazlajin/ [hazrlain] hotline), DELETION and TAPPING (/d,l/- [-r-]: e.g., /gat ləst/ [gɔrst] got lost), FRICATION and VOWEL INSERTION (/d,l/- [-zil-]: e.g., /wud lili/ [wuzilii] wood lily), FRICATION, VOWEL INSERTION, and TAPPING (/d,l/- [-zir-]: /hedlajt/ [hezirajt])
sequences occur across a word boundary. When they put long pauses between those segments, they were asked to re-read the relevant sentences including the target sequences in order to avoid the influence of pauses. Also, beginning learners of English who read very slowly (and could be expected to pause frequently) were excluded from this study.

I evaluated L1 transfer, based on the frequencies of CORONAL STOP LATERALIZATION. I considered only lateralized segments statistically in order to examine whether factors such as voicing and word boundary (vs. its absence) significantly affected CORONAL STOP LATERALIZATION. In addition, I conducted a statistical analysis of vowel-inserted pronunciations, based on the frequency of those pronunciations, in order to give a better account for the transfer of CORONAL STOP LATERALIZATION.

4.2.2.4 Results

4.2.2.4.1 General results

Table 4.8 below shows the results of the experiment. Mean frequencies of correct pronunciation ranged between 14.6% and 44.8% (total mean: 33.1%), depending on the sequences. The speakers made a lot of errors (67.4%), showing lateralized pronunciation, vowel-inserted (‘V-inserted’ in the table) pronunciation, etc. For any given sequence (/t#/l/, /tl/, /d#/l/, /dl/), lateralized pronunciation (e.g., /patlAk/ [pollAk] potluck) ranged between 0% and 45.2% (total mean: 21.1%); vowel-inserted plus [l] (i.e., the sequence of stop-[i]-lateral) pronunciation (e.g., /ded leťař/ [dedileťař] dead letter) ranged between

headlight), AFFRICATION (/t*l/- [t*l]-; e.g., /patlAk/ [patlAk] potluck), TAPPING (e.g., /hatlajn/ [hatrajn] hotline), etc. which, all together, made up less than 4% of the responses.
8.3% and 61.9% (total mean: 32.5%); vowel-inserted plus [r/l] (i.e., the sequence of stop-[i]-[r or l]) pronunciation (e.g., /hed lajn/ [hedìajn/] or [hedirajn] *headline*) ranged between 0% and 17.1% (total mean: 7.5%). ‘TAPPING/RHOTACIZATION’ (e.g., /butlegəːs/ [butlegəːs] *bootleggers* and /ded letəː/ [dedletəː] *dead letter*) and ‘others’ showed averages of 2.9% and 3.4%, respectively.

Table 4.8 Mean (%) of each category with regard to target sequences

<table>
<thead>
<tr>
<th></th>
<th>Lateralized</th>
<th>Correct</th>
<th>V-inserted plus [l]</th>
<th>V-inserted plus [r/l]</th>
<th>[t/d]-[r/l]</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>d#l</td>
<td>F</td>
<td>0.0</td>
<td>20.8</td>
<td>50.7</td>
<td>17.1</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>8.4</td>
<td>42.7</td>
<td>36.2</td>
<td>11.7</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>4.2</td>
<td>31.8</td>
<td>43.5</td>
<td>14.4</td>
<td>3.7</td>
</tr>
<tr>
<td>dl</td>
<td>F</td>
<td>2.1</td>
<td>14.6</td>
<td>61.9</td>
<td>16.8</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>14.8</td>
<td>22.9</td>
<td>55.9</td>
<td>6.5</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>8.5</td>
<td>18.8</td>
<td>58.9</td>
<td>11.7</td>
<td>0.0</td>
</tr>
<tr>
<td>t#l</td>
<td>F</td>
<td>34.4</td>
<td>44.8</td>
<td>9.4</td>
<td>2.1</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>41.7</td>
<td>44.8</td>
<td>8.3</td>
<td>0.0</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>38.1</td>
<td>44.8</td>
<td>8.9</td>
<td>1.1</td>
<td>4.7</td>
</tr>
<tr>
<td>tl</td>
<td>F</td>
<td>21.7</td>
<td>37.6</td>
<td>20.9</td>
<td>4.8</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>45.2</td>
<td>35.6</td>
<td>16.1</td>
<td>0.0</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>33.5</td>
<td>36.6</td>
<td>18.6</td>
<td>2.4</td>
<td>3.2</td>
</tr>
<tr>
<td>Stop-</td>
<td>F</td>
<td>14.6</td>
<td>29.5</td>
<td>35.7</td>
<td>10.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Lateral</td>
<td>M</td>
<td>27.5</td>
<td>36.6</td>
<td>29.2</td>
<td>4.6</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>21.1</td>
<td>33.1</td>
<td>32.5</td>
<td>7.5</td>
<td>2.9</td>
</tr>
</tbody>
</table>

4.2.2.4.2 Results for lateralized pronunciation in coronal stop-lateral sequences

To determine whether the frequency of lateralized pronunciations (dependent variable) differs depending on stop voicing (voiceless vs. voiced input), the presence/absence of a word boundary (word-internal vs. word-external sequences), or gender (male vs. female speakers), a 3-way ANOVA with repeated measures on two
independent variables was conducted. For this statistical analysis, I computed means of lateralized cases for every subject in each condition with stop voicing and word boundary. Table 4.9 displays descriptive results arranged according to the conditions on CORONAL STOP LATERALIZATION, and Table 4.10 shows a summary of the results of ANOVA on CORONAL STOP LATERALIZATION.

Table 4.9 Descriptive Statistics (Mean (% for CORONAL STOP LATERALIZATION in different conditions)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Voiced</th>
<th>Voiceless</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Word-external</td>
<td>Word-internal</td>
</tr>
<tr>
<td></td>
<td>d#l</td>
<td>dl</td>
</tr>
<tr>
<td>F</td>
<td>Mn 0.0 2.1</td>
<td>34.4</td>
</tr>
<tr>
<td></td>
<td>SD 0.0 6.0</td>
<td>31.0</td>
</tr>
<tr>
<td>M</td>
<td>Mn 8.4 14.8</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>SD 17.0 23.0</td>
<td>33.0</td>
</tr>
<tr>
<td>Column</td>
<td>Mn 4.2 8.5</td>
<td>38.1</td>
</tr>
</tbody>
</table>

Table 4.10 Summary of the results of ANOVA on CORONAL STOP LATERALIZATION (The factors marked with bold face were significant at p <.05.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>4.20</td>
<td>0.0493</td>
</tr>
<tr>
<td>Voicing</td>
<td>1, 30</td>
<td>50.41</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Voicing x Gender</td>
<td>1, 30</td>
<td>0.35</td>
<td>0.5593</td>
</tr>
<tr>
<td>Boundary</td>
<td>1, 30</td>
<td>0.00</td>
<td>0.9474</td>
</tr>
<tr>
<td>Boundary x Gender</td>
<td>1, 30</td>
<td>5.24</td>
<td>0.0294</td>
</tr>
<tr>
<td>Voicing x Boundary</td>
<td>1, 30</td>
<td>3.81</td>
<td>0.0603</td>
</tr>
<tr>
<td>Voicing x Boundary x Gender</td>
<td>1, 30</td>
<td>1.72</td>
<td>0.2002</td>
</tr>
</tbody>
</table>

Of the 7 effects, two main effects (gender and stop voicing) and one 2-way interaction effect (word boundary x gender) were significant, as shown in Table 4.10.

---

41 Two repeated independent variables are stop voicing and word boundary, and one nonrepeated independent variable is gender.
Gender played a role in lateralized pronunciation. CORONAL STOP LATERALIZATION occurred more frequently in male speakers (27.5%) than in female speakers (14.6%).

Stop voicing did play a role in lateralized pronunciation. As predicted, CORONAL STOP LATERALIZATION occurred more frequently in the case of voiceless stops (35.8%) than in the case of voiced stops (6.4%).

Word boundary did not play a significant role in lateralized pronunciation. However, it showed a significant interaction effect with gender, which suggests that the effect of a word boundary on CORONAL STOP LATERALIZATION depends on gender. As shown in Figure 4.8, in the case of male speakers, CORONAL STOP LATERALIZATION is more likely to occur within a word (30.0%) than across a word boundary (25.1%). However, in the case of female speakers, the opposite is true, that is, CORONAL STOP LATERALIZATION is more likely to occur across a word boundary (17.2%) than within a word (11.9%).

![Figure 4.8 Interaction of gender and word boundary in lateralized pronunciation](image)
4.2.2.4.3 Results for vowel-inserted pronunciation in coronal stop-lateral sequences

For coronal stop-lateral sequences, to determine whether the frequency of vowel-inserted pronunciations (dependent variable) differs depending on stop voicing (voiceless vs. voiced input), the presence/absence of a word boundary (word-internal vs. word-external sequences), or gender (male vs. female speakers), a 3-way ANOVA with repeated measures on two independent variables was conducted. For this statistical analysis, I computed the means of vowel-inserted cases for every subject in each condition with stop voicing and word boundary. Table 4.11 displays descriptive results arranged according to the conditions on VOWEL INSERTION, and Table 4.12 shows a summary of the results of ANOVA on VOWEL INSERTION.

Table 4.11 Descriptive Statistics (Mean (%) for VOWEL INSERTION in different coronal stop plus lateral conditions)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Voiced</th>
<th>Voiceless</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Word-external</td>
<td>Word-internal</td>
<td>Word-external</td>
<td>Word-internal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d#l</td>
<td>dl</td>
<td>t#l</td>
<td>tl</td>
<td></td>
</tr>
<tr>
<td>F Mn</td>
<td>67.8</td>
<td>78.7</td>
<td>11.5</td>
<td>25.7</td>
<td>45.9</td>
</tr>
<tr>
<td>SD</td>
<td>29.0</td>
<td>27.0</td>
<td>13.0</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td>M Mn</td>
<td>47.9</td>
<td>62.4</td>
<td>8.3</td>
<td>16.1</td>
<td>33.7</td>
</tr>
<tr>
<td>SD</td>
<td>43.0</td>
<td>30.0</td>
<td>19.0</td>
<td>24.0</td>
<td></td>
</tr>
<tr>
<td>Column Mn</td>
<td>57.9</td>
<td>70.6</td>
<td>9.9</td>
<td>20.9</td>
<td>39.8</td>
</tr>
</tbody>
</table>

Table 4.12 Summary of the results of ANOVA on VOWEL INSERTION between a coronal stop and a lateral (The factors marked with bold face were significant at p <.05.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>2.96</td>
<td>0.0956</td>
</tr>
<tr>
<td>Voicing</td>
<td>1, 30</td>
<td>132.96</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Voicing x Gender</td>
<td>1, 30</td>
<td>1.92</td>
<td>0.1763</td>
</tr>
<tr>
<td>Boundary</td>
<td>1, 30</td>
<td>12.80</td>
<td>0.0012</td>
</tr>
<tr>
<td>Boundary x Gender</td>
<td>1, 30</td>
<td>0.06</td>
<td>0.8100</td>
</tr>
<tr>
<td>Voicing x Boundary</td>
<td>1, 30</td>
<td>0.07</td>
<td>0.7995</td>
</tr>
<tr>
<td>Voicing x Boundary x Gender</td>
<td>1, 30</td>
<td>0.54</td>
<td>0.4685</td>
</tr>
</tbody>
</table>
Of the 7 effects, two main effects (stop voicing and word boundary) were significant and no interaction effects were significant, as shown in Table 4.12. Although gender did not play a significant role in lateralized pronunciation, VOWEL INSERTION arithmetically occurred more frequently in female speakers (45.9%) than in male speakers (33.7%).

