

## Perception of Brazilian Portuguese Nasal Vowels by Danish Listeners

Denise Cristina Kluge  
Federal University of Rio de Janeiro (UFRJ)

### Abstract

The word-final nasals /m/ and /n/ have different patterns of phonetic realizations across languages, whereas they are distinctively pronounced in English and Danish, in Brazilian Portuguese (BP) they are not fully realized and the preceding vowel is nasalized. Bearing in mind this difference, the main objective of this study was to investigate the perception of BP nasal vowels by Danish learners of BP. Two discrimination and two identification tests were used and taken by two groups composed of ten Danish learners of English, as a reference for comparison, and ten Danish learners of BP. General results showed both groups had similar difficulties in both discrimination tests. It was less difficult for the Danish learners of BP to identify the BP native-like pronunciation when presented in contrast to a non-native-like pronunciation.

### 1. Introduction

Many studies concerning the perception of second language (L2) sounds have discussed the influence of the native language (L1) on accurate perception of the L2 (Flege, 1993, 1995; Wode, 1995; Best, 1995; Kuhl & Iverson, 1995). Moreover, some L2 speech models have discussed the role of accurate perception on accurate production (Flege, 1995; Best, 1995; Escudero, 2005; Best & Tyler, 2007). According to some studies (Schmidt, 1996; Harnsberger, 2001; Best, McRoberts & Goodell, 2001; Best & Tyler, 2007), it is usually believed that, at least in initial stages of L2 learning, adults are language-specific perceivers and that they perceive L2 segments through the filter of their L1 sound system.

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As posited by Flege (1981), 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. For example, sounds that are separate phonemes in an L2 might be merely allophones of the same phoneme in the L1. Furthermore, Flege states that this may influence the production of L2 sounds by a native speaker of this L1 because of the identical mental representation that this speaker has for the two sounds. Flege (1995) also posits in his Speech Learning Model that the perceived relationship between L1 and L2 categories plays an important role in correctly perceiving or producing L2 sounds. According to one of the hypotheses of this model, 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 (Flege, 1995, p.239).

Kuhl (1993) proposes the Native Language Magnet model of speech perception and language development, which works with the concept of L1 phonetic prototypes, or the best exemplars of certain phonetic categories. These prototypes would act as perceptual magnets that pull the surrounding L2 sounds toward the same perceptual phonetic space occupied by the L1 prototype. She states that the nearer the L2 sounds are to the L1 prototype, the more difficult it becomes for the L2 speakers to discriminate L1 and L2 speech sounds.

Bearing in mind the perspective of both perception models, this article aims at investigating the perception of Brazilian Portuguese (BP) syllable-final nasal vowels by Danish learners of Brazilian Portuguese as a foreign language. In order to understand the difficulties Danish learners may face in BP with nasal vowels in word-final position, phonological differences between languages have to be considered regarding nasal vowels and nasal consonants in syllable final position. According to Fujimura and Erickson (1997), typically, nasal consonants have a place distinction between /m/ and /n/ as in English and in Danish (Ocke Bohn, 2013, personal communication). However, some languages have no place distinction for nasal consonants in syllable-final position, as Brazilian Portuguese, for instance. In BP, the nasal consonants /m/ and /n/ are not fully realized after a vowel in syllable-final position and sometimes not realized at all, and the preceding vowel is nasalized.

According to the literature, the degree of vowel nasalization differs between languages, from subtle as in English (Giegerich, 1992; Hammond,

1999; Ladefoged, 2006) to strong as in BP (Oliveira & Cristófaros-Silva 2005). It is important to state that although vowel nasalization can occur in languages such as English and Danish, for instance, nasalization of the vowel is not used to distinguish meaning in English (Ladefoged, 2005), thus vowel nasalization is not a distinctive feature. In BP, nasalization is quite an issue and has motivated different explanations and theories, but, in general and for the purpose of this study, it is assumed that: (a) phonetically, the nasal consonants /m/ and /n/ are not fully realized after a vowel in word-final position and sometimes not realized at all; and (b) the vowel assimilates nasalization from the following nasal consonant (Cristófaros Silva, 1999; Mateus; D'andrade, 2000; Câmara Jr., 1971; Kluge et al., 2009; Kluge, 2010). The differences regarding the pronunciation of word-final nasals /m/ and /n/ in Danish, English and in Brazilian Portuguese are extremely relevant to understand the difficulties that Danish learners of BP may have in the accurate discrimination/identification of BP syllable-final vowel nasals.

