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Comparison of English and Korean speakers for the nasalization of English stops

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ABSTRACT

This study compared English and Korean speakers with regard to the nasalization of the English stops /b, d, g, p, t, k/ before a nasal within and across a word boundary. Nine English and thirty Korean speakers participated in the experiment. We used 37 speech items with different grammatical structures. Overall the English informants rarely nasalized the stops while the Korean informants generally greatly nasalized them though widely varying from no nasalization to almost complete nasalization. In general, voiced stops were more likely to be nasalized than voiceless stops. Also, the alveolar stops /d, t/ tended to be nasalized the most, the bilabial stops /b, p/ the second most, and the velar stops /g, k/ the least. Besides, the closer the grammatical relationship between neighboring words, the more likely the stop nasalization occurred. In contrast, the Korean syllabification - the addition of the vowel /ɨ/ to the final stops - worked against the stop nasalization. On the other hand, different stress (accent) or rhythm effects of the two languages are assumed to contribute to the significantly different nasalization between English and Korean speakers. The spectrum of stop nasalization obtained from this study can be used as an index to measure how close a certain Korean speaker's stop nasalization is to English speakers'.

Keywords: English stop nasalization, nasals, voicing, a word boundary, syllabification, grammatical structures, a spectrum

1. Introduction

Learners of a foreign language are liable to be affected by the phonology of their mother tongue (L1) when they hear and speak the foreign language (L2). Therefore, teachers should encourage L2 learners to reduce their inclusion of speaking habits from L1 when speaking L2.

There are reasons we make listening or speaking mistakes when using L2. First, every language has its own typical phonemic system. For example, French or German does not have the dental fricatives /ɵ/ and /ð/ that are members of English phonemes (Pool, 1999, p. 62). Therefore, French and German native speakers may replace the last consonant /ɵ/ of the English word *both* and the first consonant /ð/ of the word *the* with their /s/ and /z/ respectively that are the closest to the English dental fricatives /ɵ/ and /ð/. As Korean does not have the English dental phonemes /ɵ/ and /ð/ either, Korean speakers tend to hear and speak the initial phoneme /ɵ/ of the English word *thirsty* as the Korean fricatives /s/ or /s'/ and the initial phoneme /ð/ of the English word *the* as the Korean voiceless lax unaspirated stop /t/.

Second, the syllabic structure differs between languages. For example, Korean has only four types of syllabic structures, i.e., V, CV, VC, CVC. Hence, English words with syllabic structures like CCCVC are not familiar to Koreans. As a result, the English one-syllabic word, *strike* /straɪk/ can be thought to have up to five syllables, i.e., [sɨ-tɨ-ra-i-kɨ] for them. In particular, the /aɪ/ in /straɪk/ is heard and spoken as two syllables like [a-i], as Korean has no diphthongs like /aɪ/ in English.

Third, different languages have different phonological rules. For example, Spaniards tend to add the vowel /ɛ/ to the initial of English words (e.g., *Stuart*) beginning with /sC/ (C is a consonant) (Pool, 1999, p. 62). It is because Spanish has the /ɛ/

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insertion rule in the words beginning with /sC/. On the other hand, in many languages including English a nasal sound nasalizes the preceding vowel within a syllable (i.e., V → [+nasal]/ ___ [+nasal]$). For instance, the vowel /e/ of the English word *dental* is nasalized, i.e., [dẽn$təl], while the vowel /ɪ/ of the English word *denote* will not be nasalized, i.e., [dɪ$noʊt] (Fromkin, Rodman & Hyams, 2011, p. 246). In contrast, some vowels in French, Polish, and Portuguese are spoken nasalized even without a following nasal, e.g., the French word *son* [sõ] "sound" (Fromkin, Rodman & Hyams, 2011, p. 209).

Unlike the above, we may suffer difficulties in acquiring of L2 due to the differences in the frequency or degree of a phonetic/phonological phenomenon even though both L1 and L2 basically have the same phenomenon. One example is the nasalization of stops preceding a nasal. Interestingly, concerning the nasalization, Korean and English are partly the same but at the same time considerably different.

First, Korean speakers often nasalize the English word final stops /b, d, g, p, t, k/ before the initial nasal consonant of the following words, e.g., *Good* [gʊm/gʊn] *morning!*; *Keep* [kim] *mine*. It is because Korean stops become completely nasalized before a nasal across a word boundary (e.g., *miguk* [mikuŋ] *munjae* "American problems") as well as within a word boundary, i.e., a regressive assimilation. That is, {p, p^h} → m/V__#{m, n}; {t, t^h} → n/V__#{m, n}; {k, k^h} → ŋ/V__#{m, n} (# indicates a word boundary).