Stop voicing did play a role in lateralized pronunciation. As predicted, VOWEL INSERTION occurred more frequently in voiced stop-lateral sequences (64.3%) than in the case of voiceless stops (15.4%).

A word boundary also played a role in vowel-inserted pronunciation. VOWEL INSERTION occurred more frequently within a word (45.8%) than across word boundary (33.9%).

4.2.2.4.4 Summary and discussion

As mentioned in Section 4.2.2.4.2, out of 7 effects, two main effects (gender and stop voicing) and one 2-way interaction effect (word boundary x gender) were significant, as shown in Table 4.10. The 3-way ANOVA with repeated measures on two independent variables showed a significant effect of gender on CORONAL STOP LATERALIZATION overall (F (1, 30)=4.20, p=0.0493). CORONAL STOP LATERALIZATION occurred more frequently in male speakers (27.5%) than in female speakers (14.6%). A word boundary and an interaction of voicing x word boundary did not have significant effects, as shown in Table 4.10.

Figure 4.9 shows the effect of voicing on production of coronal stop-lateral clusters.
The effect of voicing on CORONAL STOP LATERALIZATION was significant (F (1, 30)=50.41, p<.0001). In the case of voicing, gender did not play an important role in CORONAL STOP LATERALIZATION, as shown in Table 4.8. As hypothesized, CORONAL STOP LATERALIZATION occurred more frequently in voiceless stop-lateral sequences (35.8%) than in voiced stop-lateral sequences (6.4%). So it was like STOP NASALIZATION in that respect.

In addition, the process of CORONAL STOP LATERALIZATION seems to comply with the Coda Law and/or (Syllable) Contact Law proposed by Vennemann (1988), in that the process (/t.l/ [ll]) weakens the Consonantal Strength of the offset. He defines the Coda Law as follows:

“A syllable coda is the more preferred: (a) the smaller the number of speech sounds in the coda, (b) the less the Consonantal Strength of its offset, and (c) the more sharply the Consonantal Strength drops from the offset toward the Consonantal Strength of the preceding syllable nucleus.” (Vennemann 1988:21)

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42 ‘V-in. T/R’ means ‘inserted vowel followed by a tap or an English r-like sound.’
Vowel insertion was much more prevalent with voiced stops than with voiceless stops: 51.2% vs. 13.8% (V-inserted plus I); 13.1% vs. 1.8% (V-inserted plus r/l). This vowel insertion removes potential inputs from coronal stop lateralization. Thus, taking this vowel insertion into consideration, we cannot infer that coronal stop lateralization violates the similarity principle (Hutcheson 1973), whereby we would expect the more-similar sequence /d.I/ to assimilate more frequently than less-similar sequence /t.I/, even though it seems to violate the similarity principle when we consider only the fact that lateralized pronunciation occurred more frequently with voiceless coronal stops than with voiced coronal stops. As with stop nasalization, it can be inferred that this frequent vowel insertion may be a result of the priority of the phonetic patterning in Korean in which, if a stop is phonetically voiced, then it is perceived as being in syllable-initial position (cf. Park 2002a), so that it must be followed by a vowel.

Correct pronunciations occurred more frequently with voiceless stops (40.7%) than with voiced ones (25.3%). Based on this, unlike stop nasalization, voiced stop-lateral sequences seem less preferred than voiceless stop-lateral sequences. Many speakers showed pause or hesitation in voiceless stop-lateral sequences (which were not included in computing the results). Among the cases of English-like pronunciations, some speakers showed partial voicing of voiceless stops before laterals, which could be attributable to spreading of the voicing feature of the lateral. Some speakers also showed partial devoicing of voiced stops before laterals, which is perhaps because the speakers
follow the phonological patterning of Korean, where syllable-final stops on the phonetic level are voiceless.

Some speakers sometimes showed TAPPING/RHOTACIZATION (total mean 10.4%: 7.5% (between vowels) vs. 2.9% (after a consonant)), as in Table 4.8. TAPPING/RHOTACIZATION occurred more frequently between vowels than after a consonant; this might be attributable to the Korean phonological process in which a lateral becomes a tap between vowels or in word-initial position.

Figure 4.10 and 4.11 show the effect of word boundary on Korean male and female learners' production. The presence/absence of word boundary did not play an important role in CORONAL STOP LATERALIZATION if gender is disregarded, as shown in Table 4.8. But taking gender into consideration, it did play a role in CORONAL STOP LATERALIZATION (F (1, 30)=5.24, 0.0294), indicating that the effect of a word boundary on CORONAL STOP LATERALIZATION depends on gender.

![Figure 4.10 Effect of word boundary on Korean male learners' production](image)
Korean male learners lateralized more frequently in word-internal sequences than in word-external sequences (30% vs. 25.6%). In contrast, Korean female learners lateralized more frequently in word-external sequences than in word-internal sequences (17.2% vs. 11.9%).

Both male and female learners inserted a vowel more frequently in word-internal sequences than in word-external sequences (male learners: 39.3% vs. 28.2%; female learners: 52.2% vs. 39.7%), as shown in Figure 4.10 and 4.11.

In summary, Hypothesis 2-1 in (6) was supported, because Korean learners of English tended to transfer the phonological process CORONAL STOP LATERALIZATION (21.1% of their productions or 31.3% of their errors), and Hypothesis 2-2 (7) was also supported: the effect of stop voicing was significant, as shown in Table 4.8. Voiceless stops lateralized more frequently before laterals than voiced stops did (35.8% vs. 6.4%). Hypothesis 2-3 (8) was not supported: There was no significant effect of word boundary on CORONAL STOP LATERALIZATION, as shown in Table 4.8. CORONAL STOP LATERALIZATION occurred almost equally in word-external and word-internal sequences.
Korean learners of English did not show a significant effect of an interaction of voicing × word boundary.

4.2.3 N-LATERALIZATION

Like STOP NASALIZATION and CORONAL STOP LATERALIZATION, the Korean process of N-LATERALIZATION is a phonetically motivated process. As mentioned earlier in Section 3.2.3, it is automatic in Korean and does not depend on morphological information like morpheme boundary. It may apply across a word boundary, and a nasal is felt to be more difficult to pronounce in an /l.n/ sequence by native speakers of Korean than its substitute (lateral).

We expect that a phonetically motivated process, N-LATERALIZATION will transfer in second language phonology and we may expect that a word boundary will affect L1 transfer to L2, even though this factor is not relevant to the application of the process in Korean at all, because word-internal sequences are thought to be generally more susceptible to assimilation than word-external sequences, as mentioned in Section 4.2.2.

4.2.3.1 Hypotheses

Based on the above, the following hypotheses are made:

(10) Hypothesis 3-1
Korean learners of English will lateralize a coronal nasal after a lateral.

(11) Hypothesis 3-2
Korean learners of English will lateralize a coronal nasal after a lateral more frequently within a word than across a word boundary.
4.2.3.2 Materials

Sequences of a lateral plus a coronal nasal were elicited. The sequences were within words and across a word boundary. The stress pattern of stressed vowel-lateral-nasal-stressed vowel was used in the target sequences (e.g., un\_til 'noon, 'wal\_nuts). The number of the sequences was 10: 2 sequences (word-internal vs. word-external: /ln/ vs. /l\#n/) x 5 sets (i.e., 5 examples per target sequence), which are shown in Appendix C. Some examples are shown in Table 4.13. Thirty-two speakers were asked to choose their preference in each sentence with two choices and then to read the sentence twice. Thus, the total number of target sequences collected and investigated was 640 (10 stimuli x 32 speakers x 2 repetitions).

Table 4.13 Sample experimental material for N-LATERALIZATION (reproduced in full in Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln</td>
<td>The hotline won’t [close/shut] until noon.</td>
</tr>
<tr>
<td>In</td>
<td>I bought a well-knit sweater and [some/any] walnuts in Costco.</td>
</tr>
</tbody>
</table>

4.2.3.3 Data analysis

Like other sequences, the sequences of a lateral and a coronal nasal were also transcribed/categorized by the investigator and 10% of all target segments were checked by a phonetically trained native speaker of English. Transcription and checking were done with the aid of waveforms and spectrograms in the case of unclear segments and/or disagreements. In such cases, laterals were differentiated from nasals, using spectrograms. One major difference between laterals and nasals is that “the average spacing of the formants is wider in laterals than it is in nasals,” “because the primary
resonant tube in nasals is longer than it is in laterals” (Johnson 1997:155–157).\textsuperscript{43}

When I transcribed target sequences of a lateral and a coronal nasal within words and across word boundary, I categorized them as ‘lateralized,’ ‘correct,’ ‘nasalized,’ and ‘other,’\textsuperscript{44} most of which one can expect to encounter as L2 variants. ‘Lateralized’ means that the coronal nasal becomes a lateral. ‘Nasalized’ means that the lateral becomes a nasal.

Sequences of two nasalized laterals (e.g., /\textipa{welnt}/ \textipa{welnt}) were categorized as ‘lateralized.’\textsuperscript{45} Nasalized lateral-nasal sequences (e.g., \textipa{welnu}/ \textipa{welnu})\textsuperscript{46} were categorized as ‘correct.’ I evaluated L1 transfer, based on the frequencies of N-LATERALIZATION. I considered only lateralized segments statistically in order to examine whether the factor (word boundary vs. its absence) significantly affected N-LATERALIZATION.

\textbf{4.2.3.4 Results}

\textbf{4.2.3.4.1 General results}

Table 4.14 below shows the results of the experiment. Mean frequencies of correct pronunciation ranged between 48.8\% and 89.3\% (total mean: 67.4\%), depending on the sequence. The speakers showed far more lateralized pronunciations than other errors (31.4\% vs. 1.3\%). Lateralized pronunciation (e.g., \textipa{weln}\textipa{nt}/ \textipa{weln}\textipa{nt}) \textit{walnut} ranged between 9.4\% and 50.6\% (total mean: 31.4\%), depending on the sequences.

\textsuperscript{43} The average spacing between formants in laterals is 1KHz, while in nasals it is around 0.8 KHz (Johnson 1997:157).

\textsuperscript{44} This category includes VOWEL INSERTION with [ɔ], which was shown by only one speaker (less than 1\%).

\textsuperscript{45} Vowel nasalization was not focused on in this study, even though vowels adjacent to nasals tended to be nasalized to some degree. Nasalized laterals were identified auditorily. In cases where there was difficulty, spectrograms showed damped formants for nasalized laterals, while non-nasalized laterals showed clearer formants.
Nasalized pronunciation (e.g., /welnit/ [wɛnɪt] well-knit) occurred between 0.6% and 1.9% of the time (total mean: 1.1%), and vowel-inserted pronunciations occurred between 0% and 0.6% (total mean: 0.2%) of the time.

Table 4.14 Mean (%) of each category with regard to target /-In-/ sequences.

