Universidade Federal de Santa Catarina

Pós-Graduação em Letras-Inglês e Literatura Correspondente

PERCEPTION AND PRODUCTION OF ENGLISH SYLLABLE-FINAL NASALS BY BRAZILIAN LEARNERS

por

Denise Cristina Kluge

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ABSTRACT

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DENISE CRISTINA KLUGE

UNIVERSIDADE FEDERAL DE SANTA CATARINA
2004

Supervising Professor: Dr. Barbara Oughton Baptista

Considering the lack of fully realized coda nasals in Brazilian Portuguese, this cross-sectional study aims to investigate pre-intermediate Brazilian EFL learners' perception and production of the nasals /m/ and /n/ in syllable-final position. The data were collected from twenty pre-intermediate students regularly attending the Extracurricular Language Program of the Universidade Federal de Santa Catarina. Perception was assessed through a Categorial Discrimination Test (Flege, Munro and Fox, 1994) and an Identification Test. A group of three native speakers also took both perception tests as a reference for comparison. Regarding phonological context, both perception tests considered the previous vowel as a variable. Production data was collected by means of a Sentence Reading Test containing monosyllabic and disyllabic words with either /m/ or /n/ in syllable-final position. The phonological contexts considered in the production were stress and position of the target syllable for the disyllables; and previous vowel and following segment (consonant, vowel or silence) for the monosyllabic words.

The results from the perception tests revealed that the previous vowel seemed to influence the accurate perception of the target nasals /m/ and /n/ by the Brazilian learners and the native speakers. Both groups seemed to have difficulties in either discriminating or

identifying the target nasals in the context of nearly the same previous vowels, although to different degrees. As regards production, results show that the lack of fully realized syllable-final nasals in Brazilian Portuguese influenced the Brazilian learners' production. The Brazilian participants generally nasalized the vowel and deleted the nasal consonant when they did not accurately produce the English coda nasals. Regarding the phonological context, the results show that silence was the following context in which the participants had most difficulty in producing the coda nasal. These results may be accounted by the influence of degree of vowel nasality in Brazilian Portuguese, which may indicate the importance of phonological context in the production of nasal consonants in the coda. Concerning the relationship between perception and production, statistically significant results showed positive correlation between the results of the Brazilian learners in the two perception tests and the production test.

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RESUMO

A PERCEPÇÃO E A PRODUÇÃO DAS NASAIS NO FINAL DE SÍLABAS POR ALUNOS BRASILEIROS DE INGLÊS

DENISE CRISTINA KLUGE

UNIVERSIDADE FEDERAL DE SANTA CATARINA
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Este estudo investiga como um grupo de alunos brasileiros aprendendo inglês em nível pré-intermediário – no Curso Extracurricular de Inglês da Universidade Federal de Santa Catarina - produz e percebe as nasais /m/ e /n/ em final de sílaba em palavras inglesas, considerando a influência do processo de nasalização do português brasileiro. A percepção foi aferida através de um Teste de Discriminação Categórica (Flege, Munro e Fox, 1994) e um Teste de Identificação. O teste também foi aplicado a um grupo de três falantes nativos de inglês norte-americano, como medida de comparação. Os dois testes de percepção consideraram a vogal anterior à nasal alvo como variável de contexto fonológico. A produção, por sua vez, foi avaliada através da leitura de frases contendo palavras monossílabas e dissílabas com as nasais /m/ e /n/ na coda. Os contextos fonológicos considerados na produção foram acentuação vocabular nas palavras dissílabas, e vogal anterior e contexto fonológico seguinte (consoante, vogal ou silêncio) nas monossílabas.

Os resultados dos testes de percepção revelaram que a vogal anterior parece exercer certa influência sobre a performance dos participantes brasileiros e dos falantes nativos na percepção das nasais em posição final de sílaba. Os dois grupos demonstraram certa dificuldade em discriminar ou identificar a consoante nasal alvo no contexto das mesmas vogais anteriores. Quanto à produção, os resultados demonstraram que o processo de nasalização do português brasileiro influenciou a produção dos participantes brasileiros. Quando não produziram corretamente a consoante nasal em posição final de sílaba, os alunos nasalizaram a vogal anterior e apagaram a consoante. Quanto ao contexto fonológico seguinte, os resultados indicam que o contexto que mais desfavoreceu a produção correta da consoante nasal foi silêncio. Os resultados podem indicar a influência do grau de nasalidade das vogais no português brasileiro, o que pode sinalizar a importância do contexto fonológico na produção das consoantes nasais na coda. Quanto à relação entre percepção e produção, resultados estatisticamente significativos indicaram uma correlação positiva entre os resultados dos alunos brasileiros nos dois testes de percepção e no teste de produção.

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CHAPTER 1

INTRODUCTION

As claimed by Gass and Selinker (2001), phonology is a relevant field of research for both Second Language Acquisition (SLA) and Linguistics, due to the fact that one feature that these areas share is "a concern with the learning problem. That is, how can learners acquire the complexities of a second human language? " (p.141). The authors also state that phonology is "a complex process. An understanding of how learners learn a new phonological system must take into account linguistic differences between the native language and the target language systems as well as universal facts of phonology" (p.163).

One of the most important factors concerning second language acquisition is L1 transfer to L2. Early research in L2 phonetics and phonology employed contrastive analysis (CA) almost exclusively (Weinrich, 1953, cited in Major, 1994). In the 1960s and 1970s, the weakness of the CA became apparent and it was recognized that a simple comparison between native language and target language was not enough to predict and explain all the difficulties a learner had when learning a second language. As stated by Major (1994), "one of the drawbacks of CA was its failure to predict level of difficulty or order of acquisition" (p.186).

In order to provide a better explanation for the difficulties in learning a second language, in addition to L1 transfer, Eckman (1977) introduced the notion of markedness as an important factor in the development of the L2 system. Major (1994) states that markedness "has been variously defined, from statistical frequencies (i.e., the more marked the less frequent), to a strict implicational hierarchy (i.e., x is more marked than y if the

presence of x implies the presence of y but not vice versa)" (p.186). In his Markedness Differential Hypothesis (MDH), Eckman posits that markedness can predict order of acquisition: the less marked phenomenon is acquired before the more marked. In 1991, Eckman developed the interlanguage Structural Conformity Hypothesis (SCH), which states that "the universal generalizations that hold for the primary languages hold also for interlanguages" (p.24). Eckman claims that the SCH is a stronger hypothesis than the MDH due to the fact that the former can account for difficulties where the native language and the target language structures are not different and to the fact that it is falsifiable.

The studies cited above and many others have helped those who work in the field of L2 phonetics and phonology and SLA in general to identify the sources of errors in L2 acquisition. However, there is still a lot to be observed and discovered about L2 acquisition.

Some studies show that perception and production play a very important role in the acquisition of a second language. Flege (1981) 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. For instance, sounds that are separate phonemes in language A might be merely allophones of the same phoneme in language B. Flege claims that this may influence the production of these sounds in language A by a native speaker of language B because of the identical mental representation that the speaker has for the two sounds. Major (1986) proposes that a learner who can perceive a non-native sound very well may be able to create a mental representation that is identical or nearly identical to that of the native speaker. However, Major points out that a learner with poor perception will have an L2 mental representation identical to that of his/her native language or intermediate between those of the native language and the target language. Interference, as Major (1986) says, tends to occur when the difference between a phenomenon in the native language and

one in the target language is very slight, since the more different two phenomena are, the easier it is to perceive the difference.

There are few studies in interlanguage (IL) phonetics and phonology, especially concerning Brazilian speakers of English as a second language. Considering consonants and their position and combination within the syllable, there are only a few studies related to Brazilian learners: Baptista and Silva Filho (1997) and Koerich (2002), investigating English final consonants; and Rebello (1997), Rauber (2002) and Cornelian Junior (2003), investigating English initial /s/ clusters, for instance. Due to the lack of research and considering the importance of perception and production in the acquisition of a second language, the aim of this study is to investigate the perception and production of English coda nasal consonants /m/ and /n/ by Brazilian learners of English as a foreign language, with six main purposes: (1) to investigate the interference of the lack of fully realized coda nasals in Brazilian Portuguese in the learner's perception of English nasal consonants in syllable-final position; (2) to investigate whether the phonological context influences the perception of English coda nasals, considering the previous vowel as a variable; (3) to investigate the interference of lack of fully realized coda nasals in Brazilian Portuguese rhymes in the interlanguage production of English coda nasals; (4) to investigate whether the length of the word (disyllabic vs. monosyllabic words) influences the production of nasals in syllable-final position; (5) to investigate which phonological contexts favor/disfavor the interlanguage production of English coda nasals, considering stress of the target syllable as a variable for the disyllabic words, and following context (consonant, vowel or silence) and previous vowel as variables for the monosyllabic words; and (6) to

investigate whether there is a correlation between the perception and the production of the English syllable-final nasals by the participants.

The thesis is organized into five chapters. Chapter 2 presents an overview of the literature important for the present study concerning the syllable structures of English and Brazilian Portuguese (BP), the process of nasalization in both languages, as well as some theories and studies concerning production, perception and their relationship. Chapter 3 describes the method, the material and the procedures used to collect the data, as well as some details about the participants. Chapter 4 presents the data obtained and discusses the results of the investigation. Chapter 5 presents a few tentative conclusions for the study and discusses some pedagogical implications, limitations and suggestions for further research.

CHAPTER 2

REVIEW OF THE LITERATURE

As stated by Cutler, Mehler, Norris and Seguí (1986), "syllable structure is notoriously an area in which languages differ widely. This does not mean to say that some languages have syllables while others don't; part of the attraction of the syllable as a universal processing unit is that it is a true linguistic universal." (p.387). According to theses authors, consonants and vowels are present in all languages and all languages can be described in terms of syllables. The difference concerns syllable structures, as stated before. For instance, while some languages have simple syllable structures such as CV sequences, other languages have more variation, from a simple V to a CCCV:CCC sequence (V: means a long vowel).

According to Metrical Theory, the syllable consists of two phonological units: the onset and the rhyme. The rhyme of a syllable is a unit that consists of the peak or nucleus and the coda (Giegerich, 1992).

Syllable

Onset   Rhyme

Peak   Coda

Codas and onsets are optional, whereas the peak is the only obligatory unit. As posited by Goldsmith (1990), "the syllable is a phonological constituent composed of zero or more consonants, followed by a vowel [the nucleus], and ending with a shorter string of zero or more consonants" (p.108). Syllables containing a complete rhyme (peak plus coda)

are called closed syllables (a CVC sequence), and syllables containing only the peak in the

rhyme are called open syllables (a CV sequence).

The following section describes the structures of English and Brazilian Portuguese

syllables, with special attention to the coda, in order to provide insights into the production

of nasals by Brazilian speakers of English in syllable- final position.

2.1. The English and the Brazilian Syllable

2.1.1. The English Syllable

According to Brinton (2000, p. 65), an English syllable may optionally contain from

zero to three consonants in the onset and from zero to four consonants in the coda, which

can be represented as:

(C) (C) (C) (V) (C) (C) (C) (C)

Based on the representation above, some examples of English syllable types can be:

(1) VCC as in *ink*;

(2) CV as in *be*;

(3) CVC as in *bad*;

(4) CCVC as in *spun*;

(5) CCVCC as in *spark*;

(6) CCCVC as in *strap*;

(7) CCCVCC as in *strict*;

(8) CCCVCCC as in *strength*;

(9) CCCVCCCC as in *strengths*.

As can be seen in the examples, there are open and closed syllables in English. As

stated previously, onsets are not obligatory in English syllables, but when a syllable has an

onset it may contain up to three consonants. The only consonants that cannot occur in single-consonant onsets are /ŋ/ and /ʒ/ (Giegerich, 1992). Two-consonants onsets consist of two major groups (O'Connor, 1992, p.64):

(a) If the first consonant is /s/, the second consonant must be /p, t, k, f, m, n, l, w, y/ as in

spy, stay, sky, sphere, small, snow, sleep, swear, suit.

(b) If the second consonant is /l, r, w or y/, the first one must be /p, t, k, f, d, b, g, f, θ, ʃ, v, m, n, h/; however, not all these sequences are permitted. The possible sequences are:

/p/, /b/, /f/ followed by /l, r, y/ as in *play, pray, pure, blow, bread, beauty, fly, from, few*;

/t/, /d/ followed by /r, w, y/ as in *try, twice, Tuesday, dress, dwell (rare), dunes*;

/k/ followed by /l, r, w, y/ as in *climb, cry, quite, cure*;

/g/ followed by /l, r/ as in *glass, green*;

/θ/ followed by /r, w/ as in *throw, thwart* (rare);

/ʃ/ followed by /r/ as in *shrink*;

/v/ followed by /y/ as in *view*;

/m/ followed by /y/ as in *music*;

/n/ followed by /y/ as in *new*;

/h/ followed by /y/ as in *huge*.

The possible combinations for three-consonant onsets are presented in the schema below (Prator & Robinett, 1985, p.176).

/w/

/p/ /y/

/s/ /t/ /l/

/k/ /r/

The coda in English allows a greater variety of combinations. As stated before, codas in English may contain up to four consonants. The only consonant that cannot occur in a single-consonant coda in English is /h/. Two-consonant codas can be formed as follows (Jensen, 1993; O'Connor, 1992): (a) stop + stop sequences -/pt, kt, bd, gd/; (b) stop + fricative sequences - /pθ, tθ, dθ, ps, ks, bz, dz, gz/; (c) fricative + stop sequences - /sp, ft, θt, st, ʃt, vd, ðd, zd, ʒd, sk/; (d) fricative + fricative sequences - /fθ, fs, θs, vz. ðz/; (f) nasal + consonant - /mp, mf, mz, nt, nd, ntʃ, ndʒ, nθ, ns, nz, ŋd, ŋk, ŋz/; (g) /l/ + consonant - /lp, lb, lt, ld, lk, ltʃ, ldʒ, lθ, ls, lz, lf, lv, lʃ, lm, ln/; (h) /r/ + consonant - /rp, rb, rt, rd, rk, rg, rtʃ, rdʒ, rf, rv, rθ, rs, rz, rʃ, rm, rn, rl/.

Many three-consonant codas are formed by the addition of the inflectional suffixes of regular past tense, as in *learned* /rnd/, and third person singular to verbs, as in *works* /rks/, and, also, with the addition of the plural inflection to nouns as in *cards* /rds/. There are other examples of three-consonant codas, such as /kst/ in *text*, /mpt/ in *prompt*, /ŋkt/ in

distinct, /mps/ in *glimpse*, /nst/ in *against*, /rps/ in *corpse*, /rld/ in *world*, /ksθ/ in *sixth*, and /rpt/ in *excerpt* (Jensen, 1993; Prator & Robinett, 1985).

As mentioned by Jensen (1993, p.70), four-consonants sequences can be obtained by adding an inflectional suffix to three consonant codas, though some of them tend to be simplified by native speakers. For instance, some four-consonant codas are formed by adding the past tense inflection as the sequence /mpst/ in *glimpsed,* and the sequence /ltst/ in *waltzed*; others are formed by adding the plural inflection as the sequence /ksts/ in *texts*, /rsts/ in *bursts*, and /lfθs/ in *twelfths* (Prator & Robinett, 1985, p.179). The last three examples given tend to be simplified by native speakers to /kss/, /rss/ and /lfs/ or /lθs/.

2.1.2. The Brazilian Portuguese Syllable

According to Cristofáro Silva (1999), a Brazilian Portuguese syllable may optionally contain from zero to two consonants in the onset and in the coda, the vowel being the only obligatory segment. The BP syllable can be represented as (V' represents a glide segment):

(C) (C) V (V') (C) (C)

Some examples of BP syllable types are listed by Collischonn (2001):

(1) V as in **é** - 'is;

(2) VC as in **ar** – 'air';

(3) VCC as in **ins**tante – 'instant';

(4) CV as in **cá** – 'here';

(5) CVC as in **lar** – 'home';

(6) CVCC as in **mons**tro – 'monster';

(7) CCV as in **tri** – 'tri-';

(8) CCVC as in **três** – 'three';

(9) CCVCC as in **trans**porte – 'transportation';

(10) VV as in **au**la – 'class';

(11) CVV as in **lei** –'law';

(12) CCVV as in **grau** – 'degree';

(13) CCVVC as in **claus**trofobia –'claustrophobia'.

As can be seen in the examples, there are open and closed syllables in Brazilian Portuguese. As stated previously, onsets are not obligatory in BP syllables, but when they occur they may have up to two consonants. Considering the BP inventory, the only consonants that cannot occur in single-consonant onsets are [ɲ], [ʎ] and [ɾ] in word-initial position. The flap does not occur at all in word-initial onsets, and [ɲ] and [ʎ] only occur in the loan words *nhoque* –'gnochi', *lhama* – 'llama', *lhano* – 'plain' (Cristofáro Silva, 1999; Mateus and d'Andrade, 2000).

As Mateus and d'Andrade (2000) mention, "in common with other languages, Portuguese does not accept all consonant clusters as onsets" (p.40). According to Cristofáro Silva (1999, p.157), when two-consonant onsets occur, the first consonant is an obstruent (/p/, /b/, /f/, /v/, /t/, /d/, /k/, /g/) and the second one is a liquid (including /l/ and /ɾ/). The sequence /dl/ does not occur in the BP onset, and the sequence /vl/ occurs only in loan names in word-initial position as in *Vladimir*. The sequences /tl/ and /vɾ/ do not occur in word-initial position, and are not frequent in medial-word position.

The coda in Brazilian Portuguese contains far more restrictions than the onset. As mentioned before, BP codas may contain up to two consonants. The consonants in the coda position are restricted phonologically to /l/, /r/, /m/, /n/, /s/ and /z/, or as Câmara Jr. (1970) proposes /l/, /r/ and the archiphonemes /S/ and /N/.

Single-consonant codas allow exclusively one of the consonants mentioned above (/l, r, m, n, s, z/). The consonant /l/ may occur phonologically in word-final and syllable-final position in Brazilian Portuguese. Phonetically, the liquid /l/ is generally vocalized in BP, as in *sal* [ˈsaʊ] – 'salt' and *salgado* [saʊˈgadʊ] – 'salty'. However, according to Cristófaro Silva (1999), /l/ may be realized as a velarized alveolar (or dental) lateral in the South of Brazil.

The letter "r" in BP represents the phonemes /R/ and /ɾ/ (Cristófaro Silva, 1999). The /R/ may be realized as a fricative [X, ɣ, h, ɦ], the retroflex [ɹ] or the trill [ř]. The flap /ɾ/, is realized as a flap in all Brazilian Portuguese dialects.

The letter "s" in syllable-final position may be realized as [z], [ʒ], [s] or [ʃ] (Cristófaro Silva, 1999, p.157). In this context, Cristófaro Silva explains that there is no phonemic contrast of the phonemes /s, z, ʃ, ʒ/, that is, in syllable-final position any of theses phonemes may occur. For instance, the word *mês* –'month' may be realized as either [ˈmes] or [ˈmeʃ]; or [mezbuˈnitʊ] or [meʒbuˈnitʊ] in *mês bonito* – 'beautiful month' (p. 157). Therefore, the segments [s, z, ʃ, ʒ] in the coda can be represented by the archiphoneme /S/. Depending on the dialect, [z] and [ʒ] may occur in word medial and final

position before voiced consonants, as in *desviar* [diz/ʒviaR] – 'to swerve'; [s] and [ʃ] may occur, depending on the dialect, in word medial and final position before voiceless consonants, as in *luz* [lʊs/ʃ] – 'light' or *pasta* [pas/ʃta] – 'pasta'. (Cristófaro Silva, 1999, p. 158).

Two-consonant codas occur only in word-medial position and are limited to /S/, preceded by either /l/, /r/ or /n/, as in the words *solstício* /solS'tisio/ - 'solstice', *perspectiva* /peRSpek'tiva/ - 'perspective' and *transtorno* /traNS'toRno/ - 'trouble' (Cristófaro Silva, 1999, p. 164).

As Mateus and d'Andrade (2000, p.130) state, the syllable-final nasal consonants are "one of the most challenging aspects of Portuguese". Due to their controversy and the importance of this discussion for the present study, the process of nasalization is discussed in detail in the following section.