Second, English speakers may also nasalize the word final /b, d, g/ before the following word initial /m, n/, and this is phonemic (Gimson, 1989, p. 258). However, there seems to be a great difference in the degree or frequency of the nasalization between Korean and English, i.e., much less nasalization occurs in English. Gimson (1989, p. 258) also says that such kind of nasalization is often found for English speakers but it is not acceptable in RP (Received Pronunciation) speakers. Nowadays, it is difficult to define the so-called RP (Roach, 2009, p. 3), but the description in Gimson (1989, p. 258) implies that considerable differences in the degree or frequency of the nasalization could exist between English native speakers according to their accents. Moreover, this kind of nasalization mainly occurs in the voiced stops /b, d, g/ (in particular the alveolar stop /d/) and it takes place more easily in faster speech (Gimson, 1986, p. 258). In other words, the voiceless stops /p, t, k/ are less likely to be nasalized in the same conditions, and even the voiced stops /b, d, g/ show less nasalization in a slow and clear speech. Accordingly, we can say that the nasalization of stops before a nasal across a word boundary is relatively limited and optional in English, unlike in Korean where it is general and absolute. To summarize, the nasalization is more likely to be a phonetic variation in English while it is a phonological one in Korean (Yun, 2000).

The stop nasalization is an absolute phonological rule when Koreans speak Korean while it is a relative phonetic phenomenon affected by their mother tongue (L1) when they speak English. Thus, we need to be cognizant of how much Korean speakers nasalize English stops before a nasal within and across a word boundary. Unfortunately, a review of the literature yields only a dearth of references regarding the stop nasalization. Through a production experiment, Seo, Kim, Shin & Kim (2005) reported that Korean speakers frequently nasalized the English voiceless stops /p, t, k/ before a nasal within a word boundary while English native speakers did not. Kang & Lee (2001) also found a tendency for the nasalization of English stops within a word boundary by Korean highschool students. However, the data of the two studies are not sufficient enough to figure out the details of the stop nasalization. Moreover, we are much less aware of the nasalization across a word boundary. Gimson (1989, p. 258) introduces only a few lines of intuitive observations of the nasalization across a word boundary by English speakers. Fortunately, Yun (2000)'s spectrographic study shows that English speakers produce considerably less nasalization of stops across a word boundary than Koreans. But it was a preliminary study without a reliable amount of comparing data. Therefore, this study extensively compares English and Korean native speakers for the nasalization of English stops preceding a nasal both within and across a word boundary.

2. Method

2.1. Subjects

First, nine English native speakers (four Canadian males, two American males, one American female, one British male, one New Zealand male) participated in the recording. At the time of recording, they were all professors with an MA or a PhD degree, who were at their 20's to 40's, for the Hankuk University of Foreign Studies.

Table 1. Information of the Korean speakers

Speaker (sex, age)	Exceptional experiences to be exposed to English, e.g., staying abroad
1 (F, 24)	10 months in Canada as a college student
2 (F, 22)	None
3 (F, 21)	3 years in the UK as a primary student
4 (M, 23)	2 years in Canada as a primary student
5 (M, 27)	3 years in Germany, 10 years in the UK
6 (F, 24)	None
7 (M, 23)	18 years in Malaysia and China
8 (F, 22)	None
9 (F, 23)	1 year in New Zealand, 6 months in the UK
10 (F, 20)	None
11 (M, 24)	None
12 (F, 23)	1 year in the US as a primary student
13 (F, 20)	4 years in Thailand, attended an international school
14 (F, 21)	None
15 (F, 23)	21 years in Malaysia, attended an international school
16 (M, 26)	6 months in Canada as a college student
17 (M, 21)	None
18 (F, 25)	7 years in Japan, 1 year in the US, graduated from a foreign language high school in Korea
19 (M, 25)	a foreign language high school graduate
20 (M, 26)	None
21 (M, 28)	1 month in the UK
22 (F, 20)	a foreign language high school graduate
23 (F, 20)	None
24 (M, 26)	None
25 (F, 24)	None
26 (F, 21)	None
27 (M, 28)	2 months in Singapore
28 (F, 27)	None
29 (M, 24)	None
30 (M, 24)	a foreign language high school graduate

Second, 30 (13 male and 17 female) Korean native speakers aged 20's with the Seoul accent were also used as informants. They were all undergraduate or graduate students at the Hankuk University of Foreign Studies. The majority of them were majoring in English, with the other students studying other languages or Economics, etc. However, irrespective of their major, their English speaking abilities varied. They were asked to report, if there is, the period of their staying abroad, or attending an international school or a foreign language high school, etc. The information was collected to examine any possible relationship with the English stop nasalization (see Table 1).