<table>
<thead>
<tr>
<th></th>
<th>Lateralized</th>
<th>Correct</th>
<th>Nasalized</th>
<th>V-inserted</th>
</tr>
</thead>
<tbody>
<tr>
<td>#n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>9.4</td>
<td>89.3</td>
<td>1.3</td>
<td>0.0</td>
</tr>
<tr>
<td>M</td>
<td>28.9</td>
<td>70.5</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Mn</td>
<td>19.2</td>
<td>79.9</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>ln</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>36.5</td>
<td>60.9</td>
<td>1.9</td>
<td>0.6</td>
</tr>
<tr>
<td>M</td>
<td>50.6</td>
<td>48.8</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Mn</td>
<td>43.6</td>
<td>54.9</td>
<td>1.3</td>
<td>0.3</td>
</tr>
<tr>
<td>l(#)n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>23.0</td>
<td>75.1</td>
<td>1.6</td>
<td>0.3</td>
</tr>
<tr>
<td>M</td>
<td>39.8</td>
<td>59.7</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Mn</td>
<td>31.4</td>
<td>67.4</td>
<td>1.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

4.2.3.4.2 Results and discussion

To determine whether the frequency of n-lateralized pronunciations (dependent variable) differs depending on the presence/absence of a word boundary (word-external vs. word-internal sequences) or gender (male vs. female speakers), a 2-way ANOVA with repeated measures on one independent variable was conducted. For this statistical analysis, I computed means of n-lateralized cases for every subject in each condition (word-external vs. word-internal). Table 4.15 shows descriptive results arranged according to the conditions on N-LATERALIZATION and Table 4.16 shows a summary of the results of ANOVA on N-LATERALIZATION.

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[List of references and footnotes]

[46] [t] is a nasalized and velarized lateral.
Table 4.15 Descriptive Statistics (Mean (%) for N-LATERALIZATION in different lateral plus coronal conditions).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Word boundary</th>
<th>Row Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Word-external</td>
<td>Word-internal</td>
</tr>
<tr>
<td></td>
<td>l#n</td>
<td>ln</td>
</tr>
<tr>
<td>F</td>
<td>Mn 9.4</td>
<td>36.5</td>
</tr>
<tr>
<td></td>
<td>SD 19.0</td>
<td>30.0</td>
</tr>
<tr>
<td>M</td>
<td>Mn 28.9</td>
<td>50.6</td>
</tr>
<tr>
<td></td>
<td>SD 30.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Column</td>
<td>Mn 19.2</td>
<td>43.6</td>
</tr>
</tbody>
</table>

Table 4.16 Summary of the results of ANOVA on N-LATERALIZATION between a lateral and a coronal nasal (The factors marked with bold face were significant at p <.05.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>4.64</td>
<td>0.0394</td>
</tr>
<tr>
<td>Boundary</td>
<td>1, 30</td>
<td>25.76</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Boundary*Gender</td>
<td>1, 30</td>
<td>0.32</td>
<td>0.5780</td>
</tr>
</tbody>
</table>

Of the 3 effects, the two main effects (gender and word boundary) were significant and there was no significant interaction effect, as shown in Table 4.16. The effect of gender on N-LATERALIZATION (F (1, 30)= 4.64, p=0.0394) was significant. As shown in Table 4.15, male Korean learners of English (39.8%) showed N-LATERALIZATION in both environments (word-external and word-internal) more frequently than female Korean learners of English (23.0%) did.

Word boundary had a significant effect on N-LATERALIZATION (F (1, 30)=25.76, p<.0001). But the interaction of word boundary x gender was not significant, as shown in Table 4.16. N-LATERALIZATION occurred more frequently in word-internal sequences than in word-external sequences (43.6% vs. 19.2%). This confirms our prediction that
word-internal sequences are likely to be more susceptible generally to N-LATERALIZATION than word-external sequences are.

In summary, Hypothesis 3-1 in (10) was supported, because Korean learners of English tended to transfer the phonological process of N-LATERALIZATION (31.4%), and Hypothesis 3-2 in (11) was also supported: Word boundary did play a significant role in N-LATERALIZATION, which occurred more frequently in word-internal sequences than in word-external sequences (43.6% vs. 19.2%).

4.2.4 S-PALATALIZATION

Like STOP NASALIZATION, CORONAL STOP LATERALIZATION, and N-LATERALIZATION, the Korean process of S-PALATALIZATION shows the characteristics of a phonetically motivated process. As mentioned earlier in Section 3.2.4, it is automatic and it does not depend on morphological information like the presence of a morpheme boundary. A dental fricative, for example, is felt to be more difficult to pronounce in a /si/ or /sj/ sequence by native speakers of Korean than its substitute (alveo-palatal) (e.g., /sikan/ [ʃigan] ‘time’ and /osjo/ [oʃəjo] ‘(He/she) is coming’).

We expect that a phonetically motivated process, S-PALATALIZATION, will transfer in second language phonology and that factors such as the following /i/ vs. /j/ and word boundary (word-external vs. word-internal sequences) may affect its application in L2, even though neither factor is relevant to the process in Korean at all. S-PALATALIZATION does not occur across word boundary because CORONAL NEUTRALIZATION, changing Korean obstruents /s, s’, t, tʰ, t’, c, cʰ, c’/ to unreleased [t]’s (Kim-Renaud 1974), bleeds S-PALATALIZATION, that is, CORONAL NEUTRALIZATION removes the inputs of S-
PALATALIZATION at a word boundary, as illustrated in examples like /ki#kos#in-sim/

[kigot insim] ‘the mind/behavior of the villagers there.’

Neeld (1973) examined PALATALIZATION in a variety of languages and found a universal implicational hierarchy of segments that condition PALATALIZATION, which is phonetically motivated by levels of stricture (that is, tongue height). He proposed a hierarchy of palatal vocoids conditioning PALATALIZATION, as shown in the following:

(12)  j
    i
    e
    æ

The arrow points toward more preferable environments. The glide /j/ is the most preferable environment and /æ/ is the least preferable environment. PALATALIZATION before /i/ implies PALATALIZATION before /j/, but not vice versa.⁴⁷

In Korean, PALATALIZATION occurs before /i/ and /j/. In second language acquisition, we can expect the process to occur more frequently before /j/ than before /i/.

Word-internal sequences are regarded as more susceptible to assimilation than word-external sequences (Donegan and Stampe 1978), as mentioned in Sections 4.2.2 and 4.2.3. Thus, it is expected that PALATALIZATION will occur within words more frequently than across word boundary. A word boundary interferes with S-

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⁴⁷ Neeld considered only palatal vocoids as conditioners, but [ʃ], for example, also causes PALATALIZATION (e.g., these shoes, Miss Shaw, this shore, etc.).
PALATALIZATION in Korean: e.g., /ki#k#os#inc#b#ən/ [ki.g#ot'.in.c#b#ən] ‘that place Incheon: Incheon there’ in L1(*[kig#Jf.inch~n]) vs. /mos-i/ [mo.ʃi] ‘taste-case marker (subject)’ in L1 (*[masi], *[madi]) and /sin/ [ʃin] ‘sour.’ The Korean word /mas#is#-nin/ ‘delicious’ (< /mos#is#-nin/) has two variants ([mosi#nin] and [madi#nin]) in the phonetic level. These variants undergo different processes depending on whether they are regarded as one word or two, as in [mosi#nin] (after S-PALATALIZATION) and [madi#nin]: after NEUTRALIZATION and VOICING). It may also interfere in L2, as in /sit/ [ʃ#it] vs. /deʃi#its/ [de#ʃi#its] Davis eats (*[deʃiʃ#its]).

Word-final /s/ in Korean words becomes [tʃ] (e.g., /mos/ [mo#tʃ] taste), whereas word-final /s/ in Korean speakers’ L2 English stays [s] (e.g., /mæs/ [mæs] ‘mass’ and not *[mæʃ]): In the Korean phonological system, the fricative [s] occurs only before a vowel or glide. It seems that native speakers of Korean assume that a vowel follows the English final [s]. In Korean fast speech, [i] is deleted after a voiceless consonant in a weak, non-initial open syllable, as illustrated in examples like /pasrak/ [pasrak] ‘rustling, crumbly,’ /pit#ilapwa/ [pit#rəʃa] ‘Try to twist it!’ (Kim-Renaud 1987:347). Korean speakers perceive these words in which [i] is deleted in production as [i]-recovered words. Thus, in second language phonology, one can propose that production of the fricative [s] depends on the psychological anticipation of a following vowel, even though the vowel may not appear at the phonetic level. This (psychologically anticipated) vowel
may block S-PALATALIZATION. When Korean speakers hear an English word *miss* [mis],
they perceive it as /misˈ/ (or sometimes /misˈi/, based on the Korean phonological
system, which does not allow word-final [sˈ]). Korean speakers may store /mis/ as a
phonemic representation in memory, rather than /misi/, due to the influence of the
English spelling system. Korean speakers will then pronounce /misˈ/ as [misˈ] or [misˈi]
(VOWEL INSERTION), or /misˈi/ as [misˈ] (VOWEL DELETION) or [misˈi].

4.2.4.1 Hypotheses

Based on the above, the following hypotheses are made:

(13) Hypothesis 4-1

Korean learners of English will palatalize a dental voiceless fricative /s/ before /i/ and /j/.

(14) Hypothesis 4-2

Korean learners of English will palatalize /s/ more frequently before /j/ than before /i/.

(15) Hypothesis 4-3

Korean learners of English will palatalize /s/ more frequently within a word than across a word boundary.

4.2.4.2 Materials

Sequences of a fricative /s/ plus /i/ vs. /j/ were elicited. Two factors – a word
boundary (word-external vs. word-internal) and following palatals (_i vs. _j) – were
taken into consideration in order to test the above hypotheses. I conducted the statistical
analysis for each factor separately, because American English does not have the word-
internal sequence /sj/. That is, the sequences /si/ and /s#i/ were compared, and the
sequences /s#i/ and /s#j/ were compared. Here data from the sequence /s#i/ were used
twice for separate statistical analyses, as shown in Table 4.17. The palatal vocoid (i or j)
that followed the fricative /s/ in the target sequences was in a stressed syllable (e.g.,
de'ceived, this 'yacht). The number of the sequences was 15. There were 3 inputs (/si/,
/s#i/, and /s#j/) x 5 sets (i.e., 5 examples per target sequence), which are shown in
Appendix C. Some examples are shown in Table 4.17. Thirty-two speakers were asked to
choose their preference in each sentence with two choices and then to read the sentence
twice. Thus, the total number of target sequences collected and investigated was 960 (15
stimuli x 32 speakers x 2 repetitions).

Table 4.17 Sample experimental material for S-PALATALIZATION (reproduced in full in
Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word boundary</td>
<td></td>
</tr>
<tr>
<td>si</td>
<td>This young guy was deceived [into/at] buying a drip mat.</td>
</tr>
<tr>
<td>s#i</td>
<td>They pass Easter eggs [around/across] the table.</td>
</tr>
<tr>
<td>/i/ vs. /j/</td>
<td></td>
</tr>
<tr>
<td>s#i</td>
<td>They pass Easter eggs [around/across] the table.</td>
</tr>
<tr>
<td>s#j</td>
<td>John wants to kiss Eunice [on/in] this yacht.</td>
</tr>
</tbody>
</table>

### 4.2.4.3 Data analysis

As in the other experiments, the target segments were transcribed/categorized by
the investigator and 10% of all target segments were checked by a phonetically trained
native speaker of English. Transcription and checking were done with the aid of
waveforms and spectrograms in the case of unclear segments and/or disagreements. Most
of the noise energy for the fricative [s] lies above 4 KHz; for (alveo-)palatal [j], it lies
around 2 KHz and above (Borden et al. 1994). [s] is characterized by a narrower band of high frequency, high energy noise (Borden et al. 1994), which was used in distinguishing a dental fricative [s] from an (alveo-)palatal [ʃ].