## **2. Method and procedures**

The data collection occurred from February 19th to March 07th, 2013 at Aarhus University. Two discrimination tests (same or different and AXB) and two identification tests (native vs. nonnative pronunciation and oral vs. nasal vowels) as well as a questionnaire for assessing biographical information about the participants, and a word recognition test were designed for this study and administered to 20 Danish listeners divided into two groups: (1) ten Danish learners of BP; and (2) ten Danish learners of English, as a reference for comparison.

The group of Danish learners of BP consisted of 10 undergraduate student from the Bachelor's degree program in Brazilian Studies at Aarhus University at the time of data collection: 2 men and 8 women, ages ranging from 20 to 29 (mean 23,2). Nine participants reported Danish as L1 and one participant reported Danish and Finish as L1. As regards foreign language, they all mentioned English as a L2. They all reported having no hearing problems. The questionnaire that assessed the participants' profile considering BP learning showed that (a) 8 participants started learning Portuguese after 20 years old (from 20 to 29); (b) 2 participants reported having contact to Portuguese since childhood but not regular/formal learning; (c) 7 participants have studied Portuguese for 6 to 8 months by the

time of data collection; and (d) 3 participants have studied Portuguese for 2,5 to 3 years by the time of data collection. Regarding their experience in Portuguese speaking countries, 3 participants said they had lived in Brazil for 1 to 6 months about 1 year before data collection and 1 participant had lived to Portugal for one month 2 years before data collection. The questionnaire showed the participants BP usage regarding hours speaking and listening to Portuguese per day in terms of percentage which varied from 10 to 40 per cent.

The group of Danish learners of English consisted of 10 undergraduate student from the Bachelor's degree program in English at Aarhus University at the time of data collection: 6 men and 4 women, ages ranging from 20 to 27 (mean 24,4). All participants reported Danish as L1 and one participant reported German as a L2 besides English. They all reported having no hearing problems. The questionnaire that assessed the participants' profile regarding English learning showed that (a) 1 participant started learning English at the age of 5; (b) 1 participant started learning English at the age of 8, (c) 5 participants started learning English at the age of 10, and (d) 3 participants started learning English at the age of 11-12. Two participants also reported they had lived in English speaking country for 6 -10 months about 5 years before data collection. The questionnaire also showed the participants reported spending from 10 to 80 percent of the day either listening to or speaking English.

The stimuli of the four perception tests were recorded in a phonetic lab at a university in Brazil by three female native speakers of BP ages ranging from 23 to 50 years old (mean 36) with no knowledge of Danish. All of them were advanced speakers of English and were phonetically trained to pronounce the target words with and without vowel nasalization, whenever necessary.

The stimuli of same or different discrimination test consisted of 5 two-syllable words: *sabão* – 'soap', *porém* – 'however', *assim* – 'so', *batom* – 'lipstick', *atum* – 'tuna'. Each word was recorded in two different conditions: with and without vowel nasalization. That is, in the word *sabão* – 'soap', for example, the word-final vowel was recorded as a nasal vowel as well as an oral vowel by the three talkers. In each trial, the participants heard two realizations of the same word and had to indicate if the words were the same or different regarding the final sound. Each word was spoken by a different talker within a trial. Each word appeared in 4 trials varying in position of appearance (first or second position) and contrasting vowel

nasalization or not (same or different). The test consisted of 40 trials (4 trials x 5 words x 2 repetitions).

The stimuli of AXB discrimination test consisted of 5 monosyllabic words: *não* – ‘no’, *bem* – ‘well’, *sim* – ‘yes’, *bom* – ‘good’, *pum* – ‘fart’. Each word was recorded in two different conditions: with and without vowel nasalization, like the other discrimination test previously described. In each trial, the participants heard three realizations of the same word produced by three different talkers and had to indicate which final sounds of the words they heard as the same by clicking in one of the three options: “first 2 words”, “last 2 words”, “three words”. In order to investigate whether the participants would perceive any difference regarding the three pronunciations of the target word in the trial, a third answer option was included. Each word appeared in 6 trials varying in position of appearance (first, second or third position) and contrasting oral and nasalized vowels or not. The test consisted of 30 trials (6 trials x 5 words).

The first identification test was a native vs. nonnative judgment test with 5 monosyllabic words *não* – ‘no’, *sem* – ‘without’, *fim* – ‘end’, *com* – ‘with’, *um* – ‘one’. As with the other tests, each word was recorded in two different conditions: with and without vowel nasalization. In each trial, the participants heard two realizations of the same word and had to indicate which pronunciation sounds more BP native-like by circling “1” (if it was the first they heard), “2” (if it was the second they heard); “both” (native-like pronunciations); or “neither” (native-like pronunciation). For this test, the stimuli were from two out of the three female talkers. Therefore, within the trial, each pronunciation of the target word was spoken by one of the talkers. Each word appeared in 4 trials varying in position of appearance (first or second position) and contrasting oral and nasalized vowels or not. The test consisted of 40 trials (4 trials x 5 words x 2 repetitions).