2.3. Nasalization in Brazilian Portuguese

According to Cristófaro Silva (1999), there are seven oral vowels [i, e, ɛ, a, ɔ, o, u] and five nasal vowels [ĩ, ẽ, ã, õ, ũ] in stressed position. The problem is the analysis of the nasal vowels: whether to consider them phonemes in opposition to the oral vowels or a combination of the oral vowel and the archiphoneme /N/.

From some authors' point of view (Head, 1964; Pontes, 1972; Back, 1973; all cited in Cristófaro Silva, 1999, p.165), the five nasal vowels are added to the seven oral vowels; thus, the Brazilian Portuguese vocalic inventory contains twelve vowels. According to the authors who support this view, minimal pairs such as *lá* [ˈla] – 'there' and *lã* [ˈlã] –'wool',

and *mito* [ˈmitʊ] – 'myth' and *minto* [ˈmĩtʊ] – 'I lie' support the idea that the nasal vowels are opposed to the oral ones in BP.

From the other point of view, Câmara Jr. (1971) argues that 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* [ˈlĩⁿdʊ] –'beautiful'. According to this view the nasal vowels are represented as /iN, eN, aN, oN, uN/. Cristófaro Silva (1999, p.92) states that the difference between a nasal segment [n] and a nasal element [ⁿ] is the time spent in the articulation. The articulation of a nasal segment takes longer than the articulation of a nasal element.

Mateus and d'Andrade (2000, p.21) say that at the underlying level "there are no nasal vowels in Portuguese"; instead they treat them "as sequences of oral vowel plus nasal segment". The arguments supporting this hypothesis are as follows (Mateus and d'Andrade, 2000): (a) the pronunciation of /r/ after a nasal vowel is the strong /R/ as it is pronounced after a syllable-final consonant (e.g., *genro* [ˈʒěRʊ] -'son-in-law'); (b) the phonetic realization of the prefix 'in' or 'im' before a consonant is pronounced as a nasal vowel [ĭ] (e.g., incapaz [ĭkaˈpaS] – 'unable') whereas when the prefix precedes a vowel it is realized as a vowel followed by a nasal consonant (e.g., [inakaˈbadʊ] – 'unfinished']. As Mateus and d'Andrade (2000) advocate, "there seems to be enough evidence to support the idea that, underlyingly, Portuguese nasal vowels receive their nasality from a nasal segment that is deleted at the phonetic level" (p.23).

Baptista's (1988) theoretical/descriptive study of Portuguese nasalization analyzes the process of nasalization of the vowels according to the structuralist approach, the generative approach and the autosegmental approach. Among her conclusions is the fact that the autosegmental analysis shows that nasality is "an autonomous element and does not depend on one particular segment for its realization" (p.86). Baptista also demonstrates that only a non-linear approach to phonology can adequately account for the fact that there are different degrees of nasalization in Portuguese, although these varying degrees are not distinctive (p.87). Baptista based her analysis on three degrees of vowel nasality recognized by Mateus (1975, cited in Baptista, 1988, p.80): (1) strong before a deleted nasal consonant as in *fim* -'end'; (2) less strong before a nasal consonant assimilated to a following consonant as *onde* – 'where'; (3) weak before a specified nasal consonant neither deleted nor assimilated as in *ano* –'year'. Due to the fact that the degree of vowel nasalization in Brazilian Portuguese depends on the phonological environment, it is reasonable to expect that the frequency of transfer of the vowel nasalization process to English will also depend on the environment. Therefore, one of the objectives of the present study is to investigate whether the phonological environment influences the interlanguage production of English coda nasals, as will be explained in Chapter 3.

As reviewed above, nasalization in Brazilian Portuguese has provoked different views and theories. For the purpose of the present study, it will be assumed that, phonetically, nasal consonants are not fully pronounced after a vowel in syllable-final position in Brazilian Portuguese (Cristófaro Silva, 1999; Mateus and d'Andrade, 2000; Câmara Jr., 1971). The following section considers studies about nasalization in the interlanguage of Brazilian Portuguese speakers of English concerning the differences in the

pronunciation of the nasal consonants in both languages. Very few studies have dealt with this aspect of the English IL of BP learners, to the best of my knowledge.

2.4. Nasalization in the English Interlanguage of Brazilian Portuguese speakers

In English syllable-final position, the nasal consonants /m/ and /n/ are fully pronounced by lowering the soft palate and blocking the mouth as follows: for /m/ the mouth is blocked by closing the lips; whereas for /n/ the mouth is blocked by pressing the tip of the tongue against the alveolar ridge, and the sides of the tongue against the sides of the palate (O'Connor, 1975, p.64). As stated by O'Connor, the pronunciation of neither of the sounds should cause much difficulty to most speakers. However, she also states that speakers of some languages, such as Portuguese, may find the pronunciation of these nasals difficult in syllable-final position. O'Connor (1975) explains that "instead of making a firm closure with the lips or tongue tip so that all the breath goes through the nose, they may only lower the soft palate and *not* make a closure, so that some of the breath goes through the nose but the remainder goes through the mouth. When this happens we have a *nasalized vowel*" (p. 65).

A study carried out by Monahan (2001) investigated the interlanguage English of Brazilian Portuguese speakers concerning processes such as regressive assimilation of nasality and nasal deletion in the coda position, lateral gliding in the coda position, and the process of epenthesis to alleviate impermissible consonant clusters. Five native speakers of BP participated in the study. The participants had lived in the in the United States from four months to three years at the time they were tested.

In order to investigate the production of English nasal consonants is syllable-final position, a sentence reading task was designed. A phonetic and phonological analysis showed that "throughout the data, heavy nasalization of vowels was presented and in most cases there was no, or in other cases very little, evidence of the nasal consonant surfacing" (p. 23), as can be seen in the examples below (p.24):

Surface Representations of the Nasal Forms

a. English	b. BP Interlanguage English	c. Gloss
[plæ̆nt]	[plæ̆t]	'plant'
[klæ̆n]	[klæ̆]	'clan'
[ŏw̆nz]	[ŏw̆z]	'owns'
[ăw̆ns]	[ăw̆s]	'ounce'

Monahan points out that a vowel followed by a nasal consonant in the English coda regressively assimilates its nasality, as occurs in BP (as in the examples *a* and *b*). He states that the difference lies in the fact that in English the nasal consonant following the nasalized vowel is articulated (example *a*), whereas in BP the nasal consonant is deleted (example *b*). However, he does not mention the difference in the degree of nasalization of the vowel, which in English is much weaker than in Brazilian Portuguese. According to Monahan, the results show that native Brazilian Portuguese speakers transfer the process of regressive assimilation of nasality and nasal deletion in the coda position into their interlanguage English.

A study by Baptista and Silva Filho (1997) is relevant to the present research due to the fact that it investigated the influence of markedness and syllable contact on the production of English final consonants, including nasals, by Brazilian learners. Baptista and

Silva Filho based their study, among others, on Eckman and Iverson's (1994) hypothesis regarding markedness in terms of relative sonority, investigating the interlanguage production of single coda consonants. Eckman and Iverson investigated the production of single coda consonants by Japanese, Korean and Cantonese learners and they predicted that the more marked obstruent codas would be more difficult than the nasal codas. In their study, Baptista and Silva Filho compared the production of English nasals and obstruents by Brazilian speakers and the results supported the hypothesis based on Eckman and Iverson. The results also showed that "vowel-nasal sequences were frequently pronounced as nasal vowels without the final nasal consonant" (p.29) by Brazilian speakers and that a nasal consonant also sometimes caused epenthesis instead of omission.

These results of the studies reviewed in this section are particularly relevant to the present study because they show the strategies used by Brazilian speakers for the production of nasal consonants and they may also lead to insights concerning the production of English syllable-final nasals by Brazilians. It could be expected in this experiment that the participants may pronounce English coda nasals "through the grid" (Wode, 1978, cited in Flege, 1995) of Brazilian Portuguese nasalization.

The next section deals with other theoretical issues and empirical findings concerning perception and production in interlanguage as well as the relationship between them. First, it addresses the issues of perceptual foreign accent and age-related difficulties in general terms, then it describes and discusses the Speech Learning Model (SLM) of Flege and colleagues (1995), focusing on the aspects of this model that are especially relevant to the present study. Finally, it presents an overview of studies concerning the relationship between L2 speech production and perception.

2.5. Perception and Production Concerning Interlanguage Phonology

2.5.1. Foreign Accent

As stated by Flege (1995), "foreign accents in English are common in the speech of non-native speakers. Listeners hear foreign accents when they detect divergences from English phonetic norms along a wide range of segmental and suprasegmental (i.e., prosodic) dimensions" (p.233). Different explanations for the cause of foreign accent have been proposed (Flege, 1995, p.234): (a) neurological maturation, which might reduce neural plasticity (Penfield, 1965; Lenneberg, 1967, all cited in Flege, 1995), leading to a diminished ability to add or modify sensorimotor programs for producing sounds in a second language (Sapon, 1952; McLaughlin, 1977, all cited in Flege, 1995); (b) inaccurate perception of sounds in an L2 (Flege, 1992; Rochet, 1995, all cited in Flege, 1995); (c) inadequate phonetic input, insufficient motivation, psychological reasons for keeping the foreign accent, or the establishment of incorrect habits in early stages of L2 learning (Flege, 1988, cited in Flege, 1995). Many other explanations have been proposed, including attitudinal and psychosocial factors, however the actual cause of foreign accent remains uncertain (Flege, Munro & Mackay, 1995).

The issue of age-related difficulties has been widely discussed in the literature on L2 speech learning. This discussion has considered the Critical Period Hypothesis (CPH), proposed by Lenneberg in 1967, which claims that "there is a biologically determined "critical period" for language learning, extending approximately from the age of two years to puberty" (p.306). This hypothesis is based on the belief that children have an advantage over adults in learning L2 sounds. Scovel (1969, cited in Leather & James, 1991) explains that this possible advantage is due to the fact that a "cortical lateralization occurring around

puberty inhibits subsequent attempts at mastery of the sound patterns of a new language"
(p. 306).

Linguistics studies concerning L2 speech learning have been carried out in order to find evidence for a critical period for the learning of a second language (Flege and Fletcher, 1992, cited in Flege et al., 1995; Flege, 1988). In fact, the studies cited have found that "the earlier the better" (Flege, Munro & Mackay, 1995, p. 3125) considering pronunciation of L2 sounds. Studies have provided evidence that late L2 learners have a foreign accent when producing L2 vowels (Flege, Bohn & Jang, 1997; Flege, Mackay & Meador, 1999). However, it can not be said that age is the only factor that prevents L2 learners from producing L2 sounds in a native-like fashion.

Flege, Munro and Mackay (1995) assessed the relationship between age of learning (AOL) and perceived foreign accent of 240 native Italian speakers who started learning English in Canada between the ages of 2 and 23 years. The participants had lived in Canada for an average of 32 years at the time they were tested. The results showed that age of learning influenced the accurate production of English sounds by the Italian L2 learners, that is, as AOL increases the accurate production of L2 sounds linearly decreases. Flege et al. (1995) pointed out that other factors may have interfered in the degree of foreign accent of the Italian participants, such as gender, length of residence in Canada and the frequency of use of English and Italian by the participants.

Flege (1995) claims that L2 speakers may interpret L2 sounds "through the grid" (Wode, 1978, cited in Flege, 1995) of their L1. This fact, "virtually ensures that non-native speakers will perceive at least some L2 vowels and consonants differently than do native speakers" (Flege, 1995, p. 237). However, Flege states that it does not mean to say that non-native perception of L2 sounds remains constant. There is evidence from feedback

training experiments (e.g., Logan, Lively, and Pisoni 1991; Strange, 1992, both cited in Flege, 1995) that "the perceived relation between L1 and L2 sounds may change during naturalistic L2 learning" (p.237).

As reviewed above, there is a considerable number of linguistic studies investigating the cause of foreign accent, and several factors, among which age is frequently cited, may influence non-native speech production. The Speech Learning Model developed by Flege and co-workers (Flege, 1995) aims to account for age-related factors in L2 pronunciation as one of his main objectives.

2.5.2. The Speech Learning Model (SLM)

Flege (1995) developed the Speech Learning Model (SLM), which is intended to account for "age-related limits on the ability to produce L2 vowels and consonants in a native-like fashion" (p.237). The SLM consists of four postulates and seven hypotheses derived from those postulates as follows (Flege, 1995, p.239):

Postulates
P1   The mechanisms and processes used in learning the L1 system, including category formation, remain intact over the life span, and can be applied to L2 learning.
P2   Language-specific aspects of speech sounds are specified in long-term memory representations called *phonetic categories*.
P3   Phonetic categories established in childhood for L1sounds evolve over the life span to reflect the properties of all L1 or L2 phones identified as a realization of each category.
P4   Bilinguals strive to maintain contrast between L1 and L2 phonetic categories, which exist in common phonological space.

Hypotheses
H1   Sounds in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level, rather than at a more abstract phonemic level.
H2   A new phonetic category can be established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and L2 sounds.

H3   The greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound, the more likely it is that phonetic differences between the sounds will be discerned.

H4   The likelihood of phonetic differences between L1 and L2 sounds, and between L2 sounds that are noncontrastive in the L1, being discerned decreases as AOL increases.

H5   Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually, the diaphones will resemble one another in production.

H6   The phonetic category established for L2 sounds by a bilingual may differ from a monolingual's if: 1) the bilingual's category is "deflected" away from an L1 category to maintain phonetic contrast between categories in a common L1-L2 phonological space; or 2) the bilingual's representation is based on different features, or feature weights, than a monolingual's.

H7   The production of a sound eventually corresponds to the properties represented in its phonetic category representation.

As reviewed previously, considerable research has been carried out considering age related constrains in the production and perception of L2 sounds. As stated in Flege's model and other studies cited in the previous subsection, it might be said that foreign accent tends to increase as AOL increases. In spite of several studies concerning this issue, there are three relevant questions that remain unanswered: "(1) What is the *earliest* AOL at which persistent foreign accent becomes common? (2) What is the *latest* AOL at which accent-free pronunciation of an L2 remains possible? (3) Does the critical period for speech learning affect all individuals?" (Flege, Munro & Mackay, 1995, p. 3125). Due to the lack of consistent results, it may be concluded that more studies are needed related to the complexity of age- related difficulties.

The development of new categories for L2 sounds would be influenced by two main variables: age of learning and perceived cross-language phonetic distance. Considering the last variable, it is hypothesized that "the greater the perceived difference of an L2 sound

from the closest L1 sound, the more likely that a separate category will be established for the L2 sound" (Flege, 1995, p. 264).

The SLM claims that phonetic category formation may be "blocked by the mechanism of equivalence classification" (Flege, 1995, p. 239). Equivalence classification is characterized by Flege (1996) as "a basic cognitive mechanism thought to shape both L1 and L2 speech learning" (p.13). The mechanism of equivalence classification is important for first language learning due to the fact that it enables young children to identify phones produced by different speakers, or different phonetic context, as being part of the same category (Flege, 1987, p.49). However, the author hypothesizes that equivalence classification "may lead to foreign accent in older children and adults by preventing them from making effective use of auditorily accessible acoustic differences between phones in L1 and L2" (p. 50).

The concept of equivalence classification determines the classification of the L2 phones as *identical*, *similar* or *new* in relation to the L1 phones. Wode (1995, p.323) describes L2 *identical, new* and *similar* phones as follows: (a*) identical* phones are "handled via the pre-existing categories". (b) *Similar* L2 sounds "feed into pre-existing categories. As a consequence, the similar elements are handled easily and quickly in borrowing, pidginization, and L2 acquisition; but they are prone to interference, that is transfer of phonological properties of L1 onto the L2". (c) *New* sounds are those which do not exist in the original categorial inventory of the speaker; and because the perceptual space of this sound "is not yet occupied by any acquired categories, learners tend to be successful, although it may take some time".

According to the Speech Learning Model, L2 sounds "may be at first identified in terms of a positionally defined allophone of the L1" (Flege, 1995, p. 263). However as L2

learners become more experienced, they may discern the phonetic difference between L2 sounds and their closest counterparts. In this circumstance, a phonetic category representation may be established for the new L2 sound (Flege, 1995, p. 263).

The Speech Learning Model posits that the perceived relationship between categories in L1 and L2 plays an important role in accurately perceiving or producing L2 sounds (Flege, 1995). 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 (Flege, 1995, p. 239). Two experiments conducted by Aoyama (2003) on the perception of syllable-initial and syllable-final nasals in English by Korean and Japanese listeners are especially relevant to the present study, considering that few studies have dealt with the perception of nasals in cross-language studies.

In both Korean and English, /m/ and /n/ contrast syllable-initially and /m/, /n/ and /ŋ/ contrast syllable-finally. In Japanese, however, /m/ and /n/ contrast syllable-initially, whereas nasals do not contrast in syllable-final position. In the first experiment, Aoyama investigated Korean and Japanese listeners' perception of L2 segments and found that Japanese listeners had significant difficulty distinguishing the syllable-final velar nasal (/ŋ/) from the alveolar (/n/), although they had no particular problems distinguishing the final bilabial nasal /m/ from either the velar /ŋ/ or the alveolar /n/.

In the second experiment, Aoyama (2003) examined the perceived relation between English /m/, /n/ and /ŋ/ and the Japanese categories in order to investigate why it was particularly difficult for the Japanese listeners to distinguish syllable-final /n/ from /ŋ/. The

experiment showed that syllable-final /m/ was assimilated to one Japanese category, while two or more categories were used to classify /n/ and /ŋ/. Aoyama concludes that the results of both studies show that "perceptual difficulties in an L2 cannot be predicted simply from the comparison of phoneme inventories between learners' L1 and L2, and suggest that the perceived relationship between L1 and L2 segments plays an important role in how L2 segments are perceived" (p.263).

2.5.3. The relationship between L2 speech production and perception

The interrelationship between perception and production has been discussed in the L2 phonetics and phonology literature. Baker and Trofimovich (2001) state that "understanding such a relationship is important for both theoretical and pedagogical reasons" (p.273). For theoretical reasons, understanding the relationship may lead to explanations of second language acquisition. For pedagogical reasons, it may help to determine what kinds of second-language learning activities may be more effective, and contribute to minimize foreign accents.

The studies on the relationship between perception and production have taken three directions, as stated by Koerich (2002). First, studies indicate that perception outperforms production (e.g., Archibald, 1993; Broselow & Park, 1995; Flege, 1984; Flege e Hammond, 1982; Flege & Hillebrand, 1984, all cited in Koerich, 2002, p.102). Second, studies indicate a correlation between perception and production (e.g., Flege & Schmidt, 1995; Flege, 1993 both cited in Koerich, 2002; Best, 1995; Flege, 1999; Flege et al., 1999;). Third, studies indicate that production may outperform perception (e.g., Flege-Eefting, 1987; Flege et al., 1997; Gass, 1984; Sheldon. 1985; Sheldon & Strange, 1982, all cited in Koerich, 2002).

The SLM (Flege, 1995) claims that "without accurate perceptual 'targets' to guide the sensorimotor learning of L2 sounds, production of the L2 sounds will be inaccurate" (p.238). However, the model does not state that all target language errors have a perceptual origin, but that many do.

Flege (1999) discusses the accuracy with which L2 sounds are either perceived or produced, based on the model. He says that "the accuracy with which L2 segments are perceived limits how accurately they will typically be produced, although not all aspects of perceptual learning may be incorporated in production" (Flege, 1999, p. 1). This means that production and perception "may not be brought into perfect alignment, as in L1 speech acquisition" (Flege, 1999, p. 1).

A study carried out by Flege, Mackay & Meador (1999) investigated the production and perception of English vowels by highly experienced Italian EFL learners. Results showed that the later the participants started their contact with English, the lees accurately they produced and perceived English vowels in the experiment. The results also showed that there was a correlation between the measures of English vowel production and perception of the Italian speakers. It was observed that the accuracy with which L2 vowels were produced was limited by how accurately they were perceived. These findings are consistent with the SLM.

One particular piece of research conducted by Koerich (2002) is also relevant to the present study. The author investigated perception and its relationship to production of English word-final consonants by beginning Brazilian learners. She based the perception and production study mainly on Flege's SLM and found a negative correlation between the production of epenthetic vowels and the perception of the distinction between words ending

in a final consonant and words ending in a consonant plus the vowel /i/. Koerich juxtaposes

the pictures of production and perception resulting from her study and concludes that "an

association appears between the two images, indicating that degrees of variation in the

perception and production performance of the group investigated can be noted, where as

production becomes more accurate, perception also tends to improve, or the other way

round" (p.172).