When I transcribed target sequences of /s/ plus /i/ vs. /j/ within words and across word boundaries, I categorized them as ‘palatalized,’ ‘correct,’ ‘V-inserted,’ and ‘other.’48 ‘Palatalized’ means that /s/ becomes an alveo-palatal [ʃ] and ‘correct’ means English-like [s]. ‘V-inserted’ means that a vowel, usually [i], was inserted. I evaluated L1 transfer based on the frequencies of S-PALATALIZATION. I considered only palatalized segments statistically in order to examine whether the factors (word boundary vs. its absence and /i/ vs. /j/) significantly affected S-PALATALIZATION.

4.2.4.4 Results

4.2.4.4.1 General results

Table 4.18 below shows the results of the experiment. Mean frequencies of correct pronunciation ranged between 78% and 96% (total mean: 88.2%), depending on the sequences. The speakers did not make many errors (12%) with palatalized pronunciations, vowel-inserted (‘V-inserted’ in the table) pronunciations, etc: Depending on the sequences, palatalized pronunciations (e.g., /siːkwəns/ [siːkwəns] sequence and /eɪʃ jən/ [eɪʃjən] Ace Young) ranged between 0% and 21.3% (total mean: 9%); vowel-inserted pronunciations (e.g., /deɪvɪs ɪts/ [deɪvɪsiɪts] Davis eats and /pæs ʃustəs/ [pæsɪʃustəs])

48 This category includes VOICING (/s/ [z]: e.g., /deɪvɪs ɪts/ [deɪvɪz ɪts] Davis eats), which was less than 1%.
pass Eustace) ranged between 0% and 5.2% (total mean: 2.5%); others averaged only 0.4%.

Table 4.18 Mean of each category with regard to target sequences

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>Palatalized</th>
<th>Correct</th>
<th>V-inserted</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>si</td>
<td>F</td>
<td>21.3</td>
<td>78.0</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>20.7</td>
<td>79.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>21.0</td>
<td>78.7</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>s#i</td>
<td>F</td>
<td>0.0</td>
<td>92.8</td>
<td>5.2</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>1.3</td>
<td>96.0</td>
<td>2.1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>0.7</td>
<td>94.4</td>
<td>3.7</td>
<td>1.3</td>
</tr>
<tr>
<td>s#j</td>
<td>F</td>
<td>2.0</td>
<td>93.1</td>
<td>5.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>8.5</td>
<td>89.7</td>
<td>1.9</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>5.3</td>
<td>91.4</td>
<td>3.5</td>
<td>0.0</td>
</tr>
<tr>
<td>s(#)i/j</td>
<td>F</td>
<td>7.8</td>
<td>88.0</td>
<td>3.6</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>10.2</td>
<td>88.3</td>
<td>1.3</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>9.0</td>
<td>88.2</td>
<td>2.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

4.2.4.4.2 Results for palatalized pronunciation

To determine whether the frequency of palatalized pronunciations (dependent variable) differs depending on the presence/absence of a word boundary (word-external vs. word-internal sequences), /i/ vs. /j/, or gender, two separate 2-way ANOVA’s with repeated measures on one independent variable were conducted. For this statistical analysis, I computed means of palatalized cases for every subject in each condition (word-external vs. word-internal and /i/ vs. /j/). Table 4.19 displays descriptive results arranged according to the conditions on S-PALATALIZATION and Table 4.20 shows a summary of the results of ANOVA for S-PALATALIZATION, respectively.
Table 4.19 Descriptive Statistics (Mean (%) for S-PALATALIZATION in different conditions)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Word-external</th>
<th>Word-internal</th>
<th>Row Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/s#i/</td>
<td>/si/</td>
<td></td>
</tr>
<tr>
<td>F Mn</td>
<td>0.0</td>
<td>21.3</td>
<td>10.7</td>
</tr>
<tr>
<td>SD</td>
<td>0.0</td>
<td>26.0</td>
<td></td>
</tr>
<tr>
<td>M Mn</td>
<td>1.3</td>
<td>20.7</td>
<td>11.0</td>
</tr>
<tr>
<td>SD</td>
<td>5.0</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>Column Mn</td>
<td>0.7</td>
<td>21.0</td>
<td>10.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Before /i/</th>
<th>Before /j/</th>
<th>Row Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/s#i/</td>
<td>/s#j/</td>
<td></td>
</tr>
<tr>
<td>F Mn</td>
<td>0.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>SD</td>
<td>0.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>M Mn</td>
<td>1.3</td>
<td>8.5</td>
<td>4.9</td>
</tr>
<tr>
<td>SD</td>
<td>5.0</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>Column Mn</td>
<td>0.7</td>
<td>5.3</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Table 4.20 Summary of the results of ANOVA on S-PALATALIZATION (The factors marked with bold face were significant at p <.05.)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1, 30</td>
<td>0.01</td>
<td>0.9356</td>
</tr>
<tr>
<td>Boundary (/s#i/ vs. /si/)</td>
<td>1, 30</td>
<td>27.83</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Boundary*Gender</td>
<td>1, 30</td>
<td>0.06</td>
<td>0.8137</td>
</tr>
<tr>
<td>/i/ vs. /j/</td>
<td>1, 30</td>
<td>2.62</td>
<td>0.1158</td>
</tr>
<tr>
<td>/i/ vs. /j/Gender</td>
<td>1, 30</td>
<td>9.26</td>
<td>0.0048</td>
</tr>
</tbody>
</table>

The 2-way ANOVA with repeated measures on one independent variable (word boundary) showed significance of one main effect out of the three effects. Word boundary had a significant effect on S-PALATALIZATION (F (1, 30)=27.83, p<.0001). S-

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49 An interaction effect of i vs. j x word boundary could not be examined because American English lacks /sj/ sequences.
PALATALIZATION occurred more frequently in word-internal sequences than in word-external sequences (21% vs. 0.7%). There were no significant effects of gender and the interaction of word boundary x gender on S-PALATALIZATION, as in Table 4.20.

The 2-way ANOVA with repeated measures on one independent variable (/i/ vs. /j/) showed significance of one main effect out of three effects. /i/ vs. /j/ had a significant effect on S-PALATALIZATION ($F(1, 30)=9.26, p=0.0048$). S-PALATALIZATION occurred more frequently in /s#j/ sequences than in /s#i/ sequences (5.3% vs. 0.7%). There were no significant effects of gender and the interaction of /i/ vs. /j/ x gender, as in Table 4.20.

4.2.4.4.3 Summary and discussion

Hypothesis 4-1 was supported rather weakly, because Korean learners of English transferred the phonological process of S-PALATALIZATION in just 9% of their productions. Unlike other processes, S-PALATALIZATION did not frequently transfer to L2 speech (9%). This may be attributable to English reinforcement in mass media and Korean speakers' education in English, where speakers are usually drilled intensively and at length on the distinction between the English sounds /s/ [s] and /ʃ/ [ʃ], as in [si] see versus [ʃi] she and [sit] seat versus [ʃit] sheet. This also may be attributable to the existence of a surface exception: /s’iʃuta/ ‘put (a hat) on a person; impute (a guilt to a person)’ is often realized as [s’iʃuda] or [s’iuda] in careful speech, and as [ʃ’iuda] in casual speech.
/s’iţa/ ‘be possessed by demons; be written’ is also often realized as [s’iţda] or [s’iţda] in careful speech, and as [j’iţda] in casual speech.

Hypotheses 4-2 and 4-3 were also supported. The conditions (/i/ vs. /j/ and word boundary) did play a role in S-palatalization. S-PALATALIZATION occurred more frequently in word-internal sequences than in word-external sequences (21% vs. 0.7%). This confirms Hypothesis 4-2 in (14) that word-internal sequences are more susceptible to S-palatalization than word-external sequences. S-PALATALIZATION occurred more frequently in /s#j/ sequences than in /s#i/ sequences (5.3% vs. 0.7%). This confirms Hypothesis 4-3 in (15), based on Neeld (1973), that S-palatalization will occur more frequently before /j/ than /i/ in second language acquisition. This suggests that phonological factors that appear irrelevant in L1 may still affect the degree of difficulty of sequences in L2.

Vowel insertion occurred more frequently in word-external sequences than in word-internal sequences (3.7% vs. 0.4%). As suggested in Section 4.2.4, word-final /s/ in Korean words becomes [t’], whereas word-final /s/ in L2 stays [s] because native speakers of Korean assume that a vowel follows it. Vowel insertion occurred almost identically in both /s#j/ and /s#i/ sequences (3.5% vs. 3.7%).

Word-final /s/ in Korean words becomes [t’] (e.g., /mas/ [mat] taste), whereas word-final /s/ in Korean speakers’ L2 English stays [s] (e.g., /mæs/ [mæs] ‘mass’ and not *[mæt]): In the Korean phonological system, the fricative [s] occurs only before a vowel
or glide. It seems that native speakers of Korean assume that a vowel follows the English final \[s\]. Thus, in second language phonology, it may be that production of the fricative \[s\] depends on the psychological anticipation of a following vowel, even though the vowel may not appear at the phonetic level. This (psychologically anticipated) vowel may block S-PALATALIZATION. When Korean speakers hear an English word *miss* \[mis\], they perceive it as /mis/ (or sometimes /misi/ which is based on Korean phonological system that does not allow word-final \[s\]). Korean speakers may store /mis/ as a phonemic representation in memory, in addition to /misi/, due to the influence of English spelling system. Thus, Korean speakers are assumed to have a dual phonemic representation but they do not apply CORONAL OBSTRUENT NEUTRALIZATION in L2, for example, /mis/. Korean speakers will pronounce /mis/ as [mis] or [misi] (VOWEL INSERTION), and /misi/ as [mis] (VOWEL DELETION) or [misi], as result of the optional application of VOWEL INSERTION and VOWEL DELETION.
CHAPTER 5

EXPERIMENTS: MORPHOPHONOLOGICAL RULES

In this chapter, I will describe my test of the Korean morphophonological rules discussed in section 3.2 and 3.3. These experiments will test whether T-PALATALIZATION and the Duim law (L-NASALIZATION and N-DELETION) apply in the L2 speech of Korean learners of English.

5.1 General comments

The participants, data elicitation, and procedures in this chapter were the same as those in chapter four. For the statistical analysis of morphophonological rules, T-tests in SAS were used.

5.2 Morphophonological rules tested

Two morphophonological rules – T-PALATALIZATION and the Duim law (L-NASALIZATION and N-DELETION) – were tested.