2.2. Stimuli

Table 2. Speech Items

1. Goobness 2. Goodness 3. Googness 4. Upmost 5. Utmost 6. Ukmost 7. Goob morning! 8. Good morning! 9. Goog morning! 10. Goop morning! 11. Goot night! 12. Gook news! 13. What does “cab” mean? 14. What does “god” mean? 15. What does “bag” mean? 16. What does “cap” mean? 17. What does “cat” mean? 18. What does “cook” mean? 19. What does “ebb” mean? 20. What does “bad” mean? 21. What does “egg” mean? 22. What does “pipe” mean? 23. What does “bite” mean? 24. What does “bike” mean?
25. What number would you like to choose? 26. They gab merrily. 27. They gad many days. 28. Cook now. 29. Get up now. 30. At noon 31. They gag me. 32. Keep mine. 33. Let me know. 34. Kick me. 35. God made us. 36. It may be true. 37. That might be true.

We used 37 speech items, some of which are nonsense words or rarely used words (see Table 2). Expecially the exceptional words were prepared to compare the nasalization between the three different places of stops, i.e., /b, d, g/ or /p, t, k/ under the same or similar conditions. Items 1 to 6 were chosen to examine the English stop nasalization within a word boundary. Out of them, items 1, 3 and 6 (i.e., *goobness, goopness, ukmost)* are nonsense words paired with item 2 *goodness* or item 5 *utmost.* This research mainly targeted at the stop nasalization across a word boundary, but it was also designed to compare the nasalization within and across a word boundary.

The other items (i.e., items 7 to 37) were prepared in order to find out not only the stop nasalization across a word boundary, but also any possible effect on the stop nasalization of different grammatical relationships between two neighbouring words. First, items 7 to 12 are the sequence of an adjective and a noun. The nonsense words, *Goob, Goog, Goop, Goot,* and *Gook* were made according to the word *Good*. In items 13 to 24, the target words are embedded in a carrier sentence, "What does ____ mean?". As a result, the target words and the following verb *mean* are connected as a subject and a transitive verb. Out of them, items 13 to 18 are usually pronounced one-syllabic when Koreans use them as loan words. In contrast, items 19 to 21 are often spoken two-syllabic, since Koreans tend to add the Korean vowel /ɨ/ to the end of the words, e.g., *egg* [egɨ]. Also, the remaining items 22 to 24 have a diphthong /aɪ/ in common. The words *pipe, bite, bike* are regarded as one-syllabic in English, but they can be perceived as even up to three-syllabic, e.g., [pa-i-pɨ] to Koreans. Such Korean syllabification is expected to considerably deter the stop nasalization. Therefore, we wanted to know how the nasalization is affected by the Korean syllabification as well as the grammatical relationship.

Items 25 to 37 have various other grammatical structures. First, item 25, in which *What* functions as an adjective, was made to be compared to items 7 to 12 with the same structure - an adjective plus a noun. Items 26 to 29 have the relationship of an intransitive verb and an adverb, and item 30 is a prepositional phrase. Items 31 to 34 are the sequence of a transitive verb and an object. Item 35 was chosen to be compared to item 14 where the same target word *god* is inserted. Finally, items 36 and 37 are the sequence of a pronoun and an auxiliary verb.

2.3. Recording and data analysis

Recording was conducted in the recording booth in the Linguistic Research Institute of the Hankuk University of Foreign Studies and it was directly saved onto the computer. The purpose of the research was not informed to the subjects. They read three lists of the speech materials written in three different orders at their normal speech rates. Therefore, the total number of tokens obtained was 4,329 [999 (9 subjects × 37 items × 3 lists) from the English speakers; 3,330 (30 subjects × 37 items × 3 lists) from the Korean speakers].

For the most cases, it was easy to judge whether the stop closure was nasalized or not (see Figure 1). But some rare cases (i.e., 26 tokens) were ambiguous to judge (e.g., creaky or partly nasalized tokens); therefore, we gave different points to the three different cases, i.e., 2 to complete nasalization, 1 to ambiguous cases, and 0 to not nasalized cases. The more detailed classification of data will help to know the stop nasalization better. The judgements were made based on spectrograms and waveforms produced by Praat. For the analysis of the data, we obtained sums, averages, standard deviations, and performed a Chi-squared test and ANOVAs followed by post-hoc pairwise comparisons.