The studies and findings reviewed above are relevant to the present study due to the

fact that they discuss the relationship between production and perception, which is one of

the objectives of the present study. Next section presents an overview of speech perception

assessment methods frequently used in cross-language research. The section gives special

attention to the categorial discrimination test (CDT), which is employed in the present

research.

2.6. Methods of L2 speech perception assessment

Cross-language studies have employed variations of identification and

discrimination tests in order to assess perception of L2 sounds. Few studies have used

imitation tasks (e.g., Nemser, 1971; Flege & Hammond, 1982; Rochet, 1994; Diehl,

MacCusker, & Chapman, 1981, all cited in Beddor & Gottfried, 1995, p. 221).   Imitation

tasks have several advantages: (a) they do not require labeling; (b) they reduce listener's

memory load; (c) they provide a relatively natural way to elicit speech samples (Beddor &

Gottfried, 1995, p. 221). However, Beddor and Gottfried (1995) point out that the

disadvantage of imitation tasks is that "they do not distinguish between subjects' perceptual

and articulatory abilities" (p. 221).

In identification tasks, the listeners have to select a response to each stimulus from a fixed set of response alternatives. An advantage of this kind of task is that the limited set of response alternatives causes "a lighter load on memory for listeners" (Beddor & Gottfried, 1995, p. 222). However, the authors claim that a disadvantage of identification tasks is that labeling involves familiarity with L2 distinctions. That is, unfamiliarity with L2 distinctions may influence listeners' responses. Beddor and Gottfried (1995) also propose variations of identification tasks, such as category goodness judgment and measures of reaction time. According to the authors, such variations "serve the purpose of assessing listeners' sensitivity to within-category differences" (p.223).

In discrimination tasks, participants listen to multiple stimuli per trial and their task is to differentiate them (Flege, ms, p.3). Beddor and Gottfried (1995, p. 224) describe the main discrimination task formats employed in early studies of cross-language speech perception as follows: (a) "oddity" discrimination tasks, in which three stimuli are presented, one of which is acoustically different from the other two; (b) ABX discrimination tasks, in which A and B are acoustically different and X is identical to either A or B; (c) same or different AX (or 2IAX) discrimination tasks, in which two stimuli are presented, the second of which is acoustically identical to or different from the first; (d) 4IAX discrimination tasks, in which the listeners indicate which pair contains a difference; and (e) AXB discrimination tasks, in which the variable stimulus is presented between two different comparison stimuli.

Beddor and Gottfried (1995) point out that innovations in speech perception assessment tasks have occurred because of a change in theoretical questions. According to the authors, it does not seem important to ask whether L2 listeners can "discriminate among specific tokens from the same linguistic category" (p. 225). The more critical question

addressed in more recent research seems to be whether L2 listeners can "formulate categories of stimuli, using and ignoring acoustic variations across the various speech tokens appropriately" (p. 255).

Following this last tendency, Flege and co-workers (Flege, Munro & Fox, 1994; Flege, ms.) designed a categorial discrimination test (CDT). The test was designed to assess learners' ability to discriminate English vowels categorically in trials containing a single realization of one category and two realizations of another category (Flege et al., 1994, p. 3635). The odd item can occur in any position of the trial; thus, as pointed out by Flege, this test format is expected to increase uncertainty, providing for less biased results. However, this test format designed by Flege may also increase difficulty, imposing a heavier load on working memory.

One innovation of the oddity format designed for the CDT (Flege et al., 1994) was the inclusion of 'catch trials'. Differently from 'different trials' or 'change trials' in which there is an odd item, in 'catch trials' there is no odd item. As stated by Flege et al. (1994), catch trials are included to encourage listeners to "disregard variations along dimensions such as talker identity that were not relevant to vowel identity" (p. 3635). Each stimulus in both different and catch trials is spoken by a different talker. The task of the listeners is to circle '1', '2' or '3' according to the position of the odd item they hear; or 'none' if they hear three productions of the same item.

CHAPTER 3

METHOD

3.1. Introduction

The experiments described in this chapter were conducted to investigate the perception and production of the English nasals /m/ and /n/ in syllable-final position by a group of Brazilian pre-intermediate learners of English. The choice of the pre-intermediate level was based on the assumption that students of a lower level would probably make several kinds of mistakes in a more random manner that could influence the results of this research, as shown in Koerich (2002). Pre-intermediate students have been longer exposed to L2, therefore, they are more likely than beginners to have developed strategies to produce and perceive the English coda nasals.

The choice of the variables to investigate the production of the English coda nasals was based on a small-scale pilot study conducted by the researcher in the second semester of 2003. The pilot aimed at investigating the interference of the following variables in the interlanguage production of the target nasals: (a) length of word, considering monosyllables and disyllables; (b) stress of the target syllable in the disyllabic words; (c) spelling in the monosyllabic words; and (d) following context (consonant, vowel or silence) in the monosyllables. The findings of the pilot revealed that the interference of length of word, syllable stress and following context were statistically significant; therefore these are some of the variables considered in this research.

The data for the present study was collected in June 2004 at the language laboratory of the Centro de Comunicação e Expressão (CCE), Universidade Federal de Santa Catarina (UFSC). For the purpose of data collection, four instruments were designed: a questionnaire, a production test and two perception tests. This chapter describes the objectives of this study, the participants, the data collection instruments, the procedures, and method employed for data and statistical analysis.

3.2. Objectives of the study

In order to investigate perception and production of the nasal by Brazilian EFL learners, the specific objectives of this study are the following:

(1)   to investigate the interference of lack of fully realized coda nasals in Brazilian Portuguese in the learner's perception of English coda nasals;

(2)   to investigate whether the phonological context influences the perception of English coda nasals, considering the previous vowel as a variable;

(3)   to investigate the interference of the lack of fully realized coda nasals in Brazilian Portuguese rhymes in the interlanguage production of English coda nasals;

(4)   to investigate whether the length of the word (disyllabic vs. monosyllabic words) influences the production of nasals in syllable-final position;

(5)   to investigate which phonological contexts favor/disfavor the interlanguage production of English coda nasals, considering stress and position of the target syllable as a variable for the disyllabic words, and following context (consonant, vowel or silence) and previous vowel as variables for the monosyllabic words;

(6)   to investigate whether there is a correlation between the perception and the production of the English syllable-final nasals by the participants.

3.3. Participants

Twenty participants were tested: thirteen women and seven men, ranging in age from 16 to 44. All participants were considered pre-intermediate students (levels 3 and 4) regularly attending the Extracurricular Language Program at the Universidade Federal de Santa Catarina in Florianópolis. In order to ensure the level of the participants, twenty-nine students recorded a short free speech about a specific topic they were discussing in class: one topic for level 3 and one for level 4 (see Appendix A). The participants talked freely for 1 minute using an outline provided by the researcher to help them with the task. Three English speakers (one native and two non-natives, 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 (see Appendix B). Nine participants who were rated 1 or 5 were excluded in order to avoid having low or high proficient participants in English. Therefore, the twenty participants of this study were rated from 2 to 4. According to the participants' report, everyone in the group resided in Florianópolis, Santa Catarina at the time of data collection. None of them had been to any English speaking country and none had extensive exposure to English.

As a control group, three native speakers (NSs) of American English took both perception tests: two women and one man, ranging in age from 21 to 40. All native speakers were living in Brazil at the time of data collection. One of them had been living in Brazil for three months and the other two for about two years. According to Flege, Munro and Fox (1994), in order to consider the Categorial Discrimination Test a reliable tool, the control group should obtain a low error rate. The results for the native speakers and Brazilian participants are discussed in Chapter 4.

3.4. Materials

In order to test participants' production and perception of the nasals /m/ and /n/ in English syllable-final position, a questionnaire and three tests were designed: (1) a Sentence Reading Test, (2) a Categorial Discrimination Test, and (3) an Identification Test. The questionnaire and the three tests are described in the following sub-sections.

3.4.1. Questionnaire

A questionnaire (see Appendix D) was designed to assess the participants' biographical information, such as age, gender and regional accent, as well as questions related to their English learning experience. Among the questions asked were age of first exposure to English, length and type of formal language study, language skills explored, experience in English-speaking countries, amount of English input and experience with other L2.

3.4.2. Sentence Reading Test

The production data-gathering instrument consisted of a list of 144 sentences containing either a monosyllabic or a disyllabic word with one of the nasals /m/ or /n/ in syllable-final position. Seventy-two sentences contained a monosyllabic word: thirty-six words containing /n/ in syllable-final position and thirty-six with /m/ in syllable-final position. In order to investigate the influence of the previous vowel on the production of the nasals in the coda, the monosyllabic words contained the following vowels before the target nasal: /ɪ, æ, ʌ, i/. In order to avoid a spelling effect, none of the target nasals in syllable-final position were followed by "e". Nasals in syllable-final position followed by "e" may

cause epenthesis, rather than vowel nasalization and nasal consonant deletion, when produced by Brazilian learners. The choice of the previous vowel is related to this. The selected vowels followed by the nasals /m/ and /n/ in the coda are not usually spelled with a final "e". There were eighteen sentences for each previous vowel: nine with the nasal /m/ and nine with the nasal /n/ in the coda. Concerning the following context of the monosyllabic words, twenty-four of the target coda nasals were followed by a vowel, twenty-four followed by a consonant and twenty-four followed by silence (see Appendix M).

The other seventy-two sentences contained disyllabic words: thirty-six with /n/ in syllable-final position and thirty-six with /m/ in syllable-final position. In order to investigate the interference of syllable stress in the production of the nasals, the target words containing the English coda nasals followed four different patterns regarding syllable stress and position of the target nasal in the word:

(1) the target nasal was stressed in the first syllable of the word (e.g., *number* /ˈnʌmbər/);

(2) the target nasal was stressed in the second syllable of the word (e.g., *begin* /bɪˈgɪn/);

(3) the target nasal was unstressed in the first syllable of the word (e.g., *invite* /ɪnˈvaɪt/);

(4) the target nasal was unstressed in the second syllable of the word (e.g., *problem* /ˈprɒbləm/).

There were eighteen sentences - nine for each nasal - for each pattern (see Appendix N). For the present study, disyllabic words with coda nasals in both syllables word (e.g., *complain*) were avoided, as well as compound nouns because of secondary stress.

The sentences in the test were randomized for presentation so that each participant received a different order, so as to minimize ordering effects. The set of material consisted of written instructions in Portuguese, four sheets containing the sentences, an audiotape for the recording, and a red card (see Appendix O). The participants received a red card in order to slide it down as they read the sentences.

3.4.3. The Categorial Discrimination Test (CDT)

The second data gathering instrument consisted of an oddity test format to check if the participants could discriminate /n/ from /m/ in syllable-final position. The test followed the design of the Categorial Discrimination Test (CDT) designed by Flege and colleagues to assess the participants' ability to perceive English vowels categorically (see Flege, Munro & Fox, 1994), and the adaptations implemented by Koerich (2002).

The test consisted of seventy-two trials of three monosyllabic words. The target words were five minimal pairs contrasting /m/ and /n/ in syllable-final position. There was a different previous vowel (/ ɪ, æ, oʊ, eɪ, ʌ /) for each of the five minimal pairs (see Appendix E). In this test each of the five minimal pairs was repeated eight times.

Three types of trials were designed (Appendix F). The first type was a "different" or "change" trial which contained an odd item (i.e., different from the other two) contrasting /m/ and /n/ in syllable-final position (e.g., Tim/ Tim/ tin; cam/ can/ cam). The second type was a "catch" trial where there was no contrast; i.e., all three monosyllabic words were the same (e.g., Tim/ Tim/ Tim); and the third type was a "distractor" trial, where the distinction involved a non-target contrast to disguise the purpose of the test (e.g., hat/ hat/ rat). The

total of seventy-two trials consisted of thirty different trials, ten catch trials and thirty-two distractor trials. Together the different trials and the catch trials, both containing the target nasals, corresponded to forty trials.

Participants had to indicate the odd item out in each trail by circling "1", "2", "3" or "0" if they heard no difference. In the different and distractor trials, an odd item appeared in one of the three positions: "1", "2" or "3". In the catch trials where there was no odd item, and the correct answer would be "0" (see Appendix G).

The audio-stimuli were recorded by three American native speakers of English (one woman and two men). The three speakers were recorded in individual sessions. Each word was recorded twice by each speaker, and the researcher and an assistant with phonetic training selected the best production of each word. The words were recorded in the program Sound Forge 7.0 and normalized for peak intensity. The words were sequenced in the program Praat 5.0. The material was digitally edited and the inter-trial interval set at 2.8 s and the inter-stimulus at 1.3 s, following Flege (1994).

The trials were randomized to minimize any ordering effect. Each trial consisted of three items, and each item was spoken by a different native speaker, as exemplified in one trial of the /m/-/n/ contrast with the previous vowel /ɪ/:

(Speaker 1) *Tim* (Speaker 3) *Tim* (Speaker 2) *tin.*

A training session of 12 trials was also designed, which consisted of nine different trials and three catch trials (see Appendix H).

3.4.4. Native-like vs. non-native-like Identification Test

The third data gathering instrument consisted of an identification test format to check whether the participants could discriminate the nasals /m/ and /n/ in syllable-final position in native-like and non-native-like English. The test consisted of sixty-eight trials of two pronunciations of the same monosyllabic word. The target words were five minimal pairs contrasting /m/ and /n/ in syllable-final position. There was a different previous vowel (/ ɪ, æ, oʊ, eɪ, ʌ /) for each of the five minimal pairs (see Appendix I). In this test each of the five minimal pairs was repeated eight times.

Three types of trials were designed (see Appendix J). The first type was a "different" trial that contained two different pronunciations of the same word containing /m/ or /n/ in syllable-final position: one native-like pronunciation and one non-native-like English pronunciation with the Brazilian Portuguese nasalization of the vowel and deletion of the consonant (e.g., /tɪm/- /tĭ/). The second type was a "catch" trial where there was no contrast; i.e., both pronunciations of the target monosyllabic word were the same, either two native-like pronunciations or two non-native-like pronunciation (e.g., either /tɪm/- /tɪm/ or /tĭ/ /tĭ/). The third type was a "distractor" trial, where the distinction involved a non-target contrast to disguise the purpose of the test (e.g. /bɔl/- /boʊ/). The total of sixty-eight trials consisted of twenty different trials, twenty catch trials and twenty-eight distractor trials. Together the different trials and the catch trials, both containing the target nasals, corresponded to forty trials.

Participants had to indicate which pronunciation sounded more native-like in each trial by circling "1", "2"; "both" if they considered both pronunciations native-like; or "neither" if they considered neither pronunciation native-like. In the different trials, a different pronunciation appeared in one of the two positions: "1" or "2". In the catch trials where there was no different pronunciation, the correct answer would be either "both" or "neither". The participants received an answer grid for the test section with the written word, in order to know what word was being pronounced (see Appendix K). The written word was given because a small-scale pilot conducted by the researcher with high proficient speakers of English showed that the results of this identification test may be biased if the participants are not aware of word they are supposed to judge. In order to avoid a spelling effect, none of the target nasals in syllable-final position were followed by "e".

The audio-stimuli were recorded by two speakers: one American native speaker of English proficient in Brazilian Portuguese, and one native speaker of Brazilian Portuguese proficient in English. Both speakers had phonetic training and could control their pronunciation so that the nasal was the only difference in the pronunciation of the target words. The two speakers were recorded in individual sessions. Each word was recorded by each speaker twice with a native-like pronunciation and twice with an intentionally Brazilian pronunciation. The researcher and an assistant with phonetic training selected the best production of each word. The words were recorded in the program Sound Forge 7.0 and normalized for peak intensity. The words were sequenced in the program Praat 5.0. The material was digitally edited and the inter-trial interval set at 2.8 s and the inter-stimulus at 1.3 s following Flege (1994).

The order of the trials was randomized to minimize any ordering effect. Each trial consisted of two items, and each of these spoken by a different speaker, as exemplified in one trial contrasting a native-like vs. a non-native-like pronunciation of the English name Tim (with the previous vowel /ɪ/):

(Speaker 2) /tɪm/ (Speaker 1) /tĩ/

A training session of eight trials was also designed. It consisted of four different trials and four catch trials (see Appendix L), but with other difficult pronunciation items instead of the nasals.

3.5. Procedures

The participants knew they were participating in a research project, but none of them was aware of the exact purpose of the study. All participants were tested on the same day in two groups of ten students in the language laboratory of the Universidade Federal de Santa Catarina. The oral instructions before the test were given in Portuguese and the same procedures were followed for both groups. The data collection took approximately 40 minutes, divided as follows: (1) the sentence reading test – 15 minutes, (2) break of 5 minutes, (3) the categorial discrimination test – 12 minutes, and (4) the identification test – 8 minutes.

3.6. Analysis

In order to investigate the participants' perception of the English coda nasals, the analysis was based on the total of 800 responses (40 for each of the twenty participants) for the Categorial Discrimination Test and 800 responses (40 for each of the twenty

participants) for the Identification Test, considering the different trials and the catch trials. As the distractor trials did not contain the target contrast, they were not analyzed.

Considering the transcription procedure for the Sentence Reading Test, only the part of the sentences considered relevant to the present study was considered (see Appendix P). The data was analyzed concerning the production or not of the nasal consonants /m/ and /n/ in syllable-final position, as well as the following context (vowel, consonant and silence). 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 solved. Only 7 items (0,24%) were eliminated from the statistical analysis 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 statistically analyzed.

3.7. Statistical analysis

The statistical test used to analyze the variables that were considered to be possible problems in the production and perception of accurate segments was the chi-square (χ2). According to Walsh (1990), this procedure allows the testing of significance of " discrete data in form of frequencies, percentages, or proportions" (p.165).

The first step to carry out the test of significance is to calculate for each class of variables the difference between the observed number of scores and the expected number of scores. After that, the relative discrepancy is calculated "by dividing the square of each

absolute discrepancy by the expected frequency" (Woods, Fletcher and Hughes, 1986, p. 135). This procedure provides a measure of deviance from the model for each class. Next, it is necessary to sum the deviances "to decide whether or not the sample scores are consistent with their being drawn from a population of normally distributed scores" (Woods et al., 1986, p. 136). To measure the number of independent pieces of information on which to base the test of the hypotheses, it is necessary to calculate the *degrees of freedom* (df), which depend on the number of classes that have contributed to the total deviance. In order to calculate the degrees of freedom of an analysis, both the number of lines and the number of columns of the table need to be subtracted by one. The results of these subtractions have to be multiplied, and the result of this multiplication is the degree of freedom (df). The significance of the test, that is, the p value, will be shown in the present study as ($\chi2$ (1, N= 120) = 6.43, p < .05), for instance. In this example, 1 means the degree

of freedom, N is the total number of cases in the sample, 6.43 is the result found after applying chi-square, and the p value, as previously stated, indicates the significance. As posited by Barbetta (2001, p. 200) in the area of social studies, the results are commonly considered significant if the p value is less than .05.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter reports and discusses the results of both the native speakers and the Brazilian participants on the Categorial Discrimination Test and the Identification Test, and the Brazilian participants on the production test. It is divided into two major sections - one on perception, and one on production - which discuss the results concerning the objectives presented in the previous chapter (Section 3.2).

4.2 Perception

4.2.1 Native Speakers

As explained in the previous chapter (Section 3.3), the native speakers of the control group are supposed to obtain a low rate of errors, which means a success rate of 97% for different trials, and 99% for catch trials (Flege,ms). Table 1 shows the overall rate of correct responses by each of the three native speakers for both catch and different trials.

Table 1. Scores of native speakers in the Categorial Discrimination Test.