5.2.1 T-PALATALIZATION

We expect that a morphophonological rule, T-PALATALIZATION, will not apply in second language phonology, because it is conventional and depends on morphological information. It applies only across a morpheme boundary within words. In Korean, a sound [d] before high front vocoids is felt to be no more difficult to pronounce by native speakers of Korean than its substitute [j] (/mati/ [madı] ‘joint’ vs. /mat-i/ [maji] ‘oldest child’).
5.2.1.1 Hypothesis

Based on the above, the following hypothesis is made:

(1) Hypothesis 5-1

Korean learners of English will not palatalize coronal voiceless stops before high palatal vocoids in English.

5.2.1.2 Materials

Sequences of a fricative /t/ plus high palatal vocoids (/i/ and /j/) were elicited. The stress pattern of stressed Vowel-t-i/j-stressed (Vowel) was used (e.g., 'meat-eater, 'Scot-Young). A morpheme boundary was included between a voiceless coronal /t/ and a high front vocoid (/i/ or /j/). The number of the sequences was 4: 1 (/ti/) x 1 set and 1 (/tj/) x 3 sets (i.e., 3 examples per target sequence), which are shown in Appendix C. Some examples are shown in Table 5.1. Thirty-two speakers were asked to choose their preference in each sentence with two choices and then to read the sentence twice. Thus, the total number of target sequences collected and investigated was 256 (4 stimuli x 32 speakers x 2 repetitions).

Table 5.1 Sample experimental material for T-PALATALIZATION (reproduced in full in Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-j</td>
<td>Mr. Scot-Young got lost [in/on] the woods.</td>
</tr>
<tr>
<td>t-i</td>
<td>Allosauruses were [violent/dangerous] meat-eaters.</td>
</tr>
</tbody>
</table>

50 The number of the /ij/ sequence (three) is greater than that of the /ti/ sequence (one). That seemed sufficient in this experiment, because if T-PALATALIZATION occurs at all, it is more likely to apply before /j/ than before /i/.
5.2.1.3 Data analysis

Like other experiments, the target segments were transcribed/categorized by the investigator and 10% of all target segments were checked by a phonetically trained native speaker of English. Transcription and checking were done with the aid of waveforms and spectrograms in the case of unclear segments and/or disagreements.

Transcribed target sequences of a voiceless coronal stop /t/ plus a high front vocoid (/i/ or /j/) across a morpheme boundary were categorized as 'palatalized,'51 'correct,' 'voicing,' 'vowel-inserted (V-inserted in the table below),’ and ‘other’52, most of which one can expect to encounter as L2 variants. ‘Palatalized’ means that /t/ becomes an alveo-palatal or palatal [tʃ, c, j] and ‘correct’ means an English-like [t]. Although most of the /t/ sounds were pronounced as a dental, these were counted as ‘correct.’ ‘Voicing’ means that a voiceless coronal stop becomes voiced. ‘Vowel-inserted’ means that a stop is followed by an inserted vowel or that it is given a very short vowel-like release.

5.2.1.4 Results

Table 5.2 below shows the results of the experiment. Mean frequencies of correct pronunciation were 77.8% (female: 72.7%; male: 82.9%). The speakers did not show palatalized pronunciation at all, which we can attribute to the fact that T-PALATALIZATION did not occur, though.

52 This category includes TAPPING, AFFRICATION (very weak transitional /s/ insertion), NASAL INSERTION, STOP NASALIZATION (after NASAL INSERTION), etc.
Iskatjōŋ/ [skadjaŋ] Scot-Young) and vowel insertion (e.g., /lajtjiŋ/ [lajtijŋ] light-year) occurred 8.4% and 8.9% of the time, respectively. Others occurred 5% of the time.53

Table 5.2 Mean (%) of each category with regard to target sequences

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>Palatalized</th>
<th>Correct</th>
<th>Voicing</th>
<th>V-inserted</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-i/j</td>
<td>F</td>
<td>0.0</td>
<td>72.7</td>
<td>8.4</td>
<td>13.3</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0</td>
<td>82.9</td>
<td>8.4</td>
<td>4.5</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>0.0</td>
<td>77.8</td>
<td>8.4</td>
<td>8.9</td>
<td>5.0</td>
</tr>
</tbody>
</table>

5.2.2 The Du-im Law (Initial Sound Law)

A morphophonological rule, the Du-im Law, is divided into two rules. Examples were shown in Section 3.2.6. One changes word-initial /l/ to /n/ in Sino-Korean words, which is called L-nasalization, and the other deletes word-initial /n/ before palatal vocoids /j, i/, which is called N-deletion, as shown in the following:

(2) The Du-im Law (Initial Sound Law)

a. L-nasalization: l → n / #

[+lat] → [+nas, -lat] / #

b. N-deletion: n → ø / #

[+nas, +cor] → ø / #

We expect that these morphophonological rules will not apply in second language phonology, because they are conventional and thus depend on morphological information—in this case, lexical stratum. As mentioned in section 3.2.6, these rules have exceptions (e.g., /liil/ [riil] ‘the name of a Korean letter’ and /ni/ [ni] ‘you’) and they are easy to violate.
5.2.2.1 Hypothesis

Based on the assumption that the DuiM LAW is a conventionalized morphophonological rule with no synchronic phonetic motivation, the following hypotheses are made:

(3) Hypothesis 6-1
Korean learners of English will not nasalize laterals word-initially.

(4) Hypothesis 6-2
Korean learners of English will not delete word-initial nasals before high palatal vocoids.

5.2.2.2 Materials

Words beginning with a lateral /l/ and sequences of a word-initial /n/ plus /i/ were elicited. The syllable in which the /l/ or /n/ was initial was stressed. (e.g., 'Laura and 'Nina).

The number of words beginning with /l/ and word-initial /ni/ sequences was 6, which are shown in Appendix C. Some examples are shown in Table 5.3. Thirty-two speakers were asked to choose their preference in each sentence with two choices and then to read the sentence twice. Thus, the total number of target sequences collected and investigated was 384 (6 stimuli x 32 speakers x 2 repetitions).

---

53 TAPPING (0.3%: e.g., /eitju/ [eirjju] eight-year), AFFRICATION (1.3%: e.g., /skatjan/ [skat'jan] Scot-Young; very weak transitional /s/ insertion), NASAL INSERTION (0.6%: e.g., /skatjan/ [skatjan] Scot-Young), STOP NASALIZATION (after NASAL INSERTION) (1.4%: e.g., /skatjan/ [skanjan] Scot-Young), etc.
Table 5.3 Sample experimental material for L-NASALIZATION and N-DELETION (reproduced in full in Appendix C)

<table>
<thead>
<tr>
<th>Target sequences</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Laura is my seatmate [in/at] the school.</td>
</tr>
<tr>
<td>#ni</td>
<td>Nina [entered/went to] the job market.</td>
</tr>
</tbody>
</table>

5.2.2.3 Data analysis

As in other experiments, the target segments were transcribed/categorized by the investigator and 10% of all target segments were checked by a phonetically trained native speaker of English. Transcription and checking were done with the aid of waveforms and spectrograms in the case of unclear segments and/or disagreements.

When I transcribed pronunciations of the relevant target segment (/l/), I categorized them as 'nasalized,' 'correct,' 'tapped,' and 'rhotacized.' One can expect TAPPING and RHOTACIZATION to occur as L2 variants. When I transcribed pronunciations of sequences of /ni/, I categorized them as 'deleted,' 'correct,' and 'lateralized.' Deletion of /n/ in word-initial /ni/ sequences was an unexpected pronunciation.

5.2.2.4 Results

Table 5.4 below shows the results of the experiment for word-initial /l/.

Table 5.4 Mean (%) of each category with regard to the word-initial /l/

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>Nasalized</th>
<th>Correct</th>
<th>Tapping</th>
<th>Rhotacization</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>F</td>
<td>1.0</td>
<td>72.9</td>
<td>8.4</td>
<td>17.7</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0</td>
<td>82.3</td>
<td>4.2</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>0.5</td>
<td>77.6</td>
<td>6.3</td>
<td>15.6</td>
</tr>
</tbody>
</table>
Nasalized pronunciation (e.g., /luk/ [nuk] Luke) rarely occurred (0.5%), which confirms Hypothesis 6-1: Korean learners will not nasalize laterals word-initially. Correct pronunciation was 77.6% (female: 72.9%; male: 82.3%). Some speakers showed TAPPING (6.3%; e.g., /lDlɔ/ [rDlɔ] Laura) or Rhotacization (15.6%; e.g., /lujs/ [lujs] Lewis). This might be a result of Korean speakers’ learning of an English phoneme /l/ and their confusion of [l] and [ɹ]. If these [l]’s had not replaced by [ɹ], we might expect that Korean speakers would have transferred their L1 phonological process of TAPPING more than 6.3% of the time.

Table 5.5 Mean (%) and summary of t-test of nasalized pronunciation of the word-initial /l/ (significant at p < .05)

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>Nasalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>#l</td>
<td>F</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>1.00</td>
<td>0.3253</td>
</tr>
</tbody>
</table>

To determine whether or not the frequency of nasalized pronunciations of male speakers is the same as that of female speakers, a two-sample t-test was conducted. It showed that gender did not play a role in L-NASALIZATION, as shown in Table 5.5. The male speakers’ mean is almost the same as the females’ mean (male speakers’ mean: 0%; female speakers’ mean: 1%54). Actually, they hardly ever transferred L-NASALIZATION.

54 Only one female speaker showed N-nasalized pronunciation in only one case Luke, which appears as Nuga in the Korean version of the Bible. This is an old-fashioned adaptation. Duim law (Initial sound law) does not occur any more in synchronic adaptation. The occurrence of the pronunciation is probably attributable to interference by an internalized lexical item.
Table 5.6 below shows the results of the experiment for the word-initial /ni/ sequence.

Table 5.6 Mean (%) of each category with regard to the word-initial /ni/

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>N-deleted</th>
<th>Correct</th>
<th>Lateralized</th>
</tr>
</thead>
<tbody>
<tr>
<td>#ni</td>
<td>F</td>
<td>1.0</td>
<td>99.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>11.5</td>
<td>87.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>6.3</td>
<td>93.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

N-deleted pronunciation (e.g., /nita/ [itɔ] Nita) rarely occurred (total mean: 6.3%; female: 1%; male 11.5%\(^{55}\)). This can be said to confirm Hypothesis 6-2: Korean learners of English will not delete word-initial nasals before high palatal vocoids. Correct pronunciation was 93.3% (female: 99%; male: 87.5%). The speakers hardly ever showed lateralized pronunciation (total mean: 0.5%; female: 0%; male: 1%; e.g., /nil/ [lil] Neal).

Table 5.7 below shows mean and summary of t-test of n-deleted pronunciation of the word-initial /ni/ sequence.

Table 5.7 Mean (%) and summary of t-test of n-deleted pronunciation of the word-initial /ni/ (significant at p < .05) of each category with regard to the word-initial /ni/

<table>
<thead>
<tr>
<th>Sequences</th>
<th>Gender</th>
<th>N-deleted</th>
<th>df</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>#ni</td>
<td>F</td>
<td>1.0</td>
<td>16.6</td>
<td>-2.26</td>
<td>0.0376</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mn</td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{55}\) This is perhaps due to the fact that some speakers got nervous at recording their speech with a microphone before them and they read target words placed in a sentence-initial position right after the researcher read the number. For a future study, one needs to ensure that target words are placed sentence-medially and that the experiment is conducted in as natural a setting as possible.
To determine whether the frequency of n-deleted pronunciations of male speakers is the same as that of female speakers or not, a two-sample t-test was conducted. It showed that gender played a role in N-DELETION, as shown in Table 5.7. This means that male and female speakers showed different tendencies. That is, the male speakers’ mean is higher than the female speakers’ mean.