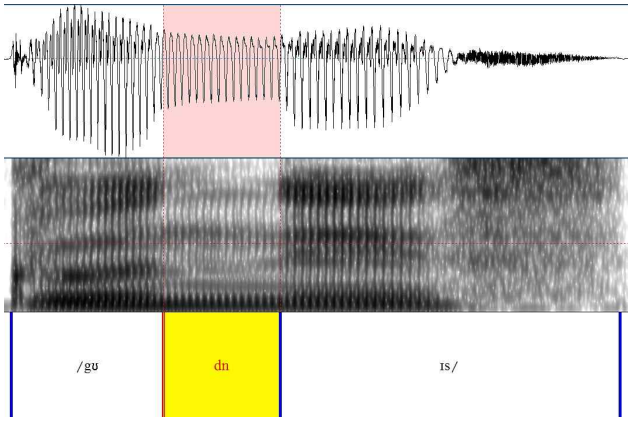

Figure 1. A set of waveform and spectrogram (goodness)

3. Results and discussion

Figures 2 & 3 show the frequency (%) of nasalization for each speaking group, i.e., English and Korean speakers. The bars in the Figures demonstrate the percentages (%) obtained by multiplying 100 after dividing the sum of nasalization points (2, 0, or 1) in each item by the number of speaking (27 for English

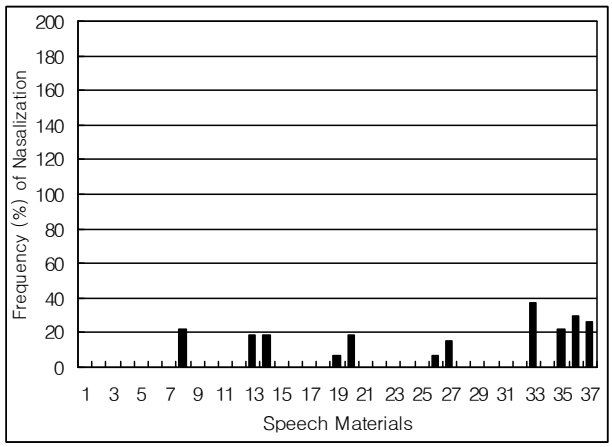

Figure 2. Frequency (%) of English stop nasalization for English speakers ((the sum of nasalization points (2, 0, or 1)/27)×100 for English speakers)

speakers; 90 for Korean speakers). For example, if every speaker in one group nasalizes all tokens of one item, the ratio of nasalization for the item becomes 200%. The reason why we convert the nasalization points to percentages (%) is that the numbers of participants of the two speaking groups differ.

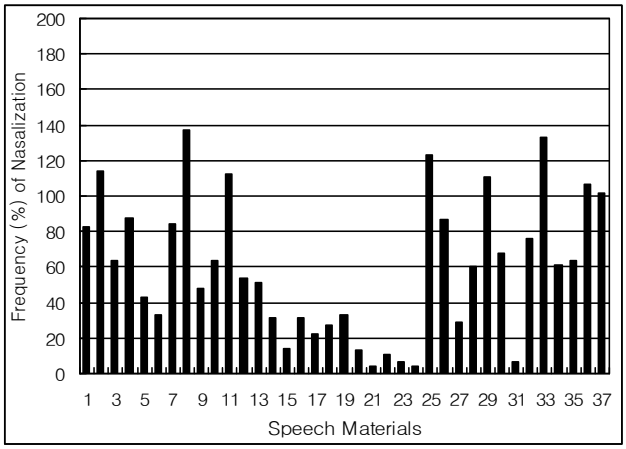

Figure 3. Frequency (%) of English stop nasalization for Korean speakers ((the sum of nasalization points (2, 0, or 1)/90) ×100 for Korean speakers)

3.1. Nasalization for English speakers

As seen in Figure 2, English speakers did hardly nasalize the English stops. Especially, contrary to our expectations that nasalization would more likely occur within a word boundary, no nasalization was observed from item 1 to item 6. Across a word boundary as well, nasalization only intermittently occurred mainly in some frequently used expressions such as *good morning, let me know, it may*, and *that might*. However, it is worth to be noted that even the small number of stops nasalized were all the alveolars /d/ (five items) and /t/ (three items) or the bilabial /b/ (three items), and the majority (i.e., eight out of the eleven nasalized items) of them are the voiced stop /d/ or /b/ (see Table 2 and Figure 2). These are, in general, supportive of Gimson (1989, p. 258)'s description that the nasalization mainly relates to the voiced alveolar /d/. On the other hand, it is interesting that the limited nasalization is focused almost on the two American speakers 8 & 9 though the number of speakers is not great enough to make a conclusion (see Figure 4). Different English accents may produce different frequencies of the stop nasalization. To sum up, the stop nasalization before a nasal, if sometimes observed, is not likely to be general among English native speakers.