Native speakers	Correct Answers Different Trials	Correct Answers Catch Trials	Total Correct Answers
1	22 (73.33%)	8 (80.00%)	30 (75.00%)
2	23 (76.67%)	10 (100.00%)	33 (82.50%)
3	22 (73.33%)	9 (90.00%)	31 (77.50%
Total	67 (74.44%)	27 (90.00%)	94 (78.33%)

The results show that the three native speakers scored under the estimated success rate suggested by Flege et al. (1994). The participants did not achieve the expected percentage for either the catch or the different trials. These results challenge the validity of the perception test used in the present study. Table 1 also shows reasonable consistency among the native speakers, who obtained similar figures, with an average of 78.33% of correct answers. The lower rate could be due to the fact that the original Categorial Discrimination Test (Flege et al) was designed to assess the perception of vowels; thus, the estimated success rate suggested by Flege may not be a realistic expectation for the perception of consonants, such as nasals. Moreover, Aoyama (2003), in her experiments reviewed in 2.5.2, tested the perception of nasal consonants by native speakers of English as a control group. The native speakers who took Aoyama's perception test also show a relative difficulty for the final /m/ -/n/ contrast. The author suggests that the low scores may be attributed to the perceptual similarity between the English target nasals. Aoyama bases her explanation on a study conducted by Miller and Nicely (1955, cited in Aoyama, 2003, p. 260) which reports that the nasal consonants /m/ and /n/ could be confused with each other, and such confusion seemed to be bi-directional.

Table 2 shows the results of the perception of the nasals /m/ and /n/ in syllable-final position by the native speakers according to the previous vowel in the CDT.

Table 2. Scores of native speakers by previous vowel in the CDT.

Previous Vowel	No. Answers	No. Correct Answers	% Correct Answers
/ʌ/	24	24	100.00
/æ/	24	23	95.83
/oʊ/	24	21	87.50
/ɪ/	24	17	70.83
/eɪ/	24	9	37.50
Total	120	94	78.33

Table 2 shows that native speakers showed difficulty in accurately discriminating the target nasals preceded by the vowel /eɪ/. The native speakers accurately discriminated the coda nasal only in 9 out of the 24 cases. The previous vowel /ɪ/ also seemed to disfavor the accurate discrimination of the nasals in syllable-final position. The control group accurately discriminated the target nasals in only 17 cases. The native speakers did not show much difficulty in discriminating the syllable-final nasal consonants preceded by the other vowels tested. The difference between the scores was statistically significant concerning the following vowel comparisons: /ɪ/ - /æ/ (X2 (1, N=48) = 5.4, p = .02); /ɪ/ - /ʌ/ (X2 (1, N = 48) = 8.19, p = .004); /ɪ/ - /eɪ/ (X2 (N = 48) = 5.37, p = .02); /æ/ - /eɪ/ (X2 (1, N = 48) = 18.37, p < .0001); and /oʊ/ - /eɪ/ (X2 (1, N = 48) = 12.8, p = .0003). However, the difference between the scores resulted in a non-significant chi-square for /ɪ/ - /oʊ/ (X2 (1, N = 48) = 2.02, p = .15); /æ/ - /oʊ/ (X2 (1, N = 48) = 1.09, p = .29); /æ/- /ʌ/ (X2 (1, N = 48) = 1.02, p = .31); and /oʊ/ - /ʌ / (X2 (1, N = 48) = 3.2, p = .07).

The native speakers also took the native-like vs. non-native-like identification test. Table 3 shows the results of correct responses by each of the three native speakers for both catch and different trials.

Table 3. Scores of native speakers by type of trial in the native-like vs. non-native-like Identification Test.

Native speakers	Correct Answers Different Trials	Correct Answers Catch Trials	Total Correct Answers
1	15 (75.00%)	15 (75.00%)	30 (75.00%)
2	15 (75.00%)	15 (75.00%)	30 (75.00%)
3	17 (85.00%)	14 (70.00%)	31 (77.50%
Total	47 (78.33%)	44 (73.33%)	91 (75.83%)

The results show that the performance of the three native speakers in this perception test was also far from perfect, although they were even more consistent than in the Categorial Discrimination Test. The tables show that the native speakers obtained similar figures, with an average of 75.83% of correct answers. The results also reveal that the NSs obtained similar scores in different and catch trials in the Identification Test, resulting in a non-significant chi-square (X2 (1, N = 120) = .40, p = 52). The low success rate obtained by the native speakers indicates that he listeners could not accurately perceive differences between English nasals and BP nasals in syllable-final position. The contrast should have been better identified if the listeners were more familiar with de differences.

Table 4 shows the results of the native speakers' perception of the nasals /m/ and /n/ in syllable-final position by the previous vowel in the native-like vs. non-native-like Identification Test.

Table 4. Scores of native speakers by previous vowel in the native-like vs. non-native-like Identification Test.

Previous Vowel	No. Answer	No. Correct Answers	% Correct Answers
/ɪ/	24	23	95.83
/ʌ/	24	22	91.67
/oʊ/	24	21	87.50
/æ/	24	13	54.17
/eɪ/	24	12	50.00
Total	120	91	75.83

Table 4 shows that the three native speakers had difficulty in accurately identifying the target nasals preceded by the vowel /eɪ/. The native speakers accurately identified the native-like pronunciation of the coda nasal only in 12 out of the 24 cases. This was the vowel that was also shown to cause most difficulty for the native speakers' perception in the CDT. The previous vowel /eɪ/ compared to the previous vowels / ɪ, oʊ, ʌ/ resulted in a significant chi-square: /eɪ/ -/ɪ/ (X2 (1, N = 48) = 12.76, p = .0003); /eɪ/ -/oʊ/ (X2 (1, N = 48) = 7.85, p = .005); and /eɪ/ -/ʌ/ (X2 (1, N = 48) = 10.08, p = .001). However, the difference between the scores of the vowels /eɪ/ and /æ/ resulted in a non-significant chi-square (X2 (1, N = 48) = .08, p = .77).

The previous vowel /æ/ also seemed to disfavor the accurate identification of the native-like nasal pronunciation in syllable-final position, which was not consistent with the results of the CDT. The NSs accurately identified the native-like the target nasals in only 13 cases. The results of this previous vowel compared to the results of /ɪ, oʊ, ʌ/ resulted in the

following significant chi-square results: /æ/ - /ɪ/ (X2 (1, N = 48) = 11.11, p = .0008); /æ/ - /oʊ/ (X2 (1, N = 48) = 6.45, p = .01); and /æ/ - /ʌ/ (X2 (1, N = 48) = 8.54, p = .003).

The comparison between the following previous-context vowels was not statistically significant: /ɪ/ - /oʊ/ (X2 (1, N = 48) = 1.09, p = .29); /ɪ/ - /ʌ/ (X2 (1, N = 48) = .35, p = .55); and /oʊ/ - /ʌ/ (X2 (1, N = 48) = .22, p = .63). The control group did not show much difficulty in identifying the coda nasals preceded by the other vowels tested. Although the native speakers' results were worse than expected, they were used as a point of reference, and the Brazilian participants were expected to score even lower.

4.2.2 Brazilian Learners

As previously described in Chapter 3, two perception tests were used in order to test the Brazilian EFL learners. Table 5 shows the total number of correctly perceived items in the Categorial Discrimination Test by each of the twenty participants, including both the different and catch trials.

Table 5. Individual results of the Categorial Discrimination Test.

Participant	No. Answers	No. Correct Answers	% Correct Answers
1	40	19	47.50
2	40	27	67.50
3	40	15	37.50
4	40	16	40.00
5	40	10	25.00
6	40	18	45.00
7	40	12	30.00
8	40	16	40.00
9	40	17	42.50
10	40	20	50.00
11	40	19	47.50
12	40	11	27.50
13	40	28	70.00
14	40	23	57.50
15	40	15	37.50
16	40	18	45.00
17	40	24	60.00
18	40	11	27.50
19	40	12	30.00
20	40	21	52.50
Total	800	352	44.00

As can be seen in the table, less than half of the CDT trials were correctly perceived overall. The individual scores of the participants reveal a large degree of variability, ranging from 25% (minimum score) to 70% (maximum score), with an average of 44%. Most of the participants (fourteen out of twenty) identified less than half of the trials correctly. Only six participants obtained 50% or higher percentage of correct identification.

Table 6 indicates the total number of correctly perceived items in the native-like vs. non-native-like Identification Test by each of the twenty participants.

Table 6. Individual results of the native-like vs. non-native-like Identification Test.

Participant	No. Answers	No. Correct Answers	% Correct Answers
1	40	22	55.00
2	40	18	45.00
3	40	23	57.50
4	40	20	50.00
5	40	12	30.00
6	40	20	50.00
7	40	17	42.50
8	40	16	40.00
9	40	15	37.50
10	40	17	42.50
11	40	20	50.00
12	40	14	35.00
13	40	21	52.50
14	40	19	47.50
15	40	18	45.00
16	40	20	50.00
17	40	25	62.50
18	40	19	47.50
19	40	13	32.50
20	40	17	42.50
Total	800	366	45.75

The results reveal that, as with the CDT, less than half of the Identification Test trials were correctly perceived overall. The results also show considerable variability

among the individual scores of the participants, ranging from 30% (minimum score) to 62.5% (maximum score), with an average of 45.75%. More than half of the participants (twelve out of twenty) identified less than half of the trials correctly. Six participants scored within the 50-55% range, and only two participants obtained over 55% of correct answers.

A comparison of the results of both perception tests seems to indicate that the perception of the target nasals in the coda must have been particularly difficult for the Brazilian learners. The overall results of the twenty Brazilian participants in both tasks support the existence of positive correlation (r = .5061) between the perception in the Categorial Discrimination Test and the native-like vs. non-native-like Identification Test, since the significance value was $p < 0.025$.

4.2.3 Influence of Brazilian Portuguese nasalization – OBJECTIVE 1

The first objective of this study was to investigate the interference of the lack of fully realized coda nasals in Brazilian Portuguese in the discrimination of the English nasal consonants /m/ and /n/ in the coda. For this, the results of the Categorial Discrimination Test and of the Identification Test were analyzed.

Table 7 shows the numbers and the percentages of accurate perception of the target nasals for both types of trials analyzed in the Categorial Discrimination Test: different and catch trials.

Table 7. The perception of the coda nasals by type of trial in the CDT.

Type of trial	No. Answers	No. Correct Answers	% Correct Answers
Different	600	238	39.67
Catch	200	114	57.00
Total	800	352	44.00

The results show that the participants obtained higher scores when there was an absence of contrast (in catch trials). Catch trials were accurately perceived in 57% of the cases, whereas the percentage of accurate perception in different trials was 39.67%. The difference between the scores of each type of trial resulted in a highly significant chi-square ($X2$ (1, N = 800) = 18.29, p < .001). It was more difficult for the Brazilian learners to accurately discriminate the target nasals when there was an odd item out than to perceive that there was no nasal contrast within the trial. These results may be related to the test format, which may impose a heavy load on working memory (Flege et al., 1994).

Table 8 indicates the numbers and percentages of accurate perception of the coda nasals for both types of trials analyzed in the native-like vs. non-native like identification test: different and catch trials.

Table 8. The perception of the English coda nasals by type of trial in the native-like vs. non-native-like Identification Test.

Type of trial	No. Answers	No. Correct Answers	% Correct Answers
Different	400	220	55.00
Catch	400	146	36.50
Total	800	366	45.75

The results show that the different trials were accurately perceived in 55% of the cases, whereas the percentage of accurate perception in catch trials was 36.5. A statistical analysis revealed that this difference between the scores of each type of trial was significant ($X2$ (1, N = 800) = 27.57, p < .001). The results reveal that the participants obtained higher scores when there was a different pronunciation in the trial, i.e., it was easier for the Brazilian learners identify the native-like pronunciation when there were two different pronunciations of the same word, than to identify the trials containing two identical pronunciations of the given word.

Table 9 indicates the numbers and percentages of accurately perceived items in the native-like vs. non-native like identification test, by place of articulation of the nasal consonant. The results in the table below are based on the analysis of both different and catch trials.

Table 9. The perception of the English coda nasals by place of articulation in the native-like vs. non-native-like Identification Test.

	No. Answers	No. Correct Answers	% Correct Answers
/m/	400	201	50.25
/n/	400	165	41.25
Total	800	366	45.75

The results show that the participants had more difficulty in identifying the native-like nasal /n/ in this test. The participants accurately identified the native-like nasal /n/ in only 41.25% of the cases, whereas the percentage of accurate identification of the nasal /m/ was 50.25%. A statistical analysis revealed that this difference is significant ($X2$ (1, N =

800) = 6.52, p < .01). This result indicates that in the Identification Test the place of articulation of the nasal (/m/ or /n/) influenced the perception of the Brazilian learners.

Considering the process of nasalization of the vowels in syllable-final position in Brazilian Portuguese explained in 2.3, it was expected that the participants would have difficulty. It seems reasonable to suggest that the results of both perception tests show influence of Brazilian Portuguese nasalization in the perception of English nasals in the coda in this study. This interference is consistent with Major's (1986) claim that " when first learning a second language, one transfers structures from the native language to the target language" (p.217).

Thus, the findings may corroborate Hypothesis 5 of Flege's Speech Learning Model (1995). This hypothesis states that the mechanism of equivalence classification may block category formation for an L2 sound, thus L2 sounds may be perceived in terms of those of the L1. Flege states the hypothesis considering phones as the unit of representation. However, in this study, the category considered was the rhyme ending in a nasal consonant. It may be evidence for larger units of representation than those posited by Flege.

4.2.4 Influence of the phonological context – OBJECTIVE 2

The second purpose of this study was to investigate whether the phonological context influences the discrimination of the nasals /m/ and /n/ in syllable final position, considering the following previous vowels as variables: / ɪ, æ, oʊ, eɪ, ʌ /. Table 10 shows the numbers and the percentages of the interference of the previous vowel in the perception of the coda nasals in the Categorial Discrimination Test. The results are based on the analysis of both trials, that is, different and catch trials.

Table 10. The influence of previous vowel on the perception of the English coda nasals in the CDT.

Previous Vowel	No. Answers	No. Correct Answers	% Correct Answers
/ʌ/	160	88	55.00
/æ/	160	79	49.37
/oʊ/	160	68	42.50
/eɪ/	160	67	41.87
/ɪ/	160	50	31.25
Total	800	352	44.00

The results show that the target nasals were most accurately discriminated when the previous vowel was /ʌ/ (55%). The difference between the scores of previous vowel /ʌ/ compared to the scores of previous vowels /ɪ, oʊ, eɪ/ resulted in a significant chi-square values: /ʌ/ -/ɪ/ ($X2$ (1, N = 320) = 18.39, p > .0001); /ʌ/ -/oʊ/ ($X2$ (1, N = 320) = 5.00, p = .02); and /ʌ/ -/eɪ/ ($X2$ (1, N = 320) = 5.51, p = .01). However, the difference between the scores of the vowels /ʌ/ and /æ/ resulted in a non-significant chi-square ($X2$ (1, N = 320) = 1.01, p = .31).

The results also show that the previous vowel in the context of which the participants had most difficulties in discriminating the coda nasal was /ɪ/ (31.25% of accurate responses). The difference between the scores of this previous vowel compared to the scores of the previous vowels /æ, oʊ, eɪ/ resulted in significant chi-square values: /ɪ/ -/æ/ ($X2$ (1, N = 320) = 10.92, p > .0009); /ɪ/ -/oʊ/ ($X2$ (1, N = 320) = 4.34, p = .03); and /ɪ/ -/eɪ/ ($X2$ (1, N = 320) = 3.89, p = .04). Note that /ɪ/ was the second most difficult context vowel for native speakers in the CDT (70% of accurate responses).

The results indicate that the participants had nearly the same difficulty in perceiving the target nasals when the previous vowel was either /eɪ/ or /oʊ/. The coda nasals were correctly perceived in 93 cases after the context vowel /eɪ/ and in 92 cases after the context vowel /oʊ/ resulting in a non-significant chi-square ($X2$ (1, N = 320) = .01, p = .90). The difference between the scores of these previous vowels compared to the vowel /æ/ also resulted in a non-significant chi-square value: /oʊ/ - /æ/ ($X2$ (1, N = 320) = 1.52, p = .21), and /eɪ/ - /æ/ ($X2$ (1, N = 320) = 1.81, p = .17). According to the results, low context vowels seemed to favor correct discrimination of the target nasals for both native speakers and non-native speakers. Overall, that there was considerable similarity between the native speakers and the Brazilian learners' results in the Categorial Discrimination Test by context vowel: the only difference in order of difficulty was between the two most difficult context vowels /eɪ/ and /ɪ/.

Table 11 shows the numbers and the percentages of correctly perceived items in the native-like vs. non-native-like Identification Test, according to previous vowel. The results are based on the analysis of both different and catch trials.

Table 11. The influence of previous vowel on the perception of the English coda nasals in the native-like vs. non-native-like Identification Test.

Previous Vowel	No. Answers	No. Correct Answers	% Correct Answers
/ʌ/	160	94	58.75
/ɪ/	160	80	50.00
/æ/	160	79	49.37
/oʊ/	160	64	40.00
/eɪ/	160	49	30.62
Total	800	366	45.75

The previous vowel in the context of which the participants had most difficulty in identifying the native-like coda nasal was / eɪ /. The participants accurately identified the target nasals in 30.62% of the cases. The difference between the scores of previous vowel /eɪ/ compared to the scores of previous vowels /ɪ, æ, ʌ/ resulted in significant chi-square values: /eɪ/ -/ɪ/ (X2 (1, N = 320) = 12.48, p = .0004), /eɪ/ -/æ/ (X2 (1, N = 320) = 11.71, p = .0006), and /eɪ/ - /ʌ/ (X2 (1, N = 320) = 25.60, p < .0001). However, the difference between the scores of the vowels /eɪ/ and /oʊ/ resulted in a non-significant chi-square (X2 (1, N = 320) = 3.07, p = .07). This result is consistent with the results of the native speakers. The previous vowel / eɪ / was also the previous vowel in the context of which the native speakers had most difficulty in perceiving the native-like nasal consonant, but this is the only similarity to the native speakers' results in the Identification Test.

The results also show that the native-like nasals /m/ and /n/ in syllable-final position were most accurately identified when the previous vowel was /ʌ/. The participants perceived the coda nasal in 94 cases. The difference between the scores of this previous vowel compared to the scores of the previous vowels /oʊ/ resulted in a significant chi-square (X2 (1, N = 320) = 11.25, p = .0007). However, the difference between the scores of the previous vowel /ʌ/ compared to the vowels /ɪ/ and /æ/ resulted in non-significant chi-square values: /ʌ/ - /ɪ/ (X2 (1, N = 320) = 2.46, p = .11); and /ʌ/ - /æ/ (X2 (1, N = 320) = 2.83, p = .09).

Table 11 reveals that the participants in general had nearly the same difficulty in identifying the coda nasal consonants when the previous vowel was either /ɪ/ or /æ/. The difference between the scores of these vowels was not statistically significant (X2 (1, N =320) = .01, p = .91). The difference between the scores of the previous vowels /ɪ/ and /æ/ compared to the vowel /oʊ/ was also statistically non-significant: /ɪ/ - /oʊ/ (X2 (1, N = 320) + 3.23, p = .07), and /æ/ - /oʊ/ (X2 (1, N = 320) = 2.84, p = .09).

Table 12 shows a comparison of the results of the accurate perception of the nasals/m/ and /n/ in both perception tests: The Categorial Discrimination Test and the Identification considering the interference of the previous vowel.

Table 12. The influence of previous vowel on the perception of the English coda nasals in both perception tests.

Previous Vowel	% Correct Answers CDT	% Correct Answers Identification Test
/ʌ /	55.00	58.75
/æ/	49.37	49.37
/oʊ/	42.50	40.00
/eɪ/	41.87	30.62
/ɪ/	31.25	50.00

Table 12 shows that the order of correct responses for each of the previous vowels in both perception tests was nearly the same. The only previous vowel that was in a different order was /ɪ/. The results of the comparison of the two perception tests 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 12 shows that the

previous vowel /æ/ yielded the same difficulty in both perception tests (49.37% of accurate responses). The results suggest that low previous vowels seem to favor the perception of the target nasal consonants by the Brazilian learners.

The previous vowels which most disfavored the accurate perception of the English coda nasals were /ɪ/ in the CDT, and /eɪ/ in the Identification Test. In fact, these vowels also seemed to influence the accurate response of the native speakers, since the previous vowel /eɪ/ most disfavored perception in both perception tests, and /ɪ/ also seemed to yield difficulty in the Categorial Discrimination Test. The fact that both native and non-native participants obtained rather low scores in the context of the same previous vowels may provide evidence that this variable influences the perceptual performance of the nasals /m/ and /n/ in syllable-final position.

4.3 Production

As described in Chapter 3, a Sentence Reading test was used in order to investigate the production of the Brazilian EFL learners. Table 13 shows individual results of the production test.

Table 13. Individual results of the production test.