5.3 Summary

The transfer of Korean morphophonological rules investigated so far is briefly summarized as follows:

Table 5.8 Percentage of transfer of morphophonological rules

<table>
<thead>
<tr>
<th>Morphophonological rules</th>
<th>L1 transfer</th>
<th>Correct</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-PALATALIZATION</td>
<td>0.0%</td>
<td>77.8%</td>
<td>22.3%</td>
</tr>
<tr>
<td>L-NASALIZATION</td>
<td>0.5%</td>
<td>77.6%</td>
<td>21.9%</td>
</tr>
<tr>
<td>N-DELETION</td>
<td>6.3%</td>
<td>93.3%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Korean morphophonological rules rarely showed transfer in English acquisition (less than 7%), as shown in Table 5.8.

T-PALATALIZATION and L-NASALIZATION did not show an effect of gender. On the other hand, N-DELETION showed an effect of gender, as shown in the table below.

Table 5.9 Percentage of transfer of morphophonological rules based on gender

<table>
<thead>
<tr>
<th>Morphophonological rules</th>
<th>Gender</th>
<th>L1 transfer</th>
<th>Correct</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-PALATALIZATION</td>
<td>F</td>
<td>0.0%</td>
<td>72.7%</td>
<td>27.4%</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0%</td>
<td>82.9%</td>
<td>17.1%</td>
</tr>
<tr>
<td>L-NASALIZATION</td>
<td>F</td>
<td>1.0%</td>
<td>72.9%</td>
<td>26.1%</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0%</td>
<td>82.3%</td>
<td>17.7%</td>
</tr>
<tr>
<td>N-DELETION</td>
<td>F</td>
<td>1.0%</td>
<td>99.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>11.5%</td>
<td>87.5%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Male speakers tended to delete a coronal nasal /n/ more frequently than female speakers, even though when male and female speakers are considered together, N-DELETION rarely occurred.
CHAPTER 6

PROCESSES and RULES

In this brief chapter, I will discuss tests of Hypotheses 1-1, 2-1, 3-1, and 4-1 – that phonological processes like STOP NASALIZATION, CORONAL STOP LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION will transfer in L2, and Hypotheses 5-1, 6-1, and 6-2 – that morphophonological rules like T-PALATALIZATION and the DuM LAW (L-NASALIZATION and N-DELETION) will not, as proposed in Chapters 4 and 5.

I will describe the results of a t-test for comparing the transfer of morphophonological rules with that of phonological processes and a t-test for transfer of each morphophonological rule and for transfer of each phonological process. In addition, I will compare the transfer of L1 phonological processes and summarize the effects of phonological conditioning factors on transfer in L2.

6.1 Test of processes versus rules

In order to examine the overall behavior of Korean phonological processes and morphophonological rules in L2, a one-sample repeated T-test was conducted. This T-test was based on the total mean of transfer of phonological processes for each participant versus the total mean of transfer of morphophonological rules for each participant. A one-sample repeated T-test showed that the type of sound substitutions did have a significant effect (df=31, t value = 14.21, P = 0.0001), indicating that the mean of transfer of morphophonological rules is significantly different from the mean of transfer of phonological processes. That is, morphophonological rules rarely transferred (2.3%), while phonological processes transferred fairly frequently (26%).
6.2 Test of each process and each rule

In order to investigate the significance of transfer for each process and each rule, a one-sample t-test was also conducted on each substitution. Percentage and summary of t-tests of transfer for each phonological process and each morphophonological rule are summarized as follows:

Table. 6.1 Percentage (%) and summary of t-tests of transfer of each phonological process and each morphophonological rule

<table>
<thead>
<tr>
<th>Phonological process</th>
<th>L1 transfer</th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOP NASALIZATION</td>
<td>42.3</td>
<td>31</td>
<td>14.31*</td>
</tr>
<tr>
<td>CORONAL STOP LATERALIZATION</td>
<td>21.1</td>
<td>31</td>
<td>6.33*</td>
</tr>
<tr>
<td>N-LATERALIZATION</td>
<td>31.4</td>
<td>31</td>
<td>7.61*</td>
</tr>
<tr>
<td>S-PALATALIZATION</td>
<td>9.0</td>
<td>31</td>
<td>5.72*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Morphophonological rule</th>
<th>L1 transfer</th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-PALATALIZATION</td>
<td>0.0</td>
<td>31</td>
<td>0.0</td>
</tr>
<tr>
<td>L-NASALIZATION</td>
<td>0.5</td>
<td>31</td>
<td>1.0</td>
</tr>
<tr>
<td>N-DELETION</td>
<td>6.3</td>
<td>31</td>
<td>2.55*</td>
</tr>
</tbody>
</table>

*p < .05

The true mean of transfer of each process for the population represented by the random sample of 32 is likely to be higher than 0. Also, the true mean of transfer of one rule (N-DELETION) for the population represented by the random sample of 32 is likely to be higher than 0. On the other hand, the true mean of transfer of two rules (T-PALATALIZATION and L-NASALIZATION) for the population represented by the random sample of 32 is likely to be 0.

Thus, Hypotheses 1-1, 2-1, and 3-1 were supported: Processes (STOP NASALIZATION, CORONAL STOP LATERALIZATION, and N-LATERALIZATION) transferred significantly in L2. Hypothesis 4-1 was weakly supported because S-PALATALIZATION occurred just 9% of the time. Hypotheses 5-1 and 6-1 also were supported: Rules (T-
PALATALIZATION and L-NASALIZATION hardly ever transfer in L2. Hypothesis 6-2, however, was not supported: N-DELETION did transfer in L2 6.3% of the time, as shown in Table 6.1.

6.3 Comparison of phonological processes

Mean frequency of transfer of each Korean phonological process is briefly summarized as follows:

<table>
<thead>
<tr>
<th>Phonological process</th>
<th>L1 transfer</th>
<th>Correct</th>
<th>V-inserted</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOP NASALIZATION</td>
<td>42.3</td>
<td>47.0</td>
<td>10.3</td>
<td>0.6</td>
</tr>
<tr>
<td>N-LATERALIZATION</td>
<td>31.4</td>
<td>67.4</td>
<td>0.2</td>
<td>1.1</td>
</tr>
<tr>
<td>CORONAL STOP LATERALIZATION</td>
<td>21.1</td>
<td>33.1</td>
<td>39.9</td>
<td>6.3</td>
</tr>
<tr>
<td>S-PALATALIZATION</td>
<td>9.0</td>
<td>88.2</td>
<td>2.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

A Korean process, STOP NASALIZATION, showed the most frequent transfer in L2 speech (42.3%). This perhaps shows that this phonological process has the greatest phonetic motivation and is the most difficult to suppress. As for L1 transfer, the phonological process second in frequency to STOP NASALIZATION was N-LATERALIZATION. CORONAL STOP LATERALIZATION showed less transfer than STOP NASALIZATION or N-LATERALIZATION. However, one interesting point is that Korean learners made the most errors with the coronal stop-lateral sequence (67.3% of their productions were errors: 21.1% (lateralized pronunciation), 39.9% (vowel-inserted pronunciation), and 6.3% (others)). In other words, Korean learners showed the lowest percentage of correct pronunciation with the coronal stop-lateral sequence, which suggests that this sequence is the most difficult. Most of the errors were vowel-inserted pronunciations which made the /t/ of /tl/ more audible (59.3% of their errors). It seems
that VOWEL INSERTION bled away the inputs of CORONAL STOP LATERALIZATION. As mentioned in Section 4.2.4.4, we also need to point out the low rate of transfer of one phonological process—S-PALATALIZATION (9.0%)—compared with other processes.

6.4 Effects of phonological conditioning factors on L1 transfer in L2

The effects of such phonological conditioning factors as stop voicing (‘voiceless’ vs. ‘voiced’), point of articulation (‘homorganic’ vs. ‘heterorganic’), or word boundaries (‘word-internal’ vs. ‘word-external’) were observed in L1 transfer or L2 speech, even though these conditioning factors usually were not relevant in Korean. A brief summary of the effects of individual phonological conditioning factors is shown below.

Table 6.3 Percentage (%) of transfer of phonological processes based on phonological conditioning factors

<table>
<thead>
<tr>
<th>Phonological process</th>
<th>Voicing</th>
<th>Homorganicity</th>
<th>Word boundary</th>
<th>Syllabic</th>
<th>/i/</th>
<th>/j/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STOP NASALIZATION</td>
<td>30.3</td>
<td>54.4</td>
<td>53.5</td>
<td>31.1</td>
<td>40.6</td>
<td>44.0</td>
</tr>
<tr>
<td>CORONAL STOP LATERALIZATION</td>
<td>6.4</td>
<td>35.8</td>
<td>21.2</td>
<td>21.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-LATERALIZATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-PALATALIZATION</td>
<td>0.7</td>
<td>21.0</td>
<td>0.7</td>
<td>5.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In STOP NASALIZATION, two factors – voicing and point of articulation – did play a role, but word boundaries did not. Hypotheses 1-2 and 1-3 were supported: Korean speakers tended to transfer STOP NASALIZATION to L2 speech more frequently in voiceless stop plus nasal sequences than in voiced stop plus nasal sequences; Korean speakers tended to transfer STOP NASALIZATION more frequently in homorganic sequences than in heterorganic sequences. Hypothesis 1-4 was not supported.
In CORONAL STOP LATERALIZATION, voicing did play a role, but word boundaries did not. Hypothesis 2-2 was supported: Korean speakers tended to transfer CORONAL STOP LATERALIZATION to L2 speech more frequently in voiceless coronal stop plus lateral sequences than in voiced coronal stop plus lateral sequences. Hypothesis 2-3 was not supported: CORONAL STOP LATERALIZATION occurred almost identically both in word-internal sequences and in word-external sequences.

In N-LATERALIZATION, word boundaries did play a role. Hypothesis 3-2 was supported: Korean speakers tended to transfer N-LATERALIZATION to L2 speech more frequently in word-internal sequences than in word-external sequences.

In S-PALATALIZATION, word boundaries and the syllabicity of high front vocoids did play a role. Hypotheses 4-2 and 4-3 were supported: S-PALATALIZATION occurred more frequently before a non-syllabic high front vocoid (/j/) than before a syllabic high front vocoid (/i/); it occurred more frequently in word-internal sequences than in word-external sequences.
CHAPTER 7
CONCLUSIONS

This study has focused on the following questions: a) Do native speakers of Korean tend to transfer phonological processes in speaking English? b) Do native speakers of Korean tend to transfer morphophonological rules in speaking English? c) Do voicing patterns (‘voiceless’ vs. ‘voiced’) affect the frequency of L1 transfer differently when native speakers of Korean speak English? d) Does word boundary (‘within a word [word-internal]’ versus ‘across a word boundary [word-external]’) affect L1 transfer when native speakers of Korean speak English? e) Does place of articulation (‘homorganic’ versus ‘heterorganic’) affect L1 transfer when native speakers of Korean speak English?