The second identification test contrasting oral and nasal vowels consisted of 3 pairs of syllables contrasting oral and nasal vowels *sá-sã*; *fá-fã*; *lá-lã*. The participants heard one realization of a syllable and had to indicate the vowel they heard: oral or nasal. The response alternatives were: *á* (oral vowel) and *ã* (nasal vowel). Each target syllable was pronounced by the three female talkers. The test consisted of 36 trials (6 syllables x 6 repetitions).

All the perception tests were designed and administrated using TP a free software to design perception test (Rauber et al, 2012). For all the four tests, the participants were only allowed to listen to each trial once before clicking on their answer. In order to avoid order effect, the stimuli were randomized for each participant for each test. The data was collected individually on a laptop computer by the researcher. It took from 20 to 22 minutes for the Danish learners of BP and from 10-12 minutes for the Danish learners of English. Instructions were given in English to both groups. Before starting each test, the participants did a familiarization test, that is, a short practice test before each of the four tests in order to get familiar to the task itself and clear any possible doubt they might have.

The order of data collection was: (1) Questionnaire; (2) Instructions and familiarization test; (3) Discrimination test: same or different; (4) Instructions and familiarization test; (5) Discrimination test: AXB; (6) Instructions and familiarization test; (7) Identification test: N vs. NN-like pronunciation; (8) Instructions and familiarization test; (9) Identification test: oral vs. nasal vowel; (10) Familiarity with the corpus. The Danish learners of English only did the discrimination tests (steps 1-5).

The statistical analysis was based on correct responses for each perception test as follows: (a) Same or Different Test: 40 trials x 10 participants= 400 responses for each group.; (b) AXB test: 30 trials x 10 participants= 300 responses for each group; (c) Native-like vs. Nonnative-like test: 40 trials x 10 participants= 400 responses for the Danish learners of BP; and (d) Oral vs. Nasal vowel test: 36 trials x 10 participants= 360 responses for the Danish learners of BP. Statistical significance (alpha level) was set at .05, and due to the limited number of participants and non-consistency between the results of skewness and kurtosis, the entire data were considered not normally distributed. Thus, non-parametric tests were used: Mann-Whitney (Inter groups) and Wilcoxon (Intra groups) using SPSS version 18.0. In this study, only significant results of the statistical tests are reported.

### **3. Results**

With regard to the first discrimination test, Same or Different test, contrasting the realization of the nasal and the oral vowels, Table 1 shows the correct responses in percentages for both groups of Danish: learners of BP and English.

	Danish Learners of BP			Danish Learner of English		
	Same	Different	Total	Same	Different	Total
P1	90	90	90	65	95	80
P2	70	60	65	70	85	77.5
P3	60	75	67.5	100	25	62.5
P4	85	60	72.5	70	85	77.5
P5	75	90	82.5	75	100	87.5
P6	65	55	60	100	70	85
P7	95	75	85	85	75	80
P8	25	100	62.5	85	60	72.5
P9	95	100	97.5	85	80	82.5
P10	60	95	77.5	80	80	80
Total	72	80	76	81.5	82.5	82
<i>SD</i>	21	17	12	12	21	7

**Note:** *SD*= Standard Deviation

Table 1. Responses of the Same or Different Discrimination Test in percentage (%).

Table 1 shows that accurate responses ranged from 25 to 95% for the same realizations of the same word for the English learners and from 65 to 100% to BP learners. As for the different realizations it ranged from 60 to 100% for the English learners and from 25 to 100% to the BP learners. Regarding intra group analysis, Wilcoxon tests revealed no significant differences regarding the same or different trial for all of the groups. Overall results showed that both groups had similar performance levels in the test and this was confirmed by Mann-Whitney tests as the results for inter group analysis showed no significant difference.

The second discrimination test, AXB, contrasted three pronunciations of the same word regarding the realization of the nasal vowel or not (oral vowel). Table 2 shows the correct responses in percentages for both groups of Danish: learners of BP and English, considering the three possible answers in: “first 2 words”, “last 2 words”, and “three words”.