Participant	No. Answers	No. Correct Answers	% Correct Answers
1	142	92	64.79
2	144	105	72.92
3	138	80	57.97
4	143	88	61.54
5	142	72	50.70
6	143	95	66.43
7	144	64	44.44
8	144	87	60.42
9	143	94	65.73
10	144	91	63.19
11	144	104	72.22
12	144	74	51.39
13	144	104	72.22
14	144	99	68.75
15	144	76	52.78
16	144	77	53.47
17	144	90	62.50
18	144	95	65.97
19	143	75	52.45
20	144	96	66.67
Total	2866	1758	61.34

The results reveal considerable variability among the individual scores of the participants, ranging from 44.44% (minimum score) to 72.92% (maximum score), with an average of 61.34%. Participant 3 produced the highest number of excluded tokens, due to mispronunciation other than the nasal (6 tokens). Only Participant 7 produced less than half

of the tokens correctly, i.e., with a fully realized syllable-final nasal. Most participants (sixteen out of twenty) correctly produced the target nasal consonants within the range of 50-60%, and only three participants obtained over 70% of correct answers. The results indicate that the production of the nasals /m/ and /n/ in syllable-final position caused all of the participants a certain degree of difficulty.

4.3.1 Influence of Brazilian Portuguese nasalization – OBJECTIVE 3

The third purpose of the present study was to investigate the interference of the lack of fully realized coda nasals in Brazilian Portuguese in the interlanguage production of English nasal consonants in syllable-final position. Table 14 indicates the total accurate production of the nasals /m/ and /n/ in the coda in monosyllabic and disyllabic words.

Table 14. The production of /m/ and /n/ in syllable-final position.

Nasal	No. Prod.	No. Correct Prod.	% Correct Prod.
/m/	1434	709	49.44
/n/	1432	1049	73.25
Total	2866	1758	61.34

The results show that in 38.66% of the data analyzed the nasal consonants were not accurately produced, i.e., fully realized. Table 14 also shows that in the present study, the nasal /n/ was more accurately produced than /m/ in syllable-final position, resulting in highly significant chi-square ($X2$ (1, N= 2,866) = 171.31, p < .0001). This reveals that the production of the nasal /m/ in monosyllabic and disyllabic words is more difficult for the Brazilian learners than the production of the nasal /n/ in the coda. Word-final nasals in

Brazilian Portuguese are almost always written with the grapheme 'm' (e.g., *fim* – 'end', *correm* – 'they run'). Few words are written with the grapheme 'n' in BP (e.g., hífen – 'hyphen', pólen – 'pollen'). Thus, results may suggest that when the English words ended in 'm', association was probably made with the L1 of the participants, causing the vowel nasalization error. On the other hand, words ending in 'n' seemed to cause less association to the L1.

Table 15 shows the strategies used by the Brazilian learners when they did not accurately produced the English coda nasals (1108 out of 2866 cases).

Table 15. 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

The results show that in most of the 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 Baptista and Silva Filho (1997), where "vowel-nasal sequences were frequently pronounced as nasal vowels without the final consonant" (p.29), and those of Monahan (2001), who found that Brazilian Portuguese learners transfer the process of regressive assimilation of nasality and nasal deletion in syllable-final position into their interlanguage production of English coda nasals.

4.3.2 Influence of the length of the word – OBJECTIVE 4

The fourth purpose of this paper was to investigate whether the length of the word (disyllabic vs. monosyllabic words) influences the production of the nasal in syllable-final position. Table 16 shows the participants' accurate production of the nasals /m/ and /n/ analyzed altogether in both types of word.

Table 16. The production of the English coda nasals in disyllabic and monosyllabic words.

Word	No. Productions	No. Correct Prod.	% Correct Prod.
Monosyllabic	1435	851	59.30
Disyllabic	1431	907	63.38
Total	2866	1758	61.34

Table 18 shows that 59.30% of the coda nasals in the monosyllabic words were accurately produced, whereas in the disyllabic words 63.38% of the coda nasals were produced, resulting in a significant chi-square (X2 (1, N= 2,866) = 5.02, p = .02). The results indicate that the participants had less difficulty in accurately producing the target nasals in disyllables. The disyllabic words in the present study were generally followed by consonants, whereas in the monosyllabic words, the following context of the target nasal varied regarding consonants, vowel and silence. Therefore, the constancy of following context in the disyllabic words seemed to favor the production of the nasal consonants, as in Brazilian Portuguese, the degree of vowel nasality is less strong before a nasal consonant assimilated to following consonant (Mateus, 1975, cited in Baptista, 1988). It is expected that environment may play an important role in the accurate production of the target nasals by the Brazilian Portuguese learners.

4.3.3 Influence of the phonological context – OBJECTIVE 5

The fifth goal of this paper was to investigate which phonological contexts interfere the most in the interlanguage production of English nasals in the coda, considering, as mentioned in Chapter 3, previous vowel and following context as variables for the monosyllables, and stress of the target syllable as a variable for the disyllables.

4.3.3.1 Monosyllabic words

Table 17 shows the results of the production of the coda nasals in monosyllabic words, according to the previous vowel of the target syllable. The previous vowels considered in this study for production, as mentioned in 3.4.2, were: / ɪ, æ, ʌ, i/.

Table 17. The influence of the previous vowel on the production of the coda nasals in monosyllabic words.

Previous Vowel	No. Productions	No. Correct Prod.	% Correct Prod
/æ/	356	232	65.17
/i/	360	227	63.06
/ɪ/	359	200	55.71
/ʌ/	360	192	53.33
Total	1435	851	59.30

The results show that the vowel after which the participants had most difficulty in producing the English coda nasal was /ʌ/. The difference between the scores of this previous vowel compared to the scores of previous vowel /æ/ and /i/ resulted in significant chi-square values: /ʌ/ - /æ/ (X2 (1, N= 716) = 10.38, p = .001); and /ʌ/ - /i/ (X2 (1, N= 720) = 6.99, p = .008). However, the difference between the scores of the vowels /ʌ/ and /ɪ/ resulted in a non-significant chi-square (X2 (1, N = 719) = .40, p = .52).

This result may be related to the fact that this vowel does not exist in Brazilian Portuguese. The analysis also reveals that the vowel /ʌ/ was produced as the vowel /u/ in 88 out of the 360 cases. This result may reveal a spelling interference of the vowel 'u' in a word such as *sum*. The analysis also reveals that in 63.64% of the cases (56 cases) in which the previous vowel was produced as /u/, it was nasalized and the nasal consonant was deleted, thus suggesting a relation between the mispronunciation of the vowel and the nasalization process. A comparison of the results between the production test and the two perception tests reveals a lack of correspondence regarding /ʌ/ as a previous vowel. Results revealed that this vowel most favored accurate perception of the target nasals in the perception tests, whereas in the production test, this previous vowel most disfavored the production of the nasal consonant.

The difference between the scores was statistically significant concerning the following vowel comparisons: /ɪ/ -/æ/ ($X2$ (1, N = 715) = 6.68, p = .009); and /ɪ/ - /i/ ($X2$ (1, N = 719) = 4.02, p < .04). However the comparison of the previous vowels /æ/ - /i/ resulted in a non-significant chi-square ($X2$ (1, N = 716) = .34, p = .55). The results suggest that the accurate production of the target nasal consonants may be influenced by the previous vowel. However, analyzing deeply the nature of the interference of these two vowels is beyond the scope of the present paper, and the difference in production among the other vowel contexts is small and quite not significant.

Regarding the following context, Table 18 shows the results of the influence of the following context on the production of the nasals in syllable-final position in the

monosyllabic words. The following contexts considered in this study, as previously mentioned, were consonant, vowel and silence.

Table 18. The influence of the following context on the production of the coda nasals in monosyllabic words.

Following context	No. Production	No. Correct Prod.	% Correct Prod
Vowel	480	311	64.79
Consonant	477	299	62.68
Silence	478	241	50.42
Total	1435	851	59.30

The following context in which the participants had most difficulty in producing the English coda nasal was silence. The participants failed in accurately producing the coda nasals in 237 cases followed by silence. The difference between the scores of silence and consonant as following context yielded highly significant results ($X2$ (1, $N = 955$) = 14.61, $p = .0001$). The difference between the score of silence and vowel also resulted in a highly significant chi-square ($X2$ (1, $N = 958$) = .20.26, $p < .0001$). The only non-significant chi-square resulted from the difference between the scores of consonants and vowel as following context in monosyllabic words ($X2$ (1, $N = 957$) = .46, $p = .49$).

Notwithstanding the lack of significance in the vowels vs. consonant context, these results seem to be consistent with the three degrees of vowel nasalization recognized by Mateus (1975, cited in Baptista, 1988) in Brazilian Portuguese (reviewed in 2.3). She states that the degree of vowel nasality before a deleted nasal consonant is strong. This seemed to be the case of the present study, concerning silence as following context in the interlanguage production of the target nasals. According to Mateus, the degree of vowel nasality in Brazilian Portuguese is less strong before a nasal consonant assimilated to a following consonant (e.g., *onde* – 'where') and weak before a specified nasal consonant

neither deleted nor assimilated (e.g., *ano* – 'year'). The results indicate that the accurate production of the English coda nasals in each of the following contexts tested followed the degree of vowel nasality in BP. Thus, the results of the present research may suggest that the accurate production of the English coda nasals may be influenced by the degree of vowel nasality of Brazilian Portuguese in similar contexts, and that Baptista's (1988) claim that nasal consonants in Brazilian Portuguese affect their environment with the spreading of their relevant feature may be true for Portuguese/English interlanguage as well.

4.3.3.2 Disyllabic Words

Regarding the influence of phonological context for the disyllabic words, Table 19 shows the rate of correct production of the syllable-final nasals, according to stress and position in the word. As mentioned in 3.4.2, the target words containing the English coda nasals followed four different patterns: (1) the target nasal was stressed in the first syllable of the word; (2) the target nasal was stressed in the second syllable of the word; (3) the target nasal was unstressed in the first syllable of the word; and (4) the target nasal was unstressed in the second syllable of the word.

Table 19. The influence of stress and position of the English coda nasals on the production of disyllabic words.

Stress Pattern	No. Prod	No. Correct Prod.	% Correct Prod
Nasal stressed in the first syllable	359	253	70.47
Nasal stressed in the second syllable	356	219	61.52
Nasal unstressed in the first syllable	359	207	57.66
Nasal unstressed in the second syllable	357	228	63.87
Total	1431	907	63.45

Table 19 shows that the participants most produced the coda nasal when it was stressed in the first position in the word (70.47%). The results also show that the participants had most difficulty in producing the English target nasals when they were unstressed in the first syllable in the word. The participants failed in accurately producing the coda nasals in 42.34% of the cases. The difference between these patterns resulted in a significant chi-square $(X2 (1, N = 718) = 12.27, p = .0004)$.

The results reveal that the participants had nearly the same difficulty in accurately producing the nasal consonant when it was placed in the second syllable, either in a stressed syllable (61.52%) or an unstressed syllable (63.45%), resulting in a non significant chi-square $(X2 (1, N = 713) = .42, p = .51)$. The difference between the scores of the nasal stressed in either first or second syllable was statistically significant $(X2 (1, N = 715) = 6.39, p = .01)$.

The target coda nasals in the second syllable were generally followed by either a consonant or silence, whereas the target nasal consonants in the first syllable were always followed by a consonant. It was expected that the Brazilian learners would have less difficulty in producing the English coda nasals in the first syllable due to the fact that those nasals were only followed by consonants, which has less strong vowel nasality in BP, as was discussed in 4.3.3.1. However, this was not the case of the present study, except in the case of stressed syllables with nasal codas. The difference between the scores comparing position of the target nasal in both stressed an unstressed syllables yielded the following non-significant results: nasal stressed in the first syllable vs. nasal unstressed in the second position $(X2 (1, N = 716) = 3.54, p = .059)$, nasal stressed in the second position vs. nasal unstressed in the first position $(X2 (1, N = 715) = .95, p = .32)$, and nasal unstressed in the first position vs. nasal unstressed in the second position $(X2 (1, N = 716) = 2.64, p = .10)$.

The results also indicate that, in the present study, production of the English coda nasals in disyllabic words seemed to be inconsistent considering stress of the target syllable by the Brazilian learners.

4.3.4. Relationship between perception and production - OBJECTIVE 6

The sixth objective of this study was to investigate whether there is a relationship between the perception and the production of the English syllable-final nasals by the participants. Table 20 lists the performance of each of the twenty participants in the perception and in the production tests, regarding the percentage of accurate responses in each test.

Table 20. Individual results in both perception tests and in the production test.

Participant	% Correct Answers CDT	% Correct Answers Identification Test	% Correct Productions
1	47.50	55.00	64.79
2	67.50	45.00	72.92
3	37.50	57.50	57.97
4	40.00	50.00	61.54
5	25.00	30.00	50.70
6	45.00	50.00	66.43
7	30.00	42.50	44.44
8	40.00	40.00	60.42
9	42.50	37.50	65.73
10	20.00	42.50	63.19
11	47.50	50.00	72.22
12	27.50	35.00	51.39
13	70.00	52.50	72.22
14	57.50	47.50	68.75
15	37.50	45.00	52.78
16	45.00	50.00	53.47
17	60.00	62.50	62.50
18	27.50	47.50	65.97
19	30.00	32.50	52.45
20	52.50	42.50	66.67

The results show that all participants had a better performance in the production test. Regarding the perception test, the participants, in general, obtained higher scores in the Identification Test than in the Categorial Discrimination Test (15 out of twenty). Only five participants performed better in the CDT than in the Identification Test. The results also show that, in general, the percentage of accurate responses of the participants gradually

increased from the Categorial Discrimination Test to the Identification Test to the production test (fifteen out of twenty). Only Participants 2, 9, 13, 14 and 20 did not follow this tendency.

The overall results of the twenty Brazilian participants in the Categorial Discrimination Test and the production test support the existence of a positive correlation (r = .6974) between their perception and production, since the significance value was p < 0.001. The overall results of the Brazilian participants in the native-like vs. non-native-like Identification Test and the production test also support the existence of a positive correlation (r = .3946) between perception and production, since the significance value was p < .05. It might be expected that for accurate production, the learner would need accurate perception, which seemed to be case of the present study, considering both perception tests. Results seem to indicate that there is a 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 does not seem to corroborate Flege's Speech Learning Model (1995) that claims that "without accurate perceptual 'targets' to guide the sensorimotor learning of L2 sounds, production of the L2 sounds will be inaccurate" (p.238).

CHAPTER 5

CONCLUSION

5.1 Major findings

As regards the perception of nasal consonants in syllable-final position, results suggest that the lack of fully realized coda nasals in Brazilian Portuguese interfered with accurate perception by the Brazilian learners in both perception tests. Results showed that both the Categorial Discrimination Test and the native vs. non-native-like Identification Test were quite difficult for the Brazilian learners, as students failed to accurately perceive the English coda nasals in less than half of the trials. The native speakers who took both perception tests also seemed to have some difficulty, although to a much lesser degree. In the CDT, the control group obtained lower scores than those suggested by Flege et al. (1994). In the native-like vs. non-native-like Identification Test, the native speakers scored even lower; however, these results may have been influenced by the fact that they might not be familiar with BP distinctions. Type of trial seemed to be relevant for both native and non-native speakers in the CDT; however in the Identification Test, the presence or absence of contrast between the coda nasals, i.e., different vs. catch trials, was only relevant for the Brazilian participants.

Considering the phonological context in both perception tests, results suggested that the Brazilian learners and the native speakers seemed to have difficulty in accurately perceiving the coda nasals in the context of nearly the same previous vowels in both perception tests. The previous vowel /eɪ/ most disfavored the perception of the English coda nasals in both tests by the native speakers, and in the Identification Test by the

Brazilian participants. /ɪ/ was the context vowel which seemed to most disfavor the discrimination of the target nasal consonant in the CDT by the Brazilian learners, and also disfavor the native group in their accurate discrimination. Results also revealed that low vowels seemed to favor accurate perception of the coda nasal consonants by the Brazilian learners in the two perception tests.

As regards production, results confirm the prediction that there was considerable influence of the lack of fully realized vowel coda nasals in Brazilian Portuguese. In most of the cases when the coda nasals were not produced, the participants nasalized the vowel and deleted the nasal consonant. Considering length of the word (monosyllabic vs. disyllabic words), the results indicated that the English coda nasals were more accurately produced in disyllabic words, which may be related to the fact that disyllabic words were generally followed by a consonant, which, in BP, causes a weaker degree of vowel nasality.

Considering the phonological context in the monosyllabic words (previous vowel and following context), the results showed that the previous vowel /ʌ/ seemed to be the context in which the participants had most difficulty in producing the English coda nasals. According to the results, the following context in which the participants had most difficulty in producing the coda nasal was silence. This result seemed to follow the degree of vowel nasality suggested by Mateus (1975, cited in Baptista, 1988), which states that the degree of vowel nasality is strongest before a deleted nasal consonant. Regarding the phonological context in the disyllabic words (stress of the target syllable), the results suggested that the production of the target nasals was inconsistent regarding stress and position of the nasal consonant.

Considering the relationship between perception and production, results showed that there was a positive correlation between the two perception tests and the production test. The overall results revealed that the performance of the Brazilian learners was better in the production test, and that, in general, their scores increased from the Categorial Discrimination Test to Identification Test to the production test.

5.2 Pedagogical implications

Research in interlanguage phonetics and phonology has produced few studies, especially considering Brazilian English interphonology. Such studies are very important both to contribute to theoretical development in this area, and to contribute to the improvement of pronunciation teaching and the development of pronunciation materials concerning the Brazilian Portuguese speakers' specific difficulties considering English learning.

The results of this study may be useful as an indication of Brazilians' tendencies towards their difficulties regarding perception and production of the nasals /m/ and /n/. Thus, if L2 teachers become aware of which variables may favor/disfavor the accurate production of the target nasals, they can help their learners to improve their production by presenting and practicing those consonants. Concerning BP learners of English, teachers could help them when teaching the pronunciation of English coda nasals by calling their attention to place of articulation differences of the target nasals in BP and English.

Phonological context seemed to play an important role in the accurate perception and production of the nasal consonants in syllable-final position. As regards production, following context seemed to be an important variable to considered when teaching English

nasals in the coda. Special attention should be given when the target nasal is followed by silence, due to the fact that this seems to be the following context that most disfavor the accurate production of the English coda nasals. Previous vowel also seems to be an important variable for accurate production of /m/ and /n/ in the coda. Teacher could call the students' attention to pronunciation of the English vowels together with the English nasal consonants in syllable-final position. As regards perception, previous vowel also seems to influence the accurate identification/discrimination of the English nasals in the coda. It was less difficult for the BP listeners identify/discriminate the target nasal consonants in the context of low previous vowels, this could be presented first to the learners.

5.3 Limitations and suggestions for further research

During the process of data analysis, several limitations of this study emerged. The present study focused only on the pre-intermediate level. Performance of Brazilian EFL students could be investigated across levels, checking whether perception and production of English coda nasals improves as students become more proficient. Another important limitation of the present study is in terms of variables in the investigation of phonological context. Other variables which could have investigated are the extent to which the production of the vowels preceding the nasals were English-like, and which following consonants favor/disfavor the accurate production of the nasal consonants.

The limitations found in this study, however, provide suggestions for future research. Research projects could investigate more thoroughly the phonological context concerning both previous and following segments. Studies could investigate which vowels, considering all the vowels in the language inventory, most favor/disfavor the production of

the target nasals, and which consonants influence the production of the nasals in syllable-final position, as regards markedness.

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Appendix A

Name: _____

Date: _____

Speaking task

Talk about the following topic for one minute.

To perform this task, press <DRILL> at the command of the researcher and start the task.
At the command of the researcher, press <STOP>.

You won some money in the lottery. Plan your next vacation around the world.
If you wish, you may use the questions below to help you.

- ❖ When are you going to take your next vacation?
- ❖ Where are you going?
- ❖ How are you going to travel?
- ❖ What places are you going to visit?
- ❖ Where are you going to stay?
- ❖ What are you going to do and see there?
- ❖ Is anyone going to travel with you? Who?
- ❖ What do you need to take with you?

UNIVERSIDADE FEDERAL DE SANTA CATARINA
CENTRO DE COMUNICAÇÃO E EXPRESSÃO
DEPARTAMENTO DE LÍNGUA E LITERATURA ESTRANGEIRA
Curso Extracurricular de Inglês - Level 4

Name: _____

Date: _____

Speaking task

Talk about the following topic for one minute.