In order to give answers to these questions, I tested four Korean phonological processes – STOP NASALIZATION, CORONAL STOP LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION – and three morphophonological rules – T-PALATALIZATION and the Duīm Law (L-NASALIZATION and N-DELETION).

My first two research questions concern the application of L1 morphophonological rules versus phonological processes in L2. Based on these questions, I proposed Hypotheses 1-1, 2-1, 3-1, and 4-1—that phonological processes like STOP NASALIZATION, CORONAL STOP LATERALIZATION, N-LATERALIZATION, and S-PALATALIZATION will transfer in L2, and Hypotheses 5-1, 6-1, and 6-2—that morphophonological rules like T-PALATALIZATION and the Duīm Law (L-NASALIZATION and N-DELETION) will not.
Morphologically conditioned morphophonological rules are easy to violate in L1 or L2 because they are usually not phonetically motivated. Korean speakers can pronounce their inputs easily. For example, /lakwɔn/ ‘paradise’ is changed to [nagwɔn] by L-NASALIZATION. This is a morphophonological rule, based on the following characteristics, discussed in Chapter 2: a) it depends on morphological information—in this case, lexical stratum, b) it has surface exceptions (e.g., /liil/ [riil] ‘the name of a Korean letter’), c) it is obligatory, d) its input is felt to be no more difficult to pronounce by native speakers of Korean than the substitute, etc. In contrast, phonological processes are not easy to violate in L1 or L2 because they are phonetically motivated. Native speakers of Korean find it difficult, for example, to pronounce stop plus nasal sequences. /kot/ # /nawa/ ‘Come out soon’ and /ip+mat/ ‘appetite’ are changed to [kon nawa] and [immat], respectively, by STOP NASALIZATION which is a phonological process showing the following characteristics, also discussed in Chapter 2: a) it does not depend on morphological information, b) it is automatic, c) it may apply across a word boundary, d) its input is felt to be more difficult to pronounce than the substitute, etc.

Hypotheses 1-1, 2-1, 3-1, and 4-1 were supported: Processes (STOP NASALIZATION, CORONAL STOP NASALIZATION, N-LATERALIZATION, and S-PALATALIZATION) transferred in L2. However, Hypothesis 4-1 was only weakly supported because S-PALATALIZATION showed a low transfer rate (9%) compared with other processes. This may be attributable to English reinforcement in mass media and Korean speakers' education in English, where speakers are usually drilled intensively and at length on the distinction of English sounds /s/ [s] and /ʃ/ [ʃ], as in [si] see vs. [ʃi] she.
and [sit] seat vs. [ jit ] sheet. It also may be attributable to the existence of surface exceptions: / s ’ i j u t a / ‘ put (a hat) on a person, impute (a guilt to a person) ’ is often realized as [ s ’ i j u d a ] ~ [ s ’ r u d a ] in careful speech and as [ j ’ i u d a ] in casual speech; / s ’ i j t a / ‘ be possessed by demons; be written ’ is often realized as [ s ’ i j d a ] ~ [ s ’ t d a ] in careful speech and as [ j ’ t d a ] in casual speech.

Hypotheses 5-1 and 6-1 also were supported: Rules (T-PALATALIZATION and L-NASALIZATION) hardly ever transfer in L2. Hypothesis 6-2, however, was not supported: N-deletion did transfer in L2. We need to consider one thing: As mentioned earlier, although it was very weak, transfer of a morphophonological rule (N-deletion) may have occurred as a kind of hypercorrect pronunciation, because some speakers became nervous about recording their speech with a microphone before them, and read the target words placed in a sentence-initial position right after the researcher read the number.

On the whole, phonological processes and morphophonological rules seem to show different tendencies: the former transfer frequently in L2, while the latter rarely transfer.

Now, let us turn to the remaining questions, about the effect of such phonological conditioning factors as voicing, point of articulation (homorganicity), or word boundaries in L1 transfer or L2 speech. A brief summary of the effects of individual phonological conditioning factors is shown below, in Table 7.1.
Table 7.1 Percentage (%) of transfer of phonological processes based on phonological conditioning factors

<table>
<thead>
<tr>
<th>Phonological process</th>
<th>Voicing</th>
<th>Homorganicity</th>
<th>Word boundary</th>
<th>Syllability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>STOP NASALIZATION</td>
<td>30.3</td>
<td>54.4</td>
<td>53.5</td>
<td>31.1</td>
</tr>
<tr>
<td>CORONAL STOP LATERALIZATION</td>
<td>6.4</td>
<td>35.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-LATERALIZATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-PALATALIZATION</td>
<td>0.7</td>
<td>21.0</td>
<td>0.7</td>
<td>5.3</td>
</tr>
</tbody>
</table>

I expected that a) STOP NASALIZATION would be affected by three factors—voicing, point of articulation, and word boundary; b) CORONAL STOP LATERALIZATION would be affected by two factors—voicing and word boundary; c) N-LATERALIZATION would be affected by one factor—word boundary; and d) S-PALATALIZATION would be affected by two factors—syllabic of the high palatal vocoid (/i/ vs. /j/) and word boundary.

As shown in Table 7.1 above, in STOP NASALIZATION, voicing did play a role. Hypothesis 1-2 was supported: Korean speakers tended to transfer STOP NASALIZATION to L2 speech more frequently in voiceless stop plus nasal sequences than in voiced stop plus nasal sequences. This seems to violate Hutcheson’s Similarity Principle, as mentioned in section 4.2.1.4. But the greater frequency of STOP NASALIZATION in voiceless stop-lateral sequences may be attributable to VOWEL INSERTION, which was much more prevalent with voiced stops than with voiceless stops. VOWEL INSERTION removes potential inputs from STOP NASALIZATION. However, the frequency of transfer STOP NASALIZATION to L2 speech is still greater in voiceless stop plus nasal sequences than in voiced stop plus nasal.
sequences, even if we include the frequency of vowel-inserted pronunciations with the frequency of nasalized pronunciations. That is, based on the frequency of correct pronunciations (42.8% for voiceless vs. 51% for voiced), we can see that voiceless stop-nasal sequences underwent STOP NASALIZATION or other substitution more frequently than voiced stop-nasal sequences. Thus, we might consider whether this violation is due to some greater phonetic (articulatory) difficulty of voiceless stop plus nasal sequences than voiced stop plus nasal sequences.

Both Korean and English avoid or make substitutions for sequences of a voiceless stop and a nasal. Korean always nasalizes the stop, while in most dialects of English, the syllable-final unreleased voiceless stop is glottalized. We assume that the sequence of a unreleased voiceless stop and a nasal presents a difficulty of some kind. According to Cho, Jun and Ladefoged (2002:210), there are four factors which affect the oral air pressure: a) the subglottal air pressure, which the oral air pressure comes from originally; b) the glottal impedance, which may make the oral air pressure less than the subglottal air pressure; c) the tension of the walls of the vocal tract, which, if it is weak, will lower the oral air pressure; d) the duration of the stop closure – stops with a long closure will get a higher oral air pressure. Based on the second and fourth factors, we may infer that voiceless stops in the coda have higher oral air pressure than voiced stops because the former have less glottal impedance and longer closure than the latter.

This may explain why voiceless stop-nasal sequences are more difficult than voiced stop-nasal sequences. When an oral stop is articulated, air pressure builds up and there may be some additional muscular tension of all the relevant articulators including velum and tongue. It may be harder to lower the velum under the higher oral air pressure.
involved in a voiceless stop than under the lower oral air pressure involved in a voiced stop. Thus, voiceless stops might not be preferred when a nasal follows. STOP NASALIZATION and Voicing in Korean avoid the problem by lowering the velum before the oral air pressure builds up and by allowing the vocal folds to continue to vibrate respectively. These assimilate an oral stop to the following nasal by changing two features \([-\text{nas}, -\text{voiced}]\) of a voiceless stop to \([+\text{nas}, +\text{voiced}]\) (or spreading two features \([+\text{nas}, +\text{voiced}]\) of a nasal).

Place of articulation also played a role in STOP NASALIZATION. Hypothesis 1-3 was supported: Korean speakers tended to transfer STOP NASALIZATION more frequently in homorganic sequences than in heterorganic sequences. This result supports the Similarity Principle, in which more similar sequences are more susceptible to assimilation than less similar sequences (Hutcheson 1973).

Word boundary did not play a role in STOP NASALIZATION. Hypothesis 1-4 was not supported, but arithmetically, STOP NASALIZATION occurred more frequently in word-internal sequences than in word-external sequences.

In CORONAL STOP LATERALIZATION, voicing did play a role. Hypothesis 2-2 was supported: Korean speakers tended to transfer CORONAL STOP LATERALIZATION to L2 speech more frequently in voiceless coronal stop plus lateral sequences than in voiced coronal stop plus lateral sequences. The greater frequency of CORONAL STOP LATERALIZATION in voiceless stop-lateral sequences may be attributable to VOWEL INSERTION, which was much more prevalent with voiced stops than with voiceless stops. VOWEL INSERTION removes potential inputs from CORONAL STOP LATERALIZATION. This may be a result of the phonetic patterning in Korean, where, if the stop is phonetically...
voiced, it is perceived as being in syllable-initial position, so that it must be followed by a vowel. Thus, we cannot say that CORONAL STOP LATERALIZATION violates the Similarity Principle.

Word boundaries did not play a role in CORONAL STOP LATERALIZATION. Hypothesis 2-3 was not supported: The mean frequency of CORONAL STOP LATERALIZATION in word-internal sequences was almost the same as in word-external sequences.

In N-LATERALIZATION, word boundaries did play a role. Hypothesis 3-2 was supported: Korean speakers tended to transfer N-LATERALIZATION to L2 speech more frequently in word-internal sequences than in word-external sequences.

In S-PALATALIZATION, syllabicity of high front vocoids did play a role. Hypothesis 4-2 was supported: S-PALATALIZATION occurred more frequently before a non-syllabic high front vocoid (/j/) than before a syllabic high front vocoid (/i/). This result supports a universal principle proposed by Neeld (1973)—that PALATALIZATION by a syllabic palatal element (/i/) implies PALATALIZATION by a non-syllabic palatal element (/j/).

Word boundaries also played a role in S-PALATALIZATION. Hypothesis 4-3 was supported: S-PALATALIZATION occurred more frequently in word-internal sequences than in word-external sequences.

Word boundaries played a role in N-LATERALIZATION and S-PALATALIZATION, even though they did not play a role in STOP NASALIZATION or CORONAL STOP LATERALIZATION. The results seem to support the general tendency for elements within a
smaller domain to be more susceptible to lenitive (that is, assimilative) processes than elements in a larger domain are, as a whole.