	English Learners				BP Learners			
	first 2	last 2	Three	Total	first 2	last 2	three	total
P1	80	80	80	80	80	80	50	70
P2	70	90	80	80	50	80	70	66.7
P3	40	50	60	50	60	80	70	70
P4	60	50	70	60	60	80	40	60
P5	40	70	60	56	80	60	70	70
P6	40	60	70	56	60	100	40	66.7
P7	60	70	60	67	80	60	20	53.4
P8	70	90	50	70	50	70	60	60
P9	70	80	60	70	70	70	60	66.7
P10	80	30	55	55	80	50	50	60
Total	61	67	64.5	64.2	67	73	53	64.3
<i>SD</i>	15	19	10	10	14	16	6	6

Note: *SD*= Standard Deviation

Table 2. Responses of the AXB Discrimination Test in percentages (%).

Overall results showed that accurate responses ranged from 50 to 80% for the English learners and from 53.4 to 70% for the BP learners. Regarding intra group analysis, Wilcoxon tests revealed no significant differences for the English learners. Performing statistical analysis of BP learners, Wilcoxon tests revealed significant differences for the results of trials with contrast (first 2 words vs. last 2 words) vs trials with no contrast (three words) ( $Z=-2.203$ ,  $p=.028$ ). These results indicate that the BP learners were better at discriminating the BP nasal vowels when in contrast to oral vowel realizations, thus indicating an effect of trial type. With regard to inter group analysis, results of the Mann-Whitney test showed no significant differences, as with the same or different test.

The third test solely included the Danish learners of PB and was a native-like vs. a nonnative-like identification test contrasting the realization or not of the BP nasal vowel. Table 3 shows the correct responses in percentages, considering the trial in which the native-like realizations of the BP nasal vowels appeared in contrast to the nonnative-like one (“1”, “2”, “3”) and trials in which there were no contrast in pronunciation (“both” and “neither”).



	Trials with contrast	Trials without contrast
P1	95	90
P2	85	40
P3	75	15
P4	85	70
P5	100	80
P6	100	90
P7	80	60
P8	95	90
P9	90	85
P10	85	55
Total	89	67.5
<i>SD</i>	8.4	25

Note: *SD*= Standard Deviation

Table 3. Responses of the Native-like vs. Nonnative-like Identification Test in percentages by the BP learners (%).

Overall results showed that accurate responses ranged from 75 to 100% for trials with contrast of native-like vs. nonnative-like pronunciation and from 15 to 90% for trials with no contrast, thus showing a higher variability. Wilcoxon test revealed significant differences for the BP learners ( $Z=-2,812$ ,  $p=,005$ ) for trials with and without contrast, thus indicating that the Danish learners of BP show less difficulty in identifying the BP native-like pronunciation when presented in contrast.

As for the fourth test, the nasal vs. oral vowel identification test, Table 4 shows the result for the learners of BP.

	A	Ã
1	100	94
2	83	94
3	94	38
4	94	88
5	100	61
6	61	77
7	94	94
8	100	66
9	100	100
10	88	77
Total	91.4	78.9
SD	12	19

**Note:** SD= Standard Deviation

Table 4. Responses of the nasal vowel Identification test by the BP learners (%).

Overall results showed that Danish learners of BP were better at identifying the oral vowel (91.4%) than the nasal ones (78.9%). However, a Wilcoxon test was performed and revealed no statistically differences possibly due to the limited number of data

#### **4. Final considerations**

The main objective of this small-scale study was to investigate the perception of Brazilian Portuguese syllable-final nasal vowels by Danish learners of Brazilian Portuguese as both languages differ in terms of nasalization specifically in syllable-final position. Two groups of Danish speakers took part in the study: one group of BP learners and a group of English learners as a matter of comparison. Both groups took two discrimination tests: a Same or different test and an AXB test. General results showed that both groups showed similar difficulties in both discrimination tests: Same or Different and AXB. The two identification tests were taken just by the BP learners.

For the native-like vs. non-native-like identification test, it was less difficult for the BP learners to identify the BP native-like pronunciation of the nasal vowel when it was presented in contrast to a non-native-like pronunciation, that is, an oral vowel realization. In the other Identification

test where the participants were asked to identify the oral and the nasal BP vowel, it was less difficult for the BP learners to identify the BP oral vowel than the nasal one; however statistical analysis showed no significance.

Regardless of the limited number of data of this small scale study, there are indications that there is a certain degree of L1 interference when Danish learners of BP perceive the BP nasal vowels in syllable-final position as predicted by Flege's model, for instance. Further studies could also analyze influence of phonological context such as the vowel or preceding context. Production and its relationship to perception may be also a great field of investigation.

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