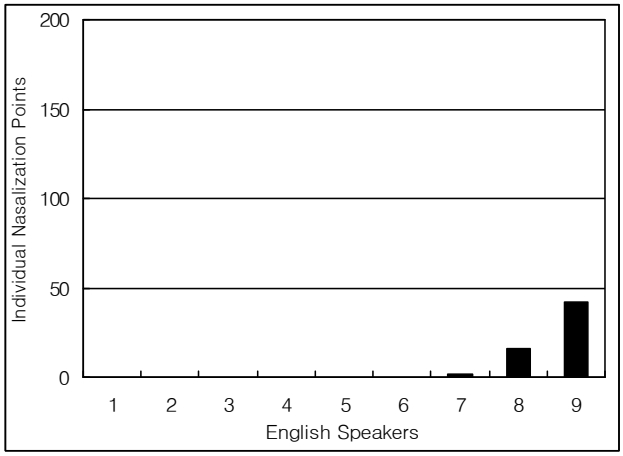

Figure 4. Individual nasalization points of English speakers for all the items (from the least nasalizing speaker to the most nasalizing speaker; This figure demonstrates not the percentage but the points themselves, i.e., the height of the bars can range from the lowest 0 point to the highest 222 points (37 items × 3 times × 2 points))

3.2. Nasalization for Korean speakers

3.2.1. Within and across a word boundary

Contrary to our expectations, the frequency of nasalization is unlikely to be greater within a word boundary than across a word boundary (see Figure 3). That is, except items 13 to 24 that nasalized relatively rarely, the degree of nasalization of the within-word-boundary items 1 to 6 is similar to that of the across-word-boundary items 7 to 12 and items 25 to 37. Rather, when the comparable items 1 to 6 and items 7 to 12 are compared, items 7 to 12 (499 % in total) produced even a higher nasalization than items 1 to 6 (425 % in total).

For the comparable items 1 to 6 and items 7 to 12 was run a three-way repeated measures (henceforth, RM) ANOVA with Boundary, Voicing, and Place as factors. The first factor Boundary had no significant effect on the nasalization: [$F(1, 29) = 2.370$, $p = 0.135$]. Thus, the difference in the total nasalization rates caused by the factor Boundary proved statistically not significant between the two groups of items. By contrast, the second factor Voicing gave a significant effect to the nasalization [$F(1, 29) = 15.084$, $p = 0.001$], i.e., voiced stops (the average nasalization point: 0.89) nasalized more than their voiceless counterparts (0.66). It explains why Gimson (1989, p. 258) suggested not the voiceless /p, t, k/, but the voiced /d/ as an example phoneme for nasalization. As well, the third factor Place had a significant effect: [$F(2, 58) = 26.955$, $p = 0.000$], which implies that the degree of the stop nasalization differed according to the place of articulation. Post-hoc comparisons showed that

the alveolar stops /d, t/ nasalized the most (the average nasalization point: 1.02), the bilabial stops /b, p/ the second most (0.80), and the velar stops /g, k/ the least (0.50) [i.e., /b, p/ *vs*. /d, t/: p = 0.006; /d, t/ *vs*. /g, k/: p = 0.000; /b, p/ *vs*. /g, k/: p = 0.001]. This confirms Gimson (1989, p. 258)'s another description that mainly the alveolars nasalize.

On the other hand, every interaction between the three factors was significant, i.e., Boundary×Voicing [F (1, 29) = 5.454, p = 0.027]; Boundary×Place [F (2, 58) = 15.544, p = 0.000]; Voicing×Place [F (2, 58) = 6.956, p = 0.002]; Boundary×Voicing×Place [F (2, 58) = 5.730, p = 0.005].

3.2.2. Within a word boundary

The nasalizing rates of the voiced stops /b, d, g/ in items 1 to 3 are 83, 114, and 64% respectively (261% in total) while those of the voiceless stops /p, t, k/ in items 4 to 6 are 88, 43 and 33% (164% in total). The voiced stops nasalized more in the order of /d/, /b/ and /g/, whereas the voiceless stops did in a different order: /p/>/t/>/k/. This supports Seo, et al. (2005)'s result (i.e., /p/>/k/>/t/) in the aspect that the bilabial stop /p/ nasalized the most. A two-way RM ANOVA with Voicing and Place as factors showed that both factors significantly affected the nasalization, i.e., Voicing [F (1, 29) = 19.811, p = 0.000]; Place [F (2, 58) = 13.063, p = 0.000]. The interaction was also significant: Voicing×Place [F (2, 58) = 12.237, p = 0.000]. Post-hoc comparisons for the factor Place revealed no significant difference between the bilabials and the alveolars, but the other two comparisons were significant (/b, p/ *vs*. /d, t/: p = 0.709; /d, t/ *vs*. /g, k/: p = 0.001; /b, p/ *vs*. /g, k/: p = 0.002).