To perform this task, press <DRILL> at the command of the researcher and start the task.
At the command of the researcher, press <STOP>.

Let's go to the movies! Talk about movies.
If you wish, you may use the questions below to help you.

> ❖ What kinds of movies are you interested in? Why?
> ❖ What kind of movies do you find boring?
> ❖ Who are your favorite actors/actresses? Why?
> ❖ Are there any actors/actresses you don't like?
> ❖ What's one of the most exciting movies you have ever seen? What did you like about it?

Appendix B

Free Speech Rating:

Rate the accent of each speech from **1 to 5**: **1** being non-native- like and **5** close to native-like.

1.

1	2	3	4	5

2.

1	2	3	4	5

3.

1	2	3	4	5

4.

1	2	3	4	5

5.

1	2	3	4	5

6.

1	2	3	4	5

7.

1	2	3	4	5

8.

1	2	3	4	5

9.

1	2	3	4	5

10.

1	2	3	4	5

11.

1	2	3	4	5

12.

1	2	3	4	5

13.

1	2	3	4	5

Appendix C

Questionnaire Results

	AGE	SEX	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
1	23	M	Y	4	10	W	N	-	-	-	-	3	1	N	-	-	-	-	N	N	Y	Y	N	N	-	-	1	1
2	21	F	Y	1H	15	W	N	-	-	-	-	3	1	N	-	-	-	-	N	N	Y	N	N	N	-	-	2	2
3	19	F	Y	5	11	W	Y	Sesc	97	99	2	3	1	N	-	-	-	-	N	N	Y	N	N	N	-	-	1	1
4	43	F	Y	1H	14	W	Y	Private Class	99	00	3	4	-	N	-	-	-	-	N	N	N	N	N	Y	F	Ger	3	3
5	19	F	Y	3	9	W	Y	CNA	95	01	3	4	1	N	-	-	-	-	N	N	Y	Y	Y	Y	S	Spa	4	4
6	19	M	Y	5	11	W	Y	Private Class	-	98	4	3	-	N	-	-	-	-			Y	Y	N	Y	F/S	Ger	5	5
7	21	F	Y	5	11	W	N	-	-	-	-	3	2	N	-	-	-	-	N	N	N	Y	Y	N	-	-	6	6
8	22	M	N	-	-	-	Y	Senac	02	02	4	3	1	N	-	-	-	-	N	N	Y	N	N	Y	S	Spa	7	7
9	23	M	Y	1H	13	W	Y	Free Way	01	01	2	4	1	N	-	-	-	-	N	N	Y	Y	Y	Y	S	Spa	1	4
10	44	M	Y	5	11	W/O	N	-	-	-	-	4	1	N	-	-	-	-	N	N	N	Y	N	Y	F	Ger	8	4
11	16	F	Y	7	13	W	N	-	-	-	-	3	1	N	-	-	-	-	N	N	Y	Y	N	Y	F	Ita	9	4
12	18	F	Y	4	10	W	N	-	-	-	-	3	1	N	-	-	-	-	N	N	N	N	N	N	-	-	10	8
13	24	M	Y	8	14	W	N	-	-	-	-	4	-	N	-	-	-	-	N	N	N	Y	Y	N	-	-	11	4
14	21	M	Y	7	13	W	N	-	-	-	-	3	4	N	-	-	-	-	Y	N	Y	N	N	Y	S	Spa	12	-
15	22	F	Y	1	7	W	Y	Yazigi	96	99	3	3	-	N	-	-	-	-	N	N	N	Y	N	Y	F	Ita	13	4
16	19	F	Y	5	12	W	Y	English for All	00	02	2	4	2	N	-	-	-	-	N	N	N	Y	Y	Y	S	Spa	14	2
17	21	F	Y	5	11	W	N	-	-	-	-	4	1	N	-	-	-	-	N	N	N	Y	Y	Y	S	Jap	15	9
18	25	F	Y	4	-	W	Y	Senac	99	02	2	4	1	N	-	-	-	-	N	N	N	Y	N	N	-	-	12	2
19	20	F	Y	5	10	W	Y	Wizard	94	95	2	4	1	N	-	-	-	-	N	N	N	Y	N	N	-	-	1	4
20	26	F	Y	4	10	W	Y	Yazigi	97	97	3	4	2	N	-	-	-	-	Y	N	Y	Y	Y	Y	S	Fren	16	9

Key

Q 6

1- 1ª série
3 - 3ª série
4 - 4ª série
5- 5ª série
7- 7ª série
8- 8ª série
1H - 1ª série ensino médio

Q 8

O- Oral
W – Writing

Q 27
F- Family
S- School

Q 28
Ger – German
Spa – Spanish
Ita – Italian
Fren – French

Q 29

1- Florianópolis - SC
2- Maravilha –SC
3- Santa Maria – RS
4- Curitiba – PR
5- Tenente Portela – RS
6- São Lourenço do Oeste –SC
7- Cascavel – PR
8- Blumenau – SC
9 - Brusque - SC
10 – Laguna – SC

11 – Marau – RS
12- Lages – RS
13- Tubarão – SC
14- Rio do Sul – SC
15- São Paulo – SP
16- São José dos Campos - SP

Q 30
1 – Florianópolis - SC
2- Santa Catarina
3- Northwest of Rio Grande do Sul
4- South of Brazil
5- Rio Grande do Sul
6- West of Santa Catarina
7- West of Paraná
8- South of Santa Catarina
9- São Paulo

Appendix D

Universidade Federal de Santa Catarina
Curso de Pós-Graduação em Inglês e Literatura Correspondentes
Aluna: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

Questionário sobre participantes de pesquisa de campo:

Por favor, responda às perguntas abaixo. Este questionário objetiva obter somente informações que serão utilizadas para auxiliar a análise de dados da presente pesquisa conduzida pela aluna acima citada. Em nenhuma hipótese os nomes dos participantes serão divulgados, pois esta é uma pesquisa quantitativa.

1. Nome: _____ 2. Data: _____
3. Idade: _____ 4. Sexo: FEM / MASC

Responda às perguntas abaixo procurando ser o mais especifico possível sobre os eu contato com a língua inglesa.

5. Fez inglês no colégio? SIM / NÃO

6. Desde que série? _____

7. Qual a sua idade na época? _____

8. As aulas exploravam comunicação escrita e oral?
_____

9. Fez curso de inglês além do Curso Extracurricular desta universidade? SIM / NÃO

10. Qual curso/escola? _____

11. Em que ano começou? _____

12. Em que ano terminou/ parou? _____

13. Quantas horas por semana tinha o curso em média? _____

14. Qual o nível que freqüenta este semestre no Curso Extracurricular desta universidade?
_____

15. Quantas horas por semana, além do curso, você se dedica ao estudo da língua inglesa?
_____

16. Tem vivência em país de língua inglesa? SIM / NÃO

17. Por quanto tempo? _____

18. Quantos anos você tinha na época? _____

19. Freqüentou escola naquele país? SIM / NÃO

20. Que tipo de escola/ curso? _____

21. Conversa com freqüência em inglês com outros brasileiros? SIM / NÃO

22. Conversa freqüentemente em inglês com falantes nativos? SIM / NÃO

23. Assiste a filmes sem dublagem com freqüência? SIM / NÃO

24. Ouve música em inglês com freqüência? SIM / NÃO

25. Transcreve (tira) letras de músicas? SIM / NÃO

26. Estuda, estudou ou tem contato com outra língua estrangeira? SIM / NÃO

27. Em que contexto? (escola, trabalho, família,...) _____

28. Qual língua? _____

29. Em que cidade foi criado/a? _____

30. Qual sotaque você considera ter no português? (por exemplo: norte/sul do país, do estado)
_____

31. Adicione qualquer informação que considere interessante em relação ao seu contato com a língua inglesa.
_____
_____
_____

Universidade Federal de Santa Catarina
Curso de Pós-Graduação em Inglês e Literatura Correspondentes
Researcher: Denise Cristina Kluge
Adviser: Profª Drª. Bárbara Oughton Baptista

Questionnaire about research participants:

Please, answer the question below.
This questionnaire aims only at getting information to help in the analysis of the data of the present study. The names of the participants will not be revealed, as this is a quantitative research.

1. Name: _____ 2. Date: _____
3. Age: _____ 4. Gender: Female / Male

Answer the questions below about your contact with English, being as specific as possible.

5. Did you study English at school? YES / NO

6. When did you start? _____

7. How old were you at that time? _____

8. Did the classes develop written and oral expression? _____

9. Have you taken other language courses besides the Extracurricular? YES / NO

10. What course? _____

11. When did you start? _____

12. When did you finish/stop? _____

13. How many class hours a week, on the average, were devoted to the course?
_____

14. What level are you in the Extracurricular?
_____

15. How many hours a week, besides the course hours, do you dedicate to English study?
_____

16. Have you lived in an English speaking country? YES / NO

17. For how long? _____

18. How old were you at that time? _____

19. Did you go to school there? YES / NO

20. What kind of school/course was it? _____

21. Do you often speak English with other Brazilians? YES / NO

22. Do you often speak English with native speakers? YES / NO

23. Do you often watch movies without dubbing? YES / NO

24. Do you often listen to music in English? YES / NO

25. Do you try to write the lyrics of the songs you hear? YES / NO

26. Do you study/have you studied/do you have contact with any other foreign language? YES / NO

27. In what context? (school, work, family...) _____

28. What language? _____

29.Where did you grow up? _____

30. What is your regional accent in Portuguese?
_____

31. Add any information about your contact with English you consider important.
_____
_____
_____

Appendix E

Categorial Discrimination Test

Minimal Pairs and the previous vowels

Previous vowel /ɪ/

Tim / tin

Previous vowel /æ/

cam / can

Previous vowel /oʊ/

tome / tone

Previous vowel /eɪ/

came / cane

Previous vowel /ʌ/

bum / bun

Appendix F

Categorial Discrimination Test - Trails

* catch trials
<u>underlined</u> – different trials (English native-like pronunciation)
bold – distractor trials

1. Tim Tim Tim *
2. cam cam <u>can</u>
3. **tree <u>three</u> tree**
4. came <u>cane</u> came
5. <u>bun</u> bum bum
6. **rat rat <u>hat</u>**
7. tome tome <u>tone</u>
8. **<u>live</u> leave leave**
9. **they they they ***
10. **<u>tree</u> three three**
11. cam cam cam *
12. tome tome tome *
13. **live <u>leave</u> live**
14. came came <u>cane</u>
15. bum <u>bun</u> bum
16. **<u>rat</u> hat hat**
17. **tree tree <u>three</u>**
18. **leave <u>live</u> leave**
19. **<u>they</u> day day**
20. <u>Tim</u> tin tin
21. can can can *
22. tone tone tone *
23. can <u>cam</u> can
24. bum bum bum *
25. bum bum <u>bun</u>
26. **hat <u>rat</u> hat**
27. tin tin tin *
28. **leave leave <u>live</u>**
29. **day <u>they</u> day**
30. tin <u>Tim</u> tin
31. <u>cam</u> can can
32. **hat hat <u>rat</u>**
33. <u>came</u> cane cane
34. bun bun bun*
35. **rat rat rat ***
36. <u>tome</u> tone tone
37. **three <u>tree</u> three**

38. <u>leave</u> live live
39. day day <u>they</u>
40. tin tin <u>Tim</u>
41. cane cane cane *
42. leave leave leave *
43. cane <u>came</u> cane
44. <u>bum</u> bun bun
45. hat hat hat *
46. <u>tone</u> tome tome
47. three three <u>tree</u>
48. came came came *
49. <u>day</u> they they
50. <u>tin</u> Tim Tim
51. can can <u>cam</u>
52. tone tone <u>tome</u>
53. cane cane <u>came</u>
54. bun <u>bum</u> bun
55. <u>hat</u> rat rat
56. tree tree tree *
57. tone <u>tome</u> tone
58. live live <u>leave</u>
59. they <u>day</u> they
60. Tim <u>tin</u> Tim
61. <u>can</u> cam cam
62. three three three *
63. <u>cane</u> came came
64. bun bun <u>bum</u>
65. rat <u>hat</u> rat
66. <u>three</u> tree tree
67. live live live *
68. day day day *
69. they they <u>day</u>
70. TimTim <u>tin</u>
71. cam <u>can</u> cam
72. tome <u>tone</u> tome

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Nome do Participante: _____

FOLHA DE RESPOSTA

De acordo com o treinamento prévio você ouvirá seqüências de 3 palavras.

**Circule '1', '2', '3' ou '0'
Não deixe nenhuma seqüência em branco.**

Circule '**1**' se a primeira palavra for diferente das outras;

Circule '**2**' se a segunda palavra for diferente das outras;

Circule '**3**' se a terceira palavra for diferente das outras;

Circule '**0**' se todas as palavras forem iguais.

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Researcher: Denise Cristina Kluge
Adviser: Profª Drª Bárbara Oughton Baptista

N:

Participant's name: _____

ANSWER SHEET

As in the previous training you are going to hear sets of 3 words.

<div style="border:1px solid black; padding:10px; text-align:center;">

Circle '1', '2', '3' ou '0'
Mark all the sequences.

</div>

Circle '**1**' if the first word is different from the others;

Circle '**2**' if the second word is different from the others;

Circle '**3**' if the third word is different from the others;

Circle '**0**' if all the words are the same.

1.	1	2	3	0
2.	1	2	3	0
3.	1	2	3	0
4.	1	2	3	0
5.	1	2	3	0
6.	1	2	3	0
7.	1	2	3	0
8.	1	2	3	0
9.	1	2	3	0
10.	1	2	3	0

1.	1	2	3	0
2.	1	2	3	0
3.	1	2	3	0
4.	1	2	3	0
5.	1	2	3	0
6.	1	2	3	0
7.	1	2	3	0
8.	1	2	3	0
9.	1	2	3	0
10.	1	2	3	0

1.	1	2	3	0
2.	1	2	3	0
3.	1	2	3	0
4.	1	2	3	0
5.	1	2	3	0
6.	1	2	3	0
7.	1	2	3	0
8.	1	2	3	0
9.	1	2	3	0
10.	1	2	3	0

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Nome do participante: _____

TREINAMENTO

Você vai ouvir seqüências de três palavras. Circule o número 1, 2, 3 ou 0, de acordo com o seguinte critério:

Circule '**1**' se a primeira palavra for diferente das outras;
Circule '**2**' se a segunda palavra for diferente das outras;
Circule '**3**' se a terceira palavra for diferente das outras;
Circule '**0**' se todas as palavras forem iguais.

Exemplo:
Para os 4 conjuntos de palavras que você ouvirá, as respostas já foram marcadas.

1.	1	**2**	3	0
2.	**1**	2	3	0
3.	1	2	**3**	0
4.	1	2	3	**0**

Agora você marcará as respostas de 8 conjuntos similares aos anteriores, como um breve treinamento.

5.	1	2	3	0
6.	1	2	3	0
7.	1	2	3	0
8.	1	2	3	0
9.	1	2	3	0
10.	1	2	3	0

1.	1	2	3	0
2.	1	2	3	0

Researcher: Denise Cristina Kluge
Adviser: Profª Drª Bárbara Oughton Baptista

N:

Participant's name: _____

TRAINING SESSION

You are going to hear sequences of 3 words. Circle '1','2','3' or '0', according to the following criteria:

Circle '**1**' if the first word is different from the others;
Circle '**2**' if the second word is different from the others;
Circle '**3**' if the third word is different from the others;
Circle '**0'** if all the words are the same.

Example:
Hear the 4 sets of 3 words each. The answers have been marked for you.

1.	1	**2**	3	0
2.	**1**	2	3	0
3.	1	2	**3**	0
4.	1	2	3	**0**

Now, you are going to hear 8 sets of 3 words each. Mark your answers in the chart bellow. This is a short training.

5.	1	2	3	0
6.	1	2	3	0
7.	1	2	3	0
8.	1	2	3	0
9.	1	2	3	0
10.	1	2	3	0

1.	1	2	3	0
2.	1	2	3	0

Appendix I

Identification Test

Minimal Pairs and the previous vowels

Previous vowel /ɪ/

Tim / tin

Previous vowel /æ/

cam / can

Previous vowel /oʊ/

loam / loan

Previous vowel /eɪ/

maim / main

Previous vowel /ʌ/

bum / bun

Appendix J

Identification Test

* catch trials

<u>underlined</u> – different trials (odd item out)

bold – distractor trials

1. Tim Tim * [tɪm] [tɪm]
2. can can * [cæ̌] [cæ̌]
3. **loan loan * [loʊn] [loʊn]**
4. **ball <u>ball</u>**   [bɔʊ] [bɔl]
5. <u>bum</u> bum   [bʌm] [bʌ̌]
6. **fall fall * [fɔʊ] [fɔʊ]**
7. **call call * [kɔl] [kɔl]**
8. loan loan * [loʊ̌] [loʊ̌]
9. **<u>that</u> that [ðæt] [dæt]**
10. Tim Tim * [tǐ] [tǐ]
11. <u>can</u> can   [cæn] [cæ̌]
12. tin <u>tin</u>   [tǐ] [tɪn]
13. **thick thick * [ɵɪk] [ɵɪk]**
14. main main * [meɪn] [meɪn]
15. bum <u>bum</u> [bʌ̌] [bʌm]
16. **<u>fall</u> fall [fɔl] [fɔʊ]**
17. **call call * [kɔʊ] [kɔʊ]**
18. loam loam * [loʊ̌] [loʊ̌]
19. **that <u>that</u> [dæt] [ðæt]**
20. <u>Tim</u> Tim [tɪm] [tǐ]
21. cam cam* [cæm] [cæm]
22. can <u>can</u> [cæ̌] [cæn]
23. <u>loan</u> loan [loʊn] [loʊ̌]
24. maim maim * [meǐ] [meǐ]
25. bun bun* [bʌn] [bʌn]
26. **fall <u>fall</u> [fɔʊ] [fɔl]**
27. **<u>call</u> call [kɔl] [kɔʊ]**
28. **thick thick * [fɪk] [fɪk]**
29. **this this* [ðɪs][ðɪs]**
30. Tim <u>Tim</u> [tǐ] [tɪm]

31. cam cam * [cæ̌] [cæ̌]

32. loam loam * [loʊm] [loʊm]

33. that that* [ðæt] [ðæt]

34. loan <u>loan</u> [loʊ̌] [loʊn]

35. bum bum * [bʌ̃] [bʌ̃]

36. ball ball* [bɔl] [bɔl]

37. call <u>call</u> [kɔʊ] [kɔl]

38. <u>thick</u> thick [ɵɪk] [fɪk]

39. this this* [dɪs][dɪs]

40. tin tin * [tɪn] [tɪn]

41. <u>cam </u>cam [cæm] [cæ̌]

42. rose <u>rose</u> [hoʊz] [roʊz]

43. maim maim * [meɪm] [meɪm]

44. main <u>main</u> [meǐ] [meɪn]

45. <u>bun </u>bun [bʌn] [bʌ̃]

46. ball ball * [bɔʊ] [bɔʊ]

47. <u>loam</u> loam [loʊm] [loʊ̌]

48. thick <u>thick</u> [fɪk] [ɵɪk]

49. <u>this</u> this [ðɪs][dɪs]

50. tin tin* [tǐ] [tǐ]

51. cam <u>cam </u> [cæ̌] [cæm]

52. rose rose * [roʊz] [roʊz]

53. main main * [meǐ] [meǐ]

54. bum bum * [bʌm] [bʌm]

55. bun <u>bun</u> [bʌ̃] [bʌn]

56. <u>ball </u>ball [bɔl] [bɔʊ]

57. **rose rose* [hoʊz] [hoʊz]**

58. <u>main</u> main [meɪn] [meǐ]

59. this <u>this</u> [dɪs][ðɪs]

60. <u>tin</u> tin [tɪn] [tǐ]

61. can can * [cæn] [cæn]

62. loam <u>loam</u> [loʊ̌] [loʊm]

63. <u>maim</u> maim [meɪm] [meǐ]

64. bun bun* [bʌ̃] [bʌ̃]

65. fall fall* [fɔl] [fɔl]

66. maim <u>maim</u> [meǐ] [meɪm]

67. <u>rose</u> rose [roʊz] [hoʊz]
68. that that * [dæt] [dæt]

Appendix K

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Nome do participante: _____

FOLHA DE RESPOSTA

De acordo com o treinamento prévio você vai ouvir seqüências de 2 pronúncias da mesma palavra em inglês e vai avaliar a pronúncia.
Para cada seqüência você vai identificar a pronúncia que pareça mais americana.