In summary, L1 phonological processes and morphophonological rules show different behavior in L2, that is, L1 phonological processes tend to transfer in L2 and morphophonological rules do not, and phonological factors that seem irrelevant in L1 may still affect the degree of difficulty of sequences in L2: a) stop voicing in STOP NASALIZATION and CORONAL STOP LATERALIZATION, b) homorganicity in STOP NASALIZATION, c) word boundaries in N-LATERALIZATION and S-PALATALIZATION, and d) /i/ versus /j/ in S-PALATALIZATION.
APPENDIX A

CONSENT FORM

AGREEMENT TO PARTICIPATE IN

Production of Korean Learners of English

In Kyu Park

Ph.D. Program of Department of Linguistics
University of Hawaii at Manoa
1890 East-West Road
Honolulu, HI 96822
(808) 946-9811; ipark@hawaii.edu

The purpose of this research is to investigate how Korean learners of English produce English words. This project collects information about Korean native speakers' speech sounds from their reading samples of certain English sentences. Recordings are once made in a sound-attenuated booth at the University of Hawaii at Manoa for at most one hour between September, 2003 and August, 2004. The approximate number of subjects involved in this study is 40.

Your participation in this study will not only contribute to the understanding of second language phonology acquisition but also to the improvement of language teaching materials and pedagogy.

No risk is anticipated in participating in this experiment. The data is collected anonymously, and you will not be identified in any report. Your participation is voluntary, you can withdraw if you wish, at any time. The results of the research will be made available to participants upon request. The tape recording will be destroyed upon graduation.

I certify that I have read and that I understand the foregoing, that I have been given satisfactory answers to my inquiries concerning project procedures and other matters and that I have been advised that I am free to withdraw my consent and to discontinue participation in the project or activity at any time without prejudice.

I herewith give my consent to participate in this project with the understanding that such consent does not waive any of my legal rights, nor does it release the principal investigator or the institution or any employer or agent thereof from liability for negligence.

______________________________
Signature of individual participant

______________________________
Date

______________________________
Participant's Name

(If you cannot obtain satisfactory answers to your questions or have comments or complaints about your treatment in this study, contact: Committee on Human Studies, University of Hawaii, 2540 Maile Way, Honolulu, Hawaii 96822. Phone: (808) 956-5007.)

c: signed copy to participant
APPENDIX B

BACKGROUND QUESTIONNAIRE

Please fill or check in the blank.

1. Name: ______________________
2. Age: ______________________
3. Sex: Male ________ Female ________
4. Native Language: Korean
5. Other languages you speak: ____________________________
6. Major: ______________________ (Undergraduate ____ Graduate ____)
7. Place of Birth: ____________________________
8. In chronological order, list places you have lived so far:

________________________________________________________

9. Period of stay in the U.S. and English-speaking countries:
   __________ year(s) __________ month(s)
10. Period of studying English: __________ year(s)
11. Have you ever studied English phonetics or phonology?
    Yes ___ (When? _____ Where? _____ How long? _____)
    No ___
12. TOEFL score:
    Listening ________ Grammar ________ Reading ________ Total ________
13. Level in the ESL/ELI classes:
    Conversation: Advanced ____ Non-advanced: ____
    Grammar: Advanced ____ Non-advanced: ____
    Reading: Advanced ____ Non-advanced: ____
14. How long do you speak English a day? _____ hour(s) _____ minutes
15. Dialect ______________
APPENDIX C

EXPERIMENTAL MATERIALS

--READING PASSAGE for rating the pronunciation level of the participants

Please read the following:

Sheila and I just celebrated our thirtieth wedding anniversary. Somebody asked her, what was our secret? She answered, "On my wedding day, I decided to make a list of ten of Tim's faults which, for the sake of our marriage, I would always overlook. I figured I could live with at least ten!"

When she was asked which faults she had listed, Sheila replied, "I never did get around to listing them. Instead, every time he does something that makes me mad, I simply say to myself, 'Lucky for him, it's one of the ten!'"

(Overlook It by Tim Hudson from DailyInbox: Chicken Soup for the Soul – 08/18/03)

--TARGET SEQUENCES/SEGMENTS

1. STOP-NASAL SEQUENCES

a. d#n, b#m

Honey, I have some good news and some bad news.
Fifteen is an odd number.
Nina entered the job market.
Jeb made a nice dish for the potluck party.
She can bob Martha's hair to keep her in style.

b. dn, bm

My shipmate is very good-natured and broadminded.
Today's headline news is the story of a kidnapping.
The topmast was broken at midnight.
Davis eats seaweed and crabmeat every evening.
He is driving a clubmobile.
The tube-maker is wearing a rib-knit sweater.
I need seed money for my new business.
The good manager is wearing hobnailed boots.
Can you do the dead man’s float?
Bob noticed the nice eagle on the coin.
Cecilia can grab nine marbles in one hand.
They couldn’t rob Nancy of her name.

Nita is a bootmaker or a bedmaker.
Two guys are loading a treadmill.
My shipmate is very good-natured and broadminded.
The good manager is wearing hobnailed boots.
The tube-maker is wearing a rib-knit sweater.
Neal is cob-nosed and bull-necked.

Arrange the pet names in alphabetical sequence.
Lewis, what’s your seat number?
The secretary put nice pictures on the desk.
This young guy was deceived into buying a drip mat.
The second footnote gives the definition of ‘group marriage’.
Danny, stop moving!

They took a catnap in the daytime.
Petnapping sometimes occurs in Hawaii.
The second footnote gives the definition of ‘group marriage’.
My shipmate is very good-natured and broadminded.
Samsung is a well-known chip-making company.
The topmast was broken at midnight.

Do you sell pot marigold seeds?
The coach got mad at the players on his baseball team.
Do you know what ‘hot money’ means?
Could you keep nice topknots on a shelf?
They’ll heap Nancy with work tomorrow.
This boat will sleep nine people.
When making cookies, I usually put nutmeats in them.
Nita is a bootmaker or a bedmaker.
Laura is my seatmate in the school.
Do you think it is a topnotch job?
Can you show me how to make a slipknot?
Could you keep nice topknots on a shelf?

2. CORONAL STOP-LATERAL SEQUENCES
a. tl
Jeb made a nice dish for the potluck party.
The hotline won't close until noon.
Two bootleggers got arrested yesterday.

b. dl
Today’s headline news is the story of a kidnapping.
Luke bought us new headlights and a padlock.

c. t#l
Mr. Scot-Young got lost in the woods.
There is a tot lot in Ala Wai Park.
He set lights around the room.

d. d#l
This is a dead loss.
The wood lily is orange-red.
This is a dead letter.

3. CORONAL NASAL-LATERAL SEQUENCES
a. l#n
The hotline won’t close until noon.
Sam is still not out of bed.
Did you read the whole newspaper?
If you’re interested, just call now.
He’s been training two seals from noon till now.

b. ln
Samsung is a well-known chip-making company.
I bought a well-knit sweater and some walnuts in Costco.
Do you know what ‘bullnose’ means?
Neal is cob-nosed and bull-necked.
4. si/sj SEQUENCES
   a. si
   This young guy was deceived into buying a drip mat.
   Do you sell pot marigold seeds?
   Arrange the pet names in alphabetical sequence.
   Lewis, what’s your seat number?
   Tom conceived a love for Tina.

   b. s#i
   Davis eats seaweed and crabmeat every evening.
   They pass Easter eggs around the table.
   Bob noticed the nice eagle on the coin.
   They kiss each other.
   This eel doesn’t have any poison.

   c. s#j
   This young guy was deceived into buying a drip mat
   Did you pass Eustace on the way to school?
   Ace Young is an eight-year-old pianist.
   John wants to kiss Eunice on this yacht.

5. t-j/i SEQUENCES
   a. t-j
   Mr. Scot-Young got lost in the woods.
   How many miles is one light-year?
   Ace Young is an eight-year-old pianist.

   b. t-i
   Allosauruses were violent meat-eaters.

6. WORD-INITIAL l
   Laura is my seatmate in the school.
   Lewis, what’s your seat number?
   Luke bought us new headlights and a padlock.

7. WORD-INITIAL ni SEQUENCES
   Nita is a bootmaker or a bedmaker
   Nina entered the job market.
   Neal is cob-nosed and bull-necked.
8. DISTRACTERS
A little pot is soon hot.
Do you need a ride?
The cat is on the chair.
The cop arrested two burglars.
Put the cap on the shelf.
The cook is baking bread.
The gap is between expenses and income.
Your book is on the desk.
The crack on the dish occurred yesterday.
My bet is that he will win the race.
Which one do you prefer in each sentence? Please read the sentence including your preference.

1. A little pot is soon hot.
2. Samsung is a well-known chip-making company.
3. Jeb made a nice dish for the potluck party.
4. When making cookies, I usually put nutmeats in them.
5. I bought a well-knit sweater and some walnuts in Costco.
6. Nita is a bootmaker or a bedmaker.
7. Davis eats seaweed and crabmeat every evening.
8. Laura is my seatmate in the school.
9. This young guy was deceived into buying a drip mat.
10. They took a catnap during the daytime.
11. Nina entered the job market.
13. Mr. Scot-Young got lost in the woods.
14. The second footnote gives the definition of ‘group marriage’.
15. Do you need a ride?
16. The cop arrested two burglars.
17. Two guys are loading a treadmill.
18. There is a tot lot at Ala Wai Park.
19. My shipmate is very good-natured and broadminded.
20. I need seed money for my new business.
21. Today’s headline news is the story of a kidnapping.
22. This is a dead loss.
23. He set lights around the room.
24. The hotline won’t shut until noon.
25. They pass Easter eggs across the table.
26. Bob noticed the nice eagle on a coin.
27. Two bootleggers were arrested yesterday.
28. Sam is still not out of bed.
29. The wood lily is orange-red.
30. The cat is on the chair.
31. The cook is baking bread.
   making

32. Do you sell pot marigold seeds?
   Did

33. Do you know what ‘bullnose’ means?
   Did

34. The coach got mad at the players on his baseball team.
   of

35. They kiss each other.
   others

36. Do you know what ‘hot money’ means?
   see

37. He is driving a clubmobile.
   running

38. This is a dead letter.
   the

39. Arrange the pet names in alphabetical sequence.
   at

40. How many miles is one light-year?
   are

41. Lewis, what’s your seat number?
   which one is

42. Tom conceived a love with Tina.
   for

43. The secretary put nice pictures on the desk.
   at

44. Did you pass Eustace on the way to school?
   campus

45. Put the cap on the shelf.
   in
46. Your book is on the desk.

47. The good manager is wearing hobnailed boots.

48. Allosauruses were violent meat-eaters.

49. Can you do the dead man’s float?

50. The topmast was broken at midnight.


52. Honey, I have some good news and some bad news.

53. Did you read the whole newspaper?

54. Fifteen is an odd number.

55. Ace Young is an eight-year-old pianist.

56. Do you think it is a topnotch job?

57. This eel doesn’t have any poison.

58. Can you demonstrate how to make a slipknot?

59. The gap is between expenses and income.

60. My bet is that he will win the race.
61. Could you keep nice topknots on a shelf?

62. If you’re interested, just call now.

63. The tube-maker is wearing a rib-knit sweater.

64. He’s been training two seals from noon till now.

65. [Danny, stop moving!]

66. Neal is cob-nosed and bull-necked.

67. They’ll heap Nancy with work tomorrow.

68. This boat will sleep nine people.

69. John wants to kiss Eunice on this yacht.

70. She can bob Martha’s hair to keep it in style.

71. Cecilia can grab nine marbles in one hand.

72. They couldn’t rob Nancy of her name.

73. The crack on the dish occurred yesterday.
REFERENCES


Hwang, Hui-Yong 1979. Han ‘gugo Umun Non (‘An Introduction to Korean Phonology’).