3.2.3. Across a word boundary

3.2.3.1. Across an adjective and a noun

Across an adjective and a noun, the rates of nasalization of the voiced /b, d, g/ in items 7 to 9 were 84, 137, 48% respectively, totalling 269%, and those of the voiceless /p, t, k/ in items 10 to 12 were 64, 112, 54%, totalling 230%. In spite of the no small difference in the total rates, a two-way RM ANOVA with Voicing and Place as factors reveals that the factor Voicing had no significant effect on the nasalization [F (1, 29) = 3.126, p = 0.088]. On the other hand, more nasalization occurred in the order of /d/>/b/>/g/ and /t/>/p/>/k/ respectively. That is, the alveolar stops /d, t/ nasalized the most (the average nasalization point: 1.24), the bilabial stops /b, p/ the second most (0.74), and the velar stops /g, k/ the least (0.51). The two-way RM ANOVA proves that the factor Place had a significant effect [F (2, 58) = 28.660, p = 0.000]. The results of post-hoc comparisons are as follows: /b, p/ *vs*. /d, t/: p = 0.000; /d, t/ *vs*. /g, k/: p = 0.000; /b, p/ *vs*. /g, k/: p = 0.053.

In item 25 (i.e., *what number*), another sequence of an adjective and a noun, the alveolar /t/ of *what* produced 123% of nasalization rate, which is fairly high. Here it should be reminded that the final consonant /t/ of *what* is an alveolar that nasalizes the most.

3.2.3.2. Across a subject and a verb (S+V) 1

Compared to the other items, noticeably small nasalization rates were observed across a subject and a verb (i.e., items 13 to 24, see Figure 3). Out of them, items 13 to 18 are one-syllabic words that are liable to be pronounced one-syllabic by Korean speakers also**.** Items 13 to 15 (*cab, god, bag*) showed 51, 31, 14% of nasalization rates respectively, totalling 96% whereas items 16 to 18 (*cap, cat, cook*) recorded 31, 22, 27%, totalling 80%.

A plausible reason for the markedly less nasalization in the structure of S+V than in the other structures is the speakers' unconscious efforts to distinguish the subject part and the verb part. In other words, a relatively longer psychological distance seems to exist between the subject noun phrase (SNP) and the following verb phrase (VP) than in the other syntactic relationships, which could cause the less frequency of stop nasalization.

In order to verify the effect of the factor Structure on the nasalization, a three-way RM ANOVA with Structure, Voicing and Place as factors was performed for items 7 to 12 with the structure of (Adj+N) and items 13 to 18 with the structure of (SNP+VP). The results revealed that the factors Structure [F (1, 29) = 22.561, p = 0.000] and Place [F (2, 58) = 18.395, p = 0.000] had a significant effect on the nasalization while the factor Voicing [F (1, 29) = 3.126, p = 0.052] narrowly missed the significance level ($p < 0.05$).

On the other hand, item 35 (*god*), another sequence of a subject and a verb, recorded 64% of nasalization rate. It is more than two times than that of item 14 with the same word *god* (31%). Different environments might produce different results of nasalization for the stop /d/ in the same word *god*. However, it should be noted that the rate (64%) in item 35 is still far lower than 137% of *good* in item 8 with the structure of an adjective + a noun.

3.2.3.3. Across a subject and a verb (S+V) 2

Items 19, 20 & 21 (i.e., *ebb, bad, egg*) are one-syllabic words that are liable to be pronounced two-syllabic by Korean speakers. They recorded 33, 13, and 4% of nasalization rates respectively, which are overall low compared to those of items 13, 14, 15 (see Figure 3). This can be attributed partly to Koreans' speaking habit to add the Korean vowel /ɨ/ after the final stops, which blocks the stop nasalization. Especially, the least nasalized word *egg* is very often pronounced as [egɨ], not [eg].

3.2.3.4. Across a subject and a verb (S+V) 3

Items 22, 23, 24 (*pipe, bite, bike*) with the diphthong /aɪ/ revealed very low nasalization rates (i.e., 11, 7, 4%). As mentioned earlier, Korean speakers tend to perceive English diphthongs as a succession of two monophthongs. In addition, they often add the Korean vowel /ɨ/ to the final stops. Therefore, English words like *pipe, bite, bike* are regarded as three-syllabic, e.g., *pipe* [pa-i-pɨ]. Interestingly, both advanced and elementary speakers of English are thought to have contributed to the low nasalization rates because of the opposite reasons: one group is free from the Korean phonology while the other is not.