Circule '1ª', '2ª', 'AMBAS' ou
'NENHUMA'
Não deixe nenhuma seqüência em branco.

Circule '**1ª**' se a pronúncia mais americana for a **primeira** que você ouviu**;**

Circule '**2ª**' se a pronúncia mais americana for a **segunda** que você ouviu;

Circule '**AMBAS**' se as **duas** pronúncias parecerem americanas;

Circule '**NENHUMA**' se **nenhuma** das pronúncias parecer americana.

Qual pronúncia é mais americana?

1.	Tim	1ª	2ª	Ambas	Nenhuma
2.	can	1ª	2ª	Ambas	Nenhuma
3.	loan	1ª	2ª	Ambas	Nenhuma
4.	ball	1ª	2ª	Ambas	Nenhuma
5.	bum	1ª	2ª	Ambas	Nenhuma
6.	fall	1ª	2ª	Ambas	Nenhuma
7.	call	1ª	2ª	Ambas	Nenhuma
8.	loan	1ª	2ª	Ambas	Nenhuma
9.	that	1ª	2ª	Ambas	Nenhuma
10.	Tim	1ª	2ª	Ambas	Nenhuma

1.	can	1ª	2ª	Ambas	Nenhuma
2.	tin	1ª	2ª	Ambas	Nenhuma
3.	thick	1ª	2ª	Ambas	Nenhuma
4.	main	1ª	2ª	Ambas	Nenhuma
5.	bum	1ª	2ª	Ambas	Nenhuma
6.	fall	1ª	2ª	Ambas	Nenhuma
7.	call	1ª	2ª	Ambas	Nenhuma
8.	loam	1ª	2ª	Ambas	Nenhuma
9.	that	1ª	2ª	Ambas	Nenhuma
10.	Tim	1ª	2ª	Ambas	Nenhuma

1.	cam	1ª	2ª	Ambas	Nenhuma
2.	can	1ª	2ª	Ambas	Nenhuma
3.	loan	1ª	2ª	Ambas	Nenhuma
4.	maim	1ª	2ª	Ambas	Nenhuma
5.	bun	1ª	2ª	Ambas	Nenhuma
6.	fall	1ª	2ª	Ambas	Nenhuma
7.	call	1ª	2ª	Ambas	Nenhuma
8.	thick	1ª	2ª	Ambas	Nenhuma
9.	this	1ª	2ª	Ambas	Nenhuma
10.	Tim	1ª	2ª	Ambas	Nenhuma

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Researcher: Denise Cristina Kluge
Adviser: Profª Drª Bárbara Oughton Baptista

N:

Participant's name: _____

ANSWER SHEET

As in the previous training you are going to hear sets of 2 pronunciations of the same English word. **For each sequence you are going identify the most English native-like pronunciation.**

> **Circle '1', '2', 'BOTH' or 'NEITHER'**
> **Mark all the sequences.**

Circle '**1**' if the first pronunciation is more English native-like;

Circle '**2**' if the second pronunciation is more English native-like;

Circle '**BOTH**' if both pronunciations are English native-like;

Circle '**NEITHER**' if none of the pronunciations is English native-like;

Which pronunciation is more English native-like?

1.	Tim	1	2	Both	Neither
2.	can	1	2	Both	Neither
3.	loan	1	2	Both	Neither
4.	ball	1	2	Both	Neither
5.	bum	1	2	Both	Neither
6.	fall	1	2	Both	Neither
7.	call	1	2	Both	Neither
8.	loan	1	2	Both	Neither
9.	that	1	2	Both	Neither
10.	Tim	1	2	Both	Neither

1.	can	1	2	Both	Neither
2.	tin	1	2	Both	Neither
3.	thick	1	2	Both	Neither
4.	main	1	2	Both	Neither
5.	bum	1	2	Both	Neither
6.	fall	1	2	Both	Neither
7.	call	1	2	Both	Neither
8.	loam	1	2	Both	Neither
9.	that	1	2	Both	Neither
10.	Tim	1	2	Both	Neither

1.	cam	1	2	Both	Neither
2.	can	1	2	Both	Neither
3.	loan	1	2	Both	Neither
4.	maim	1	2	Both	Neither
5.	bun	1	2	Both	Neither
6.	fall	1	2	Both	Neither
7.	call	1	2	Both	Neither
8.	thick	1	2	Both	Neither
9.	this	1	2	Both	Neither
10.	Tim	1	2	Both	Neither

Appendix L

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Nome do Participante: _____

TREINAMENTO

Você vai ouvir seqüências de 2 pronúncias da mesma palavra em inglês **e vai avaliar a pronúncia.**

Para cada seqüência você vai identificar a **pronúncia que pareça mais americana**; de acordo com o seguinte critério:

Circule '**1ª**' se a pronúncia mais americana for a **primeira** que você ouviu**;**

Circule '**2ª**' se a pronúncia mais americana for a **segunda** que você ouviu;

Circule '**AMBAS**' se as **duas** pronúncias parecerem americanas;

Circule '**NENHUMA**' se **nenhuma** das pronúncias parecer americana.

Exemplo:
Para os 4 conjuntos de palavras que você ouvirá, as respostas já foram marcadas.
 Qual pronúncia é mais americana?

1.	**bill**	1ª	2ª	**Ambas**	Nenhuma
2.	**bill**	1ª	**2ª**	Ambas	Nenhuma
3.	**truth**	**1ª**	2ª	Ambas	Nenhuma
4.	**truth**	1ª	2ª	Ambas	**Nenhuma**

Agora você marcará as respostas de 4 conjuntos similares aos anteriores, como um breve treinamento.

5.	**hill**	1ª	2ª	Ambas	Nenhuma
6.	**bill**	1ª	2ª	Ambas	Nenhuma
7.	**truth**	1ª	2ª	Ambas	Nenhuma
8.	**hill**	1ª	2ª	Ambas	Nenhuma

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Researcher: Denise Cristina Kluge
Adviser: Profª Drª Bárbara Oughton Baptista

N:

Participant's name: _____

TRAINING SESSION

You are going to hear sets of **2 pronunciations of the same English word**.
For each sequence you are going identify the **most English native-like pronunciation,** according to the following criteria:

Circle '**1**' if the first pronunciation is more English native-like;

Circle '**2**' if the second pronunciation is more English native-like;

Circle '**BOTH**' if both pronunciations are English native-like;

Circle '**NEITHER**' if none of the pronunciations is English native-like;

Example:
Hear the 4 sets of words. The answers have been marked for you.

Which pronunciation is more English native-like?

1.	**bill**	1	2	**Both**	**Neither**
2.	**bill**	1	**2**	**Both**	**Neither**
3.	**truth**	**1**	2	**Both**	**Neither**
4.	**truth**	1	2	**Both**	**Neither**

Now, you are going to hear 4 sets. Mark your answers in the chart bellow. This is a short training.

5.	**hill**	1	2	**Both**	**Neither**
6.	**bill**	1	2	**Both**	**Neither**
7.	**truth**	1	2	**Both**	**Neither**
8.	**hill**	1	2	**Both**	**Neither**

Appendix M

Monosyllabic Words

Previous vowel: /ɪ/

English coda nasal: /m/

Vowel as the following context:

1. Tim: They told **Tim a** lie.
2. Gym: She goes to the **gym everyday**.
3. Rim: His collar had a **rim of** dirt.

Consonant as the following context
4. Him: She called **him twice**.
5. Slim: She is a very **slim girl**.
6. Trim: She will **trim her** hair.

No following segment:
7. Dim: The place was very **dim.**
8. Grim: The future looks pretty **grim.**
9. Brim: That hat has a wide **brim**.

English coda nasal: /n/

Vowel as the following context:
1. Tin: She put the **tin away.**
2. Pin: Her **pin is** old.
3. Bin: They took the garbage **bin out.**

Consonant as the following context
4. Win: She will **win the** prize.
5. Thin: The glass has a **thin crack**.
6. Twin: He has a **twin brother**.

No following segment:
7. Gin: They bought a bottle of **gin.**
8. Skin: That baby has soft **skin.**
9. Sin: She had committed a **sin.**

Previous vowel: /æ/

English coda nasal: /m/

Vowel as the following context:
1. Clam: The **clam is** delicious.
2. Jam: Strawberry **jam is** very good.
3. Tram: The **tram arrived** at night.

Consonant as the following context
4. Ham: He ate a **ham today.**
5. Cam: The **cam has** to be fixed.
6. Swam: She **swam for** two hours.

No following segment:
7. Spam: She realized it was **spam.**
8. Gram: It was missing a **gram**.
9. Ram: He fixed the hydraulic **ram.**

English coda nasal: /n/

Vowel as the following context:
1. Can: There is a **can of** tomato sauce.
2. Ran: They **ran out** of gas.
3. Fan: She is a big **fan of** Madonna.

Consonant as the following context:
4. Man: The **man told** me the story.
5. Van: He took the **van to** go there.
6. Flan: She prepared a **flan for** me.

No following segment:
7. Plan: It is a great **plan.**
8. Gran: I will visit my **gran.**
9. Bran: They threw out all the **bran.**

Previous vowel: /ʌ/

English coda nasal: /m/

Vowel as the following context:
1. Sum: He gave me a large **sum of** dollars.
2. Swum: I had **swum across** the lake.
3. Scum: There is a black **scum along** the river.

Consonant as the following context:
4. Rum: We had a glass of **rum together.**
5. Hum: They **hum softly.**
6. Drum: He played the **drum for** her.

No following segment:
7. Gum: She gave me a **gum.**
8. Slum: They visited the **slum.**
9. Bum: He is such a **bum.**

English coda nasal: /n/

Vowel as the following context:
1. Bun: This **bun is** good.
2. Stun: The news will **stun everybody**.
3. Sun: The **sun is** beautiful today.

Consonant as the following context:
4. Run: We had to **run to** the door.
5. Fun: We had **fun going** to the movies.
6. Spun: She has **spun the** wheel by herself.

No following segment:
7. Gun: He fired the **gun.**
8. Nun: His sister is a **nun.**
9. Dun: The color of his house is **dun.**

Previous vowel: /i/

English coda nasal: /m/

Vowel as the following context:
1. Scream: They will **scream at** you.
2. Beam: We saw the **beam of** the car headlights.
3. Gleam: I saw the **gleam of** the knife.

Consonant as the following context:
4.Seem: You **seem to** like her.
5.Team: The **team played** very well.
6. Deem: They **deem necessary** this idea.

No following segment:
7. Cream: I ate peaches with **cream.**

8. Dream: We have a **dream.**
9. Ream: They need to buy a **ream.**

English coda nasal: /n/

Vowel as the following context:
1. Green: I have **green eyes**.
2. Seen: I have **seen it** before.
3. Dean: He is the **dean of** the Law Faculty.

Consonant as the following context:
4. Been: I have **been living** here.
5. Mean: He is **mean to** his sister.
6. Keen: He was very **keen to** help.

No following segment:
7. Clean: This city is very **clean.**
8. Bean: There are several types of **bean.**
9. Screen: We looked at the **screen.**

Appendix N

Disyllabic Words

English coda nasal: /m/

<u>Nasal stressed in the first syllable</u>

1. Sample: They gave me the **samples**.
2. Number: I have her **number**.
3. Symbol: She saw the **symbol**.
4. Empire: It is huge **empire.**
5. Member: He is a **member** of this group.
6. Campus: This **campus** is very nice.
7. Scramble: I will **scramble** the eggs.
8. Compass: There is a **compass** here.
9. Simple: It is a **simple** task.

<u>Nasal stressed in the second syllable</u>

1. Esteem: She is held in high **esteem.**
2. Proclaim: They still **proclaim** that their policy's worthy.
3. Acclaim: The movie received critical **acclaim**.
4. Reclaim: He will **reclaim** his prize.
5. Declaim: They will **declaim** the speech.
6. Redeem: I was able to **redeem** myself.
7. Exam: He took his final **exam.**
8. Salaam: They did the s**alaam** to show respect.
9. Kaboom: They heard **kaboom.**

<u>Nasal unstressed in the first syllable</u>

1. Compete: Many people **compete** for this trophy.
2. Compare: They **compare** me with her.
3. Compose: I will **compose** a song for you.
4. Improve: They need to **improve** their Spanish.
5. Compress: They **compress** air here.
6. Impose: He will **impose** the new rules today.
7. Comply: If you **comply** you may go.
8. Embrace: People will **embrace** this idea.
9. Bamboo: I bought a **bamboo** table.

1. Problem: There is a **problem** there.
2. System: It is a safe **system.**
3. Seldom: She **seldom** goes to the movies.
4. Poem: We like to read this **poem.**
5. Freedom: They fight for **freedom.**
6. Bottom: He could touch the **bottom.**
7. Custom: This is a very old **custom** here.
8. Victim: She was a **victim** of the tragedy.
9. Madam: She is a little **madam.**

English coda nasal: /n/

Nasal stressed in the first syllable

1. Laundry: I did the l**aundry** yesterday.
2. Country: It is a beautiful **country.**
3. Under: The cat is **under** the table.
4. Cancel: They will **cancel** the class.
5. Handle: He could **handle** the crisis.
6. Candle: She lit the **candle**.
7. Candy: It is my favorite piece of **candy.**
8. Window: She closed the **window**.
9. Enter: He had to **enter** the house.

Nasal stressed in the second syllable

1. Explain: You may **explain** your idea.
2. Remain: She will **remain** at school.
3. Between: He sat **between** us.
4. Begin: The class is about to **begin.**
5. Again: He tried **again.**
6. Balloon: The girl got a red **balloon**.
7. Cartoon: That is his favorite **cartoon**.
8. Obtain: She has to **obtain** a passport to go.
9. Domain: Physics used to be a male **domain.**

Nasal unstressed in the first syllable

1. Confess: He will **confess** to the police.
2. Control: He has **control** of the business.

3. Invite: I will **invite** you to a party.
4. Increase: The price of oil will **increase.**
5. Enjoy: They will **enjoy** it.
6. Unlike: **Unlike** you, she is very ugly.
7. Unpack: I will **unpack** later.
8. Include: The tour will **include** a visit to the park.
9. Consult: I need to **consult** my doctor.

Nasal unstressed in the second syllable

1. Broken: The chair is **broken.**
2. Children: The **children** play soccer everyday.
3. Open: She left the door **open.**
4. Woman: I saw the **woman.**
5. Chicken: He loves fried **chicken.**
6. Kitchen: The **kitchen** is very dirty.
7. Happen: It will **happen** everyday.
8. Lemon: I ate a **lemon** pie.
9. Bacon: They cook **bacon** for breakfast.

Appendix O

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Nome do participante: _____

Sentence Reading Test

Instruções:

1. Escreva seu nome na etiqueta da fita cassete e coloque a fita no aparelho.
2. Não pressione nenhuma tecla.
3. Você vai gravar a leitura das frases contidas nas folhas que você recebeu.
4. Cubra as sentenças com o cartão e vá correndo o mesmo à medida que for lendo cada frase.
5. LEIA CADA FRASE UMA VEZ.
6. EXISTEM PALAVRAS DESCONHECIDAS, LEIA COMO ACHAR QUE DEVE SER. NÃO É ESPERADA PERFEIÇÃO.
7. Coloque o fone confortavelmente.
8. Ao comando da pesquisadora, pressione a tecla **< DRILL>** e inicie a gravação da leitura das frases.
9. Quando terminar a sua leitura, pressione **<STOP>** e retire o fone **COM O MÍNIMO BARULHO POSSÍVEL.**
10. Aguarde.

Grata pela colaboração.

Universidade Federal de Santa Catarina

Curso de Pós-Graduação em Inglês e Literatura Correspondentes

Pesquisadora: Denise Cristina Kluge
Orientadora: Profª Drª Bárbara Oughton Baptista

N:

Participant's name: _____

Sentence Reading Test

<u>Instructions</u>

1. Write your name on the tag of the tape and insert in the tape recorder.
2. Do not press any button.
3. You are going to record your reading of the sentences that you received.
4. Cover the sentences with the red card and keep sliding the card down as you read each sentence.
5. READ EACH SENTENCE ONLY ONCE.
6. THERE ARE SOME UNFAMILIAR WORDS. READ THE WAY YOU BELIEVE TO BE CORRECT.
7. Set the earphone comfortably.
8. At the command of the researcher, press**<DRILL>** and start recording the sentences.
9. When you finish, press **<STOP>** and remove the earphones **AS QUIET AS POSSIBLE**.
10. Wait.

Thank you for your cooperation.

Sentence Reading Test - Sample

1.   She saw the symbol.
2.   I was able to redeem myself.
3.   Many people compete for this trophy.
4.   They heard kaboom.
5.   They did the salaam to show respect.
6.   They will declaim the speech.
7.   The tram arrived at night.
8.   The clam is delicious.
9.   They fight for freedom.
10.   He could touch the bottom.
11.   This is a very old custom here.
12.   She was a victim of the tragedy.
13.   I have been living here.
14.   I ate peaches with cream.
15.   He was very keen to help.
16.   He is the dean of the Law Faculty.
17.   He is mean to his sister.
18.   This campus is very nice.
19.   They compare me with her.
20.   She is a little madam.
21.   I did the laundry yesterday.
22.   It is a beautiful country.
23.   They gave me the samples.
24.   They still proclaim that their policy's worth.
25.   There is a compass here.
26.   The movie received critical acclaim.
27.   She is held in high esteem.
28.   It is huge empire.
29.   It is a simple task.
30.   You may explain your idea.
31.   She will remain at school.
32.   He has control of the business.
33.   He sat between us.
34.   He tried again.
35.   He will confess to the police.
36.   I will invite you to a party.
37.   The class is about to begin.
38.   The girl got a red balloon.

Appendix P

Transcriptions of monosyllabic and disyllabic words containing the nasals /m/ and /n/ in syllable-final position.

Symbol: * mispronounced item

Sentences produced by the Brazilian participants 1, 2 and 3.

/m/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
Tim a	[tĭa]	[timə]	[tia]
gym everyday	[gɪmevrideɪ]	[gɪmevrideɪ]	[gĭevrideɪ]
rim of	[rĭof]	[rɪmof]	[rimovʝ]

Following context: consonant

	Participant 1	Participant 2	Participant 3
him twice	[hɪmtwis]	[hɪmtwais]	[hɪmtwais]
slim girl	[slɪmgɪrl]	[islĭgʌl]	[slĭgarl]
trim her	[trɪmhər]	[trimher]	[trimhər]

No following context

	Participant 1	Participant 2	Participant 3
dim	[dĭ]	[dĭ]	[dĭ]
grim	[grɪm]	[grĭ]	[grɪm]
brim	[brɪ]	[brĭ]	[brĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
clam is	[klemis]	[klamis]	[klemɪs]
jam is	[dʒɛ̆is]	[dʒæmɪz]	[dʒɛ̆is]
tram arrived	[træmarɪved]	[tramarɪv]	[træmarɪved]

Following context: consonant

	Participant 1	Participant 2	Participant 3
ham today	[hɛmtudeɪ]	[hʌmtudeɪ]	[hɛ̃tudeɪ]
cam has	[kɛɪwas]*	[kæmhɛs]	[kɛtu]*
swam for	[swɛ̆for]	[swæmfor]	[swɛ̆for]

No following context

	Participant 1	Participant 2	Participant 3
spam	[spæm]	[spam]	[spæm]
gram	[græm]	[græm]	[græm]
ram	[ræm]	[rʌ̃]	[rɛm]

Previous vowel: /ʌ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
sum of	[sʌmof]	[sʌmof]	[sʌ̃of]
swum across	[swumakros]	[sumakros]	[swʌ̃akros]
scum along	[skualoʊŋ]	[iskumaloŋ]	[skẵaloʊŋ]

Following context: consonant

	Participant 1	Participant 2	Participant 3
rum together	[hʌ̃tugeðər]	[humtugeðər]	[hʌ̃tugedər]
hum softly	[hʌ̃softlɪ]	[humsoftlɪ]	[hʌ̃softlɪ]
drum for	[drumfor]	[drumfor]	[drumfor]

No following context

	Participant 1	Participant 2	Participant 3
gum	[gʌ̃]	[gʌ̃]	[gʌ̃]
slum	[slʌm]	[islŭ̃]	[slŭ̃]
bum	[bŭ̃]	[bŭ̃]	[bŭ̃]

Previous vowel: /i/

Following context: vowel

	Participant 1	Participant 2	Participant 3
scream at	[skrimət]	[skrimət]	[skrimət]
beam of	[bĭof]	[bĭof]	[bĭov]

	Participant 1	Participant 2	Participant 3
gleam of	[glimof]	[glimov]	[glimof]

Following context: consonant

	Participant 1	Participant 2	Participant 3
seem to	[sĭtu]	[simtu]	[simtu]
team played	[timpleɪed]	[timpleɪed]	[tĭpleɪed]
deem necessary	[dĭnesesæri]	[dimneseseri]	[dimnesesæri]

No following context

	Participant 1	Participant 2	Participant 3
cream	[krim]	[krĭ]	[krim]
dream	[drim]	[drim]	[drĭ]
ream	[him]	[rĭ]	[him]

/ n/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
tin away	[tɪnaweɪ]	[tɪnaweɪ]	[tɪnaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]	[pĭnɪs]
bin out	[bɪnɪout]	[bɪnaut]	[bɪnaut]

Following context: consonant

	Participant 1	Participant 2	Participant 3
win the	[wɪnðə]	[wɪnðə]	[wɪnðə]
thin crack	[tɪnkræk]	[ɵɪnkræk]	[ɵɪnkræk]
twin brother	[twɪnbroder]	[twɪnbroðər]	[twɪnbroðer]

No following context

	Participant 1	Participant 2	Participant 3
gin	[dʒĭ]	[dʒɪn]	[dʒin]
skin	[skɪn]	[iskɪn]	[skɪ]
sin	[sɪn]	[sĭ]	[sĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
can of	[kænof]	[kænof]	[kæ̆of]
ran out	[rænoʊt]	[rænoʊt]	[rɛ̃aʊt]
fan of	[fænof]	[fænof]	[fænov]

Following context: consonant

	Participant 1	Participant 2	Participant 3
man told	[mentold]	[mæntoʊld]	[mentuld]
van to	[væntu]	[vʌntu]	[vă̆tu]
flan for	[flanfor]	[flænfor]	[flɛ̃for]

No Following context

	Participant 1	Participant 2	Participant 3
plan	[plæn]	[plɛ̆]	[plæn]
gran	[grɛ]	[græn]	[græn]
bran	[brɛn]	[bră̆]	[brɛn]

Previous vowel: /ʌ/

Following context: vowel

	Participant 1	Participant 2	Participant 3
bun is	[bʌnis]	[bʌnis]	[bʌnis]
stun everybody	[stʌneverɪbodɪ]	[stʌneverɪbədɪ]	[stʌneverɪbodɪ]
sun is	[sʌnɪs]	[sʌnɪs]	[sʌ̆ɪs]

Following context: consonant

	Participant 1	Participant 2	Participant 3
run to	[rontʊ]	[rʌntu]	[rʌntə]
fun going	[fʌngoiŋ]	[fʌ̃goiŋ]	[fʌngoiŋ]
spun the	[spʌndə]	[spunðə]	[spʌndə]

No following context

	Participant 1	Participant 2	Participant 3
gun	[gʌ̃]	[gʌn]	[gʌ̃]
nun	[nʌ̃]	[nun]	[nʌ̃]

dun	[dʌ̃]	[dʊ̃]	[dun]

Previous vowel: /i/

Following context: vowel

	Participant 1	Participant 2	Participant 3
green eyes	[grineɪs]	[grinaɪs]	[grinaɪs]
seen it	[sinit]	[sinit]	[sĭit]
dean of	[dinov]	[dinov]	[dinof]

Following context: consonant

	Participant 1	Participant 2	Participant 3
been living	[binliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mentʊ]	[mintʊ]	[mĭtʊ]
keen to	[kintu]	[kintə]	[kĭtə]

No following context

	Participant 1	Participant 2	Participant 3
clean	[klin]	[klin]	[klin]
bean	[bin]	[bĭ]	[bin]
screen	[skrin]	[skrin]	[skrin]

/ m̩/ Disyllables

Nasal stressed in the first syllable

	Participant 1	Participant 2	Participant 3
samples	[sempləs]	[sempls]	[sæmple]
number	[nʌme]*	[nʌmbər]	[nʌ̃mber]
symbol	[sɪmbol]	[sɪmbol]	[sɪmbou]
empire	[ĕpaɪri]	[ĭpaɪri]	[ĕpaɪr]
member	[membər]	[membər]	[membər]
campus	[kăpus]	[kʌmpus]	[kăpus]
scramble	[skremb]	[iskrambol]	[skrembl]
compass	[kompas]	[kompes]	[kŏpes]
simple	[sɪmplə]	[sɪmplə]	[sɪmpl]

Nasal stressed in the second syllable

	Participant 1	Participant 2	Participant 3
esteem	[ɪstim]	[ɪstĭ]	[ɪstim]
proclaim	[prokleɪm]	[prokleɪm]	[proklam]
acclaim	[akleĭ]	[aklem]	[aklɛm]
reclaim	[reklem]	[reklem]	[riklem]
declaim	[deklɛm]	[deklɛm]	[deklɛm]
redeem	[rɪdĭ]	[rɪdim]	[rɪdim]
exam	[egzem]	[egzam]	[ɪgzem]
salaam	[saləm]	[salam]	[sală]
kaboom	[kabŭ]	[kabŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 1	Participant 2	Participant 3
compete	[kŏpit]	[kompit]	[kŏpit]
compare	[kompar]	[komper]	[kompar]
compose	[kŏpoʊz]	[kompoz]	[kompoʊz]
improve	[ĭpruv]	[ɪmpruv]	[ĭpruv]
compress	[kompres]	[komprɛs]	[kŏpres]
impose	[ĭpoʊz]	[ĭpʊz]	[ĭpoʊz]
comply	[kompli]	[kŏpli]	[kŏpli]
embrace	[embreɪs]	[ĩbrɛs]	[ĕbras]
bamboo	[băbu]	[bambu]	[băbu]

Nasal unstressed in the second syllable

	Participant 1	Participant 2	Participant 3
problem	[probləm]	[probləm]	[prɔbləm]
system	[sɪstem]	[sɪstəm]	[sɪstəm]
seldom	[seldŏ]	[seldəm]	[seldom]
poem	[poəm]	[poə̆]	[poəm]
freedom	[frɪdom]	[frɪdŏ]	[frɪdŏ]
bottom	[butŏ]	[bʌtə̆]	[butom]
custom	[kʌstə̆]	[kɪʊstəm]	[kostum]
victim	[viktĭ]	[viktɪm]	[viktĭ]
madam	[mædə̆]	[madam]	[mædəm]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 1	Participant 2	Participant 3
laundry	[lʌndrɪ]	[laʊndri]	[laʊndrɪ]
country	[koʊtri]	[kʌntri]	[kʌntri]
under	[ʌndər]	[ʌndər]	[ʌndər]
cancel	[kænsəl]	[kansel]	[kænsəl]
handle	[hændli]	[hændl]	[hændl]
candle	[kandlə]	[kădl]	[kɛ̆dlə]
candy	[kændi]	[kændi]	[kændi]
window	[wɪndoʊ]	[wɪndoʊ]	[wĭdoʊ]
enter	[entər]	[entər]	[entər]

Nasal stressed in the second syllable

	Participant 1	Participant 2	Participant 3
explain	[ekspleɪn]	[espleĭ]	[eple]*
remain	[rɪmeɪn]	[remen]	[remeɪn]
between	[bɪtwin]	[bɪtwi]	[bɪtwĭ]
begin	[begɪn]	[begɪn]	[begɪn]
again	[agən]	[agən]	[agən]
balloon	[balun]	[balun]	[balun]
cartoon	[kartŭ]	[kartŭ]	[kartun]
obtain	[obtən]	[obteĭ]	[obte]
domain	[doʊmən]	[domeɪn]	[domeɪn]

Nasal unstressed in the first syllable

	Participant 1	Participant 2	Participant 3
confess	[konfes]	[kŏfes]	[kŏfeɪs]
control	[kontroʊ]	[kontrəl]	[kontrol]
invite	[ɪnvaɪt]	[ɪnvaɪt]	[visit]*
increase	[ɪnkriz]	[ɪnkris]	[ĭkraɪz]
enjoy	[endʒoɪ]	[endʒoɪ]	[ĕdʒoɪ]
unlike	[ʌnlaɪk]	[ʌnlaɪk]	[alaɪk]
unpack	[ʌnpɛk]	[ʌnpɛk]	[ʌnpɛk]
include	[ɪnklud]	[ɪnklud]	[ĭklud]
consult	[konsul]	[kŏsult]	[kŏsul]

Nasal unstressed in the second syllable

	Participant 1	Participant 2	Participant 3
broken	[broke]	[broʊkən]	[broʊken]
children	[tʃɪldren]	[tʃɪldrən]	[tʃɪldren]
open	[oʊpən]	[opən]	[opən]
woman	[uman]	[wuman]	[wuman]
chicken	[tʃɪtkə̆]	[tʃɪtken]	[tʃɪtken]
kitchen	[kɪtʃən]	[kɪtʃən]	[tʃikən]*
happen	[hɛpən]	[hɛpən]	[hɛpən]
lemon	[lemən]	[lemən]	[lem]*
bacon	[beɪkən]	[beɪkon]	[beɪk]*

Sentences produced by the Brazilian participants 4, 5 and 6.

/ m̥/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
Tim a	[tĭa]	[tĭa]	[tima]
gym everyday	[gĭeverideɪ]	[dʒɪevrideɪ]	[dʒimevrideɪ]
rim of	[rĭof]	[rɪof]	[rimov̥]

Following context: consonant

	Participant 4	Participant 5	Participant 6
him twice	[hĭtwais]	[hɪtwais]	[hɪmtwais]
slim girl	[slɪmgəl]	[islĭgərl]	[slĭgarl]
trim her	[trɪmhɛr]	[tĭher]	[trmhər]

No following context

	Participant 4	Participant 5	Participant 6
dim	[dĭ]	[dĭ]	[dĭ]
grim	[grĭ]	[grĭ]	[grɪm]
brim	[brɪ]	[brĭ]	[brɪm]

Previous vowel: /æ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
clam is	[klamis]	[klæmis]	[klamɪs]
jam is	[dʒɛ̆is]	[dʒɛɪs]	[dʒɛmiz]
tram arrived	[træmaraɪved]	[træaraɪved]	[træmaraɪv]

Following context: consonant

	Participant 4	Participant 5	Participant 6
ham today	[hɛ̆tudeɪ]	[hʌmtudeɪ]	[hæmtudeɪ]
cam has	[kɛnhas]	[kæmhɛs]	[kæmhəs]
swam for	[swɛ̆for]	[swæmfor]	[swŭfor]

No following context

	Participant 4	Participant 5	Participant 6
spam	[spʌ̆]	[ispæ̃]	[spam]
gram	[græm]	[græm]	[græ̆]
ram	[ræm]	[ræm]	[rɛm]

Previous vowel: /ʌ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
sum of	[sʌ̆of]	[sʌmof]	[sʌmof]
swum across	[swumakros]	[sumakros]	[sumakros]
scum along	[skŭaloʊŋ]	[iskumaloŋ]	[skŭalɔŋ]

Following context: consonant

	Participant 4	Participant 5	Participant 6
rum together	[hʊmtugedər]	[hʌ̆tugedər]	[rumtugedər]
hum softly	[hʌmsoftelɪ]	[hŭsoftli]	[humsoftlɪ]
drum for	[drʌmfor]	[drŭfor]	[drŭfor]

No following context

	Participant 4	Participant 5	Participant 6
gum	[gʌm]	[gʌ̃]	[gʌ̃]
slum	[slʌm]	[slŭ]	[slum]
bum	[bŭ]	[bʌm]	[bu]

Previous vowel: /i/

Following context: vowel

	Participant 4	Participant 5	Participant 6
scream at	[skrĭat]	[skrimət]	[skrimət]
beam of	[biof]	[bĭof]	[bĭof]
gleam of	[glɛ̆of]	[glĭof]	[glimof]

Following context: consonant

	Participant 4	Participant 5	Participant 6
seem to	[sĭtu]	[sĭtu]	[sĭtu]
team played	[timpleɪed]	[timpleɪed]	[timpleɪed]
deem necessary	[dimnesesɛri]	[dĭneseseri]	[dimnesesæri]

No following context

	Participant 4	Participant 5	Participant 6
cream	[krim]	[krĭ]	[krim]
dream	[drĭ]	[drĭ]	[drim]
ream	[rĭ]	[rĭ]	[rĭ]

/ ɲ/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
tin away	[tɪnaweɪ]	[tɪnaweɪ]	[tɪnaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]	[pɪnɪs]
bin out	[bɪnaʊt]	[bɪnaʊt]	[bɪnaʊt]

Following context: consonant

	Participant 4	Participant 5	Participant 6
win the	[wɪndə]	[wĭdə]	[wĭðə]

thin crack	[tɪnkrak]	[tɪnkræk]	[tɪnkræk]
twin brother	[twɪnbrodər]	[twɪnbrodər]	[twɪnbroðər]

No following context

	Participant 4	Participant 5	Participant 6
gin	[dʒin]	[dʒɪn]	[dʒĭ]
skin	[skɪ]	[iskɪn]	[skɪn]
sin	[sɪn]	[sɪn]	[sĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
can of	[kænov]	[kænof]	[kænof]
ran out	[răoʊt]	[rænoʊt]	[rɛ̆aʊt]
fan of	[fænof]	[fænof]	[făof]

Following context: consonant

	Participant 4	Participant 5	Participant 6
man told	[mentold]	[mæntoʊd]	[mentuld]
van to	[vă̆tu]	[vʌntu]	[væntu]
flan for	[flɛnfor]	[flæ̆for]	[flanfor]

No following context

	Participant 4	Participant 5	Participant 6
plan	[plæn]	[plæn]	[plæn]
gran	[grɛn]	[græn]	[græn]
bran	[broʊ]*	[bro]*	[bræn]

Previous vowel: /ʌ/

Following context: vowel

	Participant 4	Participant 5	Participant 6
bun is	[bʌnis]	[bʌnis]	[bʌnis]
stun everybody	[stʌnevibodɪ]	[stʌ̆evrɪbədɪ]	[stʌneverɪbodɪ]
sun is	[sʌ̆ɪs]	[sʌnɪs]	[sʌnɪs]

Following context: consonant

	Participant 4	Participant 5	Participant 6
run to	[hʌntʊ]	[rʌntʊ]	[rʌ̆tʊ]

fun going	[fʌngoiŋ]	[fʌngoiŋ]	[fʌngoiŋ]
spun the	[spondə]	[spǔðə]	[spʌ̌də]

No following context

	Participant 4	Participant 5	Participant 6
gun	[gʌ̌]	[gʌ̌]	[gʌn]
nun	[nun]	[nʌ̌]	[nǔ]
dun	[dʌ̌]	[dʌ̌]	[dun]

Previous vowel: /i/

Following context: vowel

	Participant 4	Participant 5	Participant 6
green eyes	[grineɪs]	[grinaɪs]	[grinaɪs]
seen it	[sinit]	[sinit]	[siit]
dean of	[dinov]	[dĭof]	[dĭof]

Following context: consonant

	Participant 4	Participant 5	Participant 6
been living	[binliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mentʊ]	[mintʊ]	[mintʊ]
keen to	[kintu]	[kintʊ]	[kĭtə]

No following context

	Participant 4	Participant 5	Participant 6
clean	[klin]	[klin]	[klin]
bean	[bin]	[bin]	[bin]
screen	[skrĭ]	[skrĭ]	[skrĭ]

/ m̃/ Disyllables

Nasal stressed in the first syllable

	Participant 4	Participant 5	Participant 6
samples	[sampləs]	[seɪpls]	[sɛ̃ples]
number	[nʌmbər]	[nʌ̌bər]	[nʌ̌ber]
symbol	[sĭbəl]	[sĭbou]	[sĭbou]
empire	[epaɪər]	[empar]	[ĕpaɪr]
member	[membər]	[mimbər]	[mĕbər]

campus	[kampus]	[kæmpus]	[kăpus]
scramble	[skrɛ̆blɪ]	[eskramble]	[iskrembl]
compass	[kompas]	[kŏpes]	[kŏpas]
simple	[sɪmpol]	[sɪmpl]	[sĭpl]

Nasal stressed in the second syllable

	Participant 4	Participant 5	Participant 6
esteem	[ɪstim]	[ɪstĭ]	[estĭ]
proclaim	[proklam]	[prok]*	[proklem]
acclaim	[akleɪm]	[aklem]	[aklɛm]
reclaim	[reklam]	[reklĕɪ]	[reklam]
declaim	[deklɛĭ]	[deklɛm]	[deklɛm]
redeem	[rɪdĭ]	[rɪdĭ]	[red]*
exam	[ɪgzem]	[egzəm]	[ɪgzam]
salaam	[salam]	[salã]	[salam]
kaboom	[keɪbŭ]	[kabŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 4	Participant 5	Participant 6
compete	[kŏpet]	[kŏpit]	[kompit]
compare	[kŏpar]	[kŏper]	[komper]
compose	[kŏpoʊz]	[kŏpoʊz]	[kŏpoʊz]
improve	[ĭpruv]	[ĭpruv]	[ĭpruv]
compress	[kŏpres]	[komprɛs]	[kŏpres]
impose	[ĭpoʊz]	[ĭpoʊz]	[ipʊz]
comply	[kŏplai]	[kŏplai]	[kŏplai]
embrace	[ĕbraɪs]	[ibreɪs]	[embreɪs]
bamboo	[bambu]	[bambu]	[bambu]

Nasal unstressed in the second syllable

	Participant 4	Participant 5	Participant 6
problem	[proble]	[probləm]	[prɔbləm]
system	[sɪstəm]	[sɪstĕ]	[sɪstəm]
seldom	[seldom]	[seldəm]	[seldom]
poem	[poəm]	[poem]	[poəm]
freedom	[frɪdŏ]	[frɪdŏ]	[frɪdəm]
bottom	[botŏ]	[bɔtŏ]	[butŏ]

custom	[kʌstəm]	[kɪʊstum]	[kustŭ]
victim	[viktĭ]	[viktĭ]	[viktĭ]
madam	[mædə̆]	[madəm]	[mædəm]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 4	Participant 5	Participant 6
laundry	[laʊdrɪ]	[laʊndri]	[lɔndrɪ]
country	[koŭtri]	[koŭtri]	[kʌntri]
under	[ʌndər]	[ʌndər]	[ʌ̆dər]
cancel	[kænsəl]	[kensel]	[kænsəl]
handle	[hændle]	[hændl]	[hændəl]
candle	[kandlɪ]	[kandl]	[kɛdəl]
candy	[kădi]	[kændi]	[kændi]
window	[wɪndoʊ]	[wĭdoʊ]	[wĭdoʊ]
enter	[entər]	[ĕtər]	[entər]

Nasal stressed in the second syllable

	Participant 4	Participant 5	Participant 6
explain	[ekspleɪn]	[espleɪn]	[ekspleɪn]
remain	[remeɪn]	[rɪmen]	[remĕ]
between	[bɪtwin]	[bɪtwin]	[bɪtwɪn]
begin	[begɪn]	[begɪn]	[begɪn]
again	[agen]	[agən]	[agen]
balloon	[balun]	[balun]	[balu]
cartoon	[kartŭ]	[kartŭ]	[kartun]
obtain	[obtən]	[obten]	[obteɪn]
domain	[doʊmaɪn]	[domen]	[domeĭ]

Nasal unstressed in the first syllable

	Participant 4	Participant 5	Participant 6
confess	[kŏfes]	[kŏfes]	[konfes]
control	[kontrol]	[kontrəl]	[kontrol]
invite	[ɪvaɪt]	[ɪvaɪt]	[ɪnvaɪt]
increase	[ɪnkreiz]	[ɪnkris]	[inkriz]
enjoy	[ĕdʒɔɪ]	[endʒɔɪ]	[endʒɔɪ]

unlike	[ʌ̃laɪk]	[ʌlaɪk]	[ʌnlaