



The Relationship between the Perception and Production of English Nasal Codas by Brazilian Learners of English

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Abstract

This study aims at investigating the perception and production of the English nasals /m/ and /n/ in syllable-final position by 20 Brazilian EFL learners and 3 native speakers of American English. Perception was assessed by means of both a discrimination and an identification test. Production data was collected by means of a Sentence Reading Test. The results from the perception tests revealed that the Brazilian learners and the native speakers seemed to have difficulties in distinguishing between the coda nasals, although to different degrees. Interestingly, the context of the preceding vowel influenced the perception of both natives and non-natives. The production results show that the participants had difficulty to produce the coda nasals. Concerning the relationship between perception and production, a positive correlation was found between the results of the Brazilian learners in the two perception tests and in the production test.

Index Terms: nasal perception, nasal production, English

1. Introduction

The interrelationship between perception and production has been discussed in the second/foreign (L2) language phonetics and phonology literature and some studies show that perception plays a very important role in the production of second language sounds [1-4]. Flege posits that L2 sounds may be perceived in terms of those of the L1 by the learner, making this perception different from that of a native speaker [5]. For instance, sounds that are separate phonemes in an L2 might be merely allophones of the same phoneme in the native language (L1). Flege claims that this may influence the production of L2 sounds by a native speaker of this L1 because of the identical mental representation that the speaker has for the two sounds.

Flege's Speech Learning Model (SLM) posits that the perceived relationship between L1 and L2 categories plays an important role in accurately perceiving or producing L2 sounds [6]. The model hypothesizes that L1 and L2 sounds are "related perceptually to one another at a position-sensitive allophonic level" and acquisition of L2 sounds depends on the perceived dissimilarity between L1 and L2 sounds. According to Flege, the accuracy with which sounds are perceived suggests how accurate they will be produced, although sometimes production does not reach the same level of accuracy of perception [3], [6].

In order to understand the difficulties Brazilian learners have with English coda nasals, phonological differences of both languages have to be considered. According to [7], typically, nasal consonants have a place distinction between /m/ and /n/, as in English. However, many languages have no place distinction for those nasal consonants in the coda, as Brazilian Portuguese (BP), for instance.

According to [8], nasal vowels in BP consist of the combination of an oral vowel and the archiphoneme /N/, which nasalizes the preceding vowel and is reduced to a nasal element as in *lindo* [ˈlĩːndu] –'beautiful'. Mateus and d'Andrade say that at the underlying level there are no nasal vowels in BP; instead they are treated as sequences of an oral vowel plus a nasal segment [9]. For the purpose of the present study, it will be assumed that, phonetically, nasal consonants are not fully pronounced after a vowel in the coda in BP or not even pronounced [8, 9].

As regards production, a study carried out by [10] investigated the process of regressive assimilation of nasality and nasal deletion in coda position by BP speakers of English. According to [10], the results show that native Brazilian speakers transferred the process of regressive assimilation of nasality and nasal deletion in the coda position into their interlanguage English. Monahan points out that a vowel followed by a nasal consonant in the English coda regressively assimilates its nasality, as occurs in BP. He states that the difference lies in the fact that in English the nasal consonant following the nasalized vowel is articulated, whereas in BP the nasal consonant is deleted [10].

Baptista and Silva Filho investigated the influence of markedness and syllable contact on the production of English final consonants, including nasals, by Brazilian learners [11]. The results for the nasal consonants show the same results found by [10]. As reviewed above, research on the production of nasal consonants in syllable-final position by Brazilian EFL learners has been carried out [10, 11], but there is no investigation concerned with perception and its relationship to production. Therefore, in order to investigate the perception and the production of the nasal Brazilian EFL learners, the main objectives of this study are the following: (i) to investigate the common deviations from English used by the participants to produce the English coda nasals; (ii) to investigate whether the phonological context influences the perception of English coda nasals, considering the previous vowel as a variable; and (iii) to investigate whether there is a correlation between the perception and the production of the English syllable-final nasals by the participants.

2. Method

2.1. Participants

Twenty participants were tested (13 women and 7 men), ranging in age from 16 to 44 years. All participants were considered pre-intermediate learners of English regularly attending an Extracurricular Language Program. In order to ensure the participants' proficiency level, one-minute free speech about a specific topic was recorded by 29 students. Three English speakers (one native with phonetic training and two non-natives with phonetic training, one of them being the researcher) rated the pronunciation of the participants from non-native-like to close to native-like on a 1-5 scale, 1 being

non-native like and 5 close to native-like. Nine participants who were rated 1 or 5 were excluded in order to avoid having participants from extreme levels of proficiency, either too low or too high. According to the participants' report, none of them had been to any English speaking country. As a control group, three native speakers of American English took both perception tests: two women and one man, ranging in age from 21 to 40 years. All native speakers were living in Brazil at the time of data collection: one had been living in Brazil for three months and the other two for about two years.

2.2. Experiment 1: Production

2.2.1. Material

The production data-gathering instrument (Sentence Reading test) consisted of a list of 144 sentences containing either a monosyllabic and disyllabic word with one of the nasals /m/ or /n/ in syllable-final position. In order to avoid a spelling effect, none of the target nasals in the coda were followed by "e" due to the fact that they may cause vowel paragoge, rather than vowel nasalization and nasal consonant deletion when produced by Brazilian learners. The sentences in the test were randomized for presentation so that each participant received a different order, thus minimizing ordering effects.

2.2.2. Procedure

The participants were asked to read the sentences and were recorded in a quiet room of the language laboratory of the Federal University of Santa Catarina, with a Sony MZ-NHF800 minidisk recorder and a Sony ECM-MS907 directional microphone. The focus of the data analysis was on the production or not of the nasal consonants /m/ and /n/ in the coda. The relevant parts of each sentence were first transcribed by the researcher twice, within an interval of two weeks. Then the relevant parts were also transcribed by a second listener with experience in phonetic transcription. The original percentage of disagreement was 1.84%, that is, 53 items. Both transcribers listened together to all the sentences that they had disagreed on, and most discrepancies were resolved. Only 7 items (0.24%) were eliminated because of listener discrepancies. Sentences which participants misread or skipped were also excluded: a total of 7 (0.24%). Therefore, out of the 2,880 sentences read by the participants, 2,866 (99.51%) were analyzed.

2.3 Experiment 2: Perception

Perception was assessed by means of a (1) Categorial Discrimination Test (CDT) based on [12], and a (2) Native-like vs. Non-native-like Identification Test (IT). As regards phonological context, both perception tests considered the following previous vowel as a variable: /ɪ, æ, ɔʊ, eɪ, ʌ/.

2.3.1. CDT's stimuli

The CDT consisted of 72 trials of three monosyllabic words. The target words were five minimal pairs contrasting /m/ and /n/ in syllable-final position with a different previous vowel (Tim-tin; cam-can; came-cane; bum-bun; tome-tone). Three types of trials were designed: (i) "different" or "change" trial which contained an odd item (e.g., Tim-Tim-tin); (ii) "catch" trial where all the items were the same (e.g., Tim-Tim-Tim);

and (3) "distractor" trial, where the distinction involved a non-target contrast to disguise the purpose of the test (e.g., hat-hat-rat). Only the different and catch trials were analyzed. The audio-stimuli were recorded by three American native speakers of English (one woman and two men). The words were recorded in Sound Forge 7.0 and normalized for peak intensity. The words were sequenced in Praat. The inter-trial interval was set at 2.8 s and the inter-stimulus interval at 1.3 s, following [12]. The trials were randomized to minimize any ordering effect. Each trial consisted of three items (e.g., Tim-Tim-tin), and each item was spoken by a different native speaker.

2.3.2 CDT's procedure

The participants received an answer sheet and had to indicate the odd item in each trial by circling "1", "2", "3", or they circled "0" if they heard no difference. A familiarization test of 12 trials was also designed. All the participants were tested in the language laboratory of the Federal University of Santa Catarina.

2.3.3. Identification test's stimuli

The native-like vs. non-native-like identification test (IT) consisted of 68 trials of two pronunciations of the same monosyllabic word with either /m/ or /n/ in syllable-final position with five different previous vowels: Tim-tin, cam-can, loam-loan, maim-main, bum-bun. Three types of trials were designed: (i) a "different" trial (e.g., /tɪm/-/tĩ/) that contained two different pronunciations of the same word (one native-like pronunciation and one non-native-like English pronunciation, the latter was recorded with the BP nasalization of the vowel and deletion of the consonant), (ii) a "catch" trial (e.g., /tɪm/-/tɪm/ or /tĩ/-/tĩ/) where there was no contrast (either two native-like pronunciations or two non-native-like pronunciations); and (iii) a "distractor" trial, where the distinction involved a non-target contrast (e.g., /bɔɪ/-/bɔʊ/). Only the different and catch trials were analyzed. The audio-stimuli were recorded by two speakers: one native speaker of American English who was proficient in BP, and one native speaker of BP who was proficient in English. Both speakers had phonetic training and were asked to control their pronunciation so that the nasal was the only difference in the pronunciation of the target words. The words were recorded in Sound Forge 7.0 and normalized for peak intensity. The words were sequenced in the Praat. The inter-trial interval was set at 2.8 s and the inter-stimulus interval was set at 1.3 s, following [12]. The order of the trials was randomized to minimize any ordering effect. Each trial consisted of two items (e.g., /tɪm/- /tĩ/), and each of these was spoken by a different speaker.

2.3.4. Identification test's procedures

The participants had to indicate which pronunciation sounded more native-like in each trial by circling "1", or "2"; "both" if they considered both pronunciations native-like; or "neither" if they considered neither pronunciation native-like. The participants received an answer grid for the test section with the written word in order to know which word was being pronounced. A familiarization test of eight trials was also designed, but with other difficult pronunciation items instead of the nasals. All the participants were tested in the language laboratory of the Federal University of Santa Catarina.