A three-way RM ANOVA with Syllable, Voicing and Place was run for the items 13 to 24 (i.e., items 13 to 18 pronounced one-syllabic *vs.* items 19 to 24 often pronounced with the vowel /ɨ/ after the final stops) to verify especially if the addition of the Korean vowel /ɨ/ after the final stops significantly works against the nasalization. The results indicate that all the three factors had a significant effect on the nasalization: Syllable [$F(1, 29) = 8.305$, $p = 0.007$]; Voicing: [$F(1, 29) = 10.222$, $p = 0.003$]; Place [$F(2, 58) = 10.194$, $p = 0.000$]. Hence, the Korean syllabification (i.e., the addition of the vowel /ɨ/) proves to significantly deter the English stop nasalization. Also, it is noted that unlike the above observation, the bilabials nasalized the most, the alveolars the next, and the velars the least: /b, p/ *vs.* /d, t/: $p = 0.020$; /d, t/ *vs.* /g, k/: $p = 0.097$; /b, p/ *vs.* /g, k/: $p = 0.004$ by post-hoc comparisons (see Figure 3).

3.2.3.5. Across a verb and an adverb

Items 26 (*gab merrily*) to 29 (*Get up now*) have the sequence of an intransitive verb and an adverb. They revealed 87, 29, 60, 111% of nasalization rates respectively and the rates are generally higher than those obtained across a subject and a verb. Speakers seem to regard the sequence of an intransitive verb and an adverb as a closer grammatical unit (VP: Verb Phrase) than that of a Subject and a Verb (SV).

3.2.3.6. Across a preposition and a noun

Item 30, *at noon*, is the only prepositional phrase of our stimuli and its nasalization rate is 68%, which is relatively high. This may come from the close relationship (PP) between the preposition *at* and the noun *noon*. In addition, the final stop /t/ is an alveolar.

3.2.3.7. Across a transitive verb and an object

Items 31 to 34, which have the structure of a transitive verb and an object, also showed relatively high rates (i.e., 76, 133, 61%) except item 31 (7%). This may be because a transitive verb and an object form a close grammatical unit, VP. The reason for the very low rate of item 31 will be that the stop /g/ is a velar and Koreans normally speak the word *gag* as two-syllabic [gægɨ], adding the Korean vowel /ɨ/ to the final stop /g/.

3.2.3.8. Across a demonstrative pronoun and a modal verb

Items 36 and 37 (i.e., *It may*, *That might*) consist of a demonstrative pronoun and a modal verb. As seen in Figure 3, the two items show relatively high nasalization rates (i.e., 107% and 102%). Though they have the structure of a subject and a verb, *it* and *that* are demonstrative pronouns and the verbs are modal verbs. It is likely that modal verbs are pronounced as a closer unit with the subject than non-modal verbs. Besides, Korean speakers tend to put a weaker stress on the subject *it* or *that* than English speakers do, which could contribute to the high rates. As well, the final stop /t/ in *it* or *that* is an alveolar. Interestingly, English speakers also showed relatively high nasalization rates in items 36 and 37, even though very low compared to those of Korean speakers (Cf. Figures 2 & 3).

3.3. Comparison between Korean speakers

Nasalization widely varied between speakers. That is, out of the thirty Korean speakers, four made no nasalization (0 point) while one yielded almost complete nasalization (195 points) (see Figure 5). Considering that the Korean informants are college students who are relatively fluent in English, other Korean speakers who are not fluent would produce a higher degree of nasalization.

Seven subjects (Speakers 1 to 7) who yielded less than 10 nasalization points were analyzed with regard to their special experiences exposed to English such as staying in English speaking countries (Cf. Figure 5 and Table 1). Out of them, five had stayed abroad from 10 months to 18 years, but the other

two had no such experiences at all. The analysis of another seven informants (Speakers 8 to 14) who received less than 50 points also showed that four out of them had no experiences like living abroad or attending an international school, etc. These results indicate that English speaking environment is not the absolute condition for a good English pronunciation though it must help. What is more important will be how to teach and practice to achieve the native level of pronunciation.

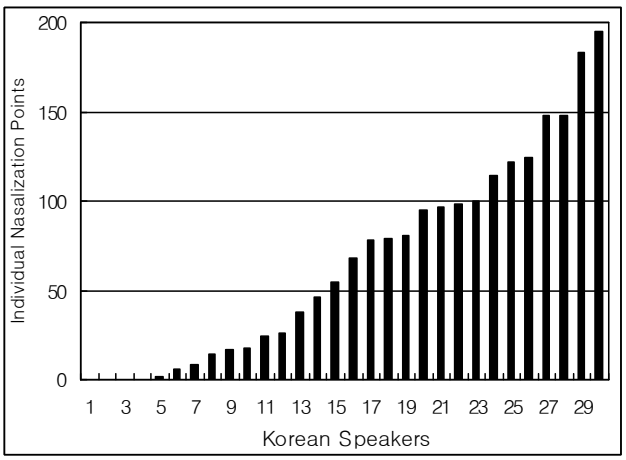

Figure 5. Individual nasalization points of Korean speakers for all the items (from the least nasalizing speaker to the most nasalizing speaker; This figure demonstrates not the percentage but the points themselves, i.e., the height of the bars can range from the lowest 0 point to the highest 222 points (37 items × 3 times × 2 points))

3.4. Comparison of English and Korean speakers

Overall, English native speakers hardly nasalized the English stops, while Korean speakers revealed from no nasalization to almost complete nasalization. Although some English speakers like Speaker 9 (the nasalization points: 42, see Figure 4) may sometimes nasalize the stops, the high frequency of nasalization as in many Korean speakers is not likely to be general for English speakers. A Chi-squared test confirmed that the two speaking groups significantly differ in the nasalization ($p < 0.001$).

One more possible reason for the significant differences between English and Korean speakers may be the different stress (accent) or rhythm effects of the two languages. As is well known, stressed and unstressed syllables phonetically clearly differ in English. For example, the first stressed syllable *good* of *goodness* is relatively high in pitch, long in length, and strong in intensity, while the second unstressed syllable *-ness* is spoken relatively low, short and weak. Therefore, the effect of the following /n/ would be small or negligible on the preceding /d/. The two syllables may be even heard as two separate words to Koreans. By contrast, stress or accent does not significantly affect especially syllable duration in Korean speech (Yun, 2008). This tendency can be reflected in their English speech as well; so, *good* of *goodness* may not be said long, high and strong enough while the following *-ness* may not be spoken short, low and weak enough as in native English speech. It may contribute to the much higher frequency of the stop nasalization for Korean speakers. In sum, the markedly different frequencies of stop nasalization may be partly due to the different effects of stress (accent) or rhythm between the two languages.

4. Summary and conclusion

This study informs us of the phonetic and phonological meanings the English stop nasalization has for English and Korean speakers. To summarise, English speakers rarely nasalize the English stops before a nasal sound while Korean speakers generally greatly nasalize them though widely varying from no nasalization to almost complete nasalization. Even though different data (items) could yield somewhat different results, voiced stops are, in general, more likely to be nasalized than their voiceless cognates. Also, the alveolar stops /d, t/ tend to be nasalized the most, the bilabial stops /b, p/ the second most, and the velar stops /g, k/ the least. These tendencies seem to commonly apply to both English and Korean speakers, considering Gimson (1989, p. 258)'s descriptions and our data. Besides, the closer the grammatical relationship between neighboring words, the more likely the stop nasalization occurs. In contrast, the Korean syllabification, especially the addition of the vowel /ɨ/ to the final stops, e.g., *gag* [gægɨ], works against the stop nasalization. On the other hand, different stress (accent) or rhythm effects in the two languages are assumed to contribute to the significant differences in the nasalization between English and Korean speakers.

The results of this study can help Koreans to improve their English pronunciation with reference to the stop nasalization. In reality, many Korean students do not have opportunities to properly correct their poor English pronunciations. They often finish their school education even without knowing what the problems are in their English pronunciation. Therefore, regarding the stop nasalization at least, the results of this research suggest a kind of standard to follow for both Korean teachers and students. In other words, we have now obtained a spectrum or a

continuum concerning the frequency or degree of stop nasalization. By means of the ruler, we will be able to measure how close or similar the English stop nasalization of a certain Korean speaker is to that of native English speakers.

Based on Figure 5, we established six levels of the English stop nasalization: (1) the high-advanced level: a score lower than 10; (2) the advanced level: a score between 10 and 50; (3) the high-intermediate level: a score between 50 and 100; (4) the low-intermediate level: a score between 100 and 125; (5) the high-elementary level: a score between 125 and 150; (6) the low-elementary level: a higher score than 150. Now, students, who get their scores through reading our stimuli, could judge the level of their English stop nasalization, and the level of English native speakers will be the target that they should arrive at to overcome the L1 interference.

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