3. Results and discussion

3.1. Experiment 1: Production

As regards production, the results revealed considerable variability among the participants' individual scores, ranging from 44.44% to 72.92% of accurate production of the target nasals. Table 1 shows the strategies used by the Brazilian participants when they did not accurately produce the English coda nasals (1108 out of 2866 cases). The results show that in most of the inaccurate productions (91.96%), the participants nasalized the vowel and did not produce the nasal consonant as a strategy to produce the English coda nasals. These results corroborate those of [10, 11], who found that BP learners transfer the process of regressive assimilation of nasality and nasal deletion in syllable-final position into their production of English coda nasals.

Table 1. *Strategies used by Brazilian learners on the inaccurate production of English coda nasals.*

Strategy	No. Productions	% Productions
Deletion of the nasal consonant with vowel nasalization	1009	91.96
Deletion of the nasal consonant without vowel nasalization	97	8.75
Epenthesis	2	0.18
Total of inaccurate nasal production	1108	100

3.2. Experiment 1: Perception

The results showed that less than half of the CDT trials and the IT trials were correctly perceived overall by the Brazilian group. The individual scores of the Brazilian participants reveal a large degree of variability, ranging from 25% to 70% in the CDT, and from 30% to 62.5% in the IT. In Table 2, the results from the two perception tests reveal that native and non-native participants obtained rather low scores in the context of nearly the same previous vowels in both perception tests, although to different degrees.

Table 2. *Previous vowel and correct perception of the coda nasal in both perception tests.*

Prev. vow.	CDT		Identification Test	
	Native Group	Brazilian Group	Native Group	Brazilian Group
/ɪ/	70.83%	31.25%	95.83%	50.00%
/æ/	95.83%	49.37%	54.17%	49.37%
/ou/	87.50%	42.50%	87.50%	40.00%
/ʌ/	100.00%	55.00%	91.67%	58.75%
/eɪ/	37.50%	41.97%	50.00%	30.62%

The previous vowels which most disfavored the accurate perception of the English coda nasals by the Brazilian learners were /ɪ/ in the CDT, and /eɪ/ in the IT. In fact, these vowels also influenced the accurate response of the native speakers, since the previous vowel /eɪ/ most disfavored

perception in both perception tests, and /ɪ/ also yielded difficulty in the CDT. The fact that both native and non-native participants obtained rather low scores in the context of the same previous high vowels provides evidence that this variable influences the perceptual performance of the nasals /m/ and /n/ in syllable-final position. The results of the comparison between the two perception tests by the Brazilian participants also reveal that the target nasals were more accurately perceived when the previous vowel was /ʌ/: 55% in the CDT, and 58.75% of the cases in the Identification Test. Table 2 also shows that the previous vowel /æ/ yielded the same difficulty in both perception tests (49.37% of accurate responses). Therefore, results indicate that the high vowels seemed to disfavor the accurate discrimination of the coda nasals by the Brazilian learners and the native speakers, corroborating the results of [13]; while the low vowels seemed to favor the accurate discrimination of the target nasals, as suggested by [13, 14]. However, discussing why certain vowels affect nasal identification/discrimination by both native and no-native groups, as regards formant patterns, duration and amplitude, is beyond the scope of this study.

3.3. Relationship between perception and production

The results show that all participants had a better performance in the production test. Regarding the perception tests, the participants, in general, obtained higher scores in the Identification Test than in the CDT (15 out of 20). Only 5 participants performed better in the CDT than in the IT. The results also show that, in general, the percentage of accurate responses of the participants gradually increased from the CDT to the IT to the production test (15 out of 20). The overall results of the Brazilian group in the CDT and the production test support the existence of a significant positive correlation between their perception and production ($r = .6974$, $p < .0001$). The overall results of the Brazilian group in the IT and the production test also support the existence of a significant positive correlation between perception and production ($r = .3946$, $p < .05$). It might be expected that for accurate production, the learner would need accurate perception, which was the case in the present study, considering the two perception tests. The results indicate that there is some relationship between the identification/discrimination of the target coda nasals and their accurate production. However, the tendency of the present study is for production to be more accurate than perception. These results do not corroborate Flege's SLM [6].

4. Conclusion

As regards the production results, this study revealed considerable variability of the accurate production of the target nasal consonants. The findings showed that there was considerable influence of the lack of fully realized coda nasals in BP in the production of the English coda nasals by the Brazilian learners. As regards perception, this study provided evidence that the lack of fully realized coda nasals in BP was associated with inaccurate perception by the Brazilian learners in both perception tests, as the participants failed to accurately perceive the English coda nasals in less than half of the trials. The native speakers who took both perception tests also had some difficulty in accurately

perceiving the coda nasals, although to a much lesser degree. Considering phonological context, the results revealed that both the Brazilian learners and the native speakers have difficulty in accurately perceiving the coda nasals in the context of /ɪ/ and /eɪ/ in both perception tests. Finally, the study also showed that there was a positive correlation between perception and production: the better the production results, the better the perception of the target phonemes.

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6. References

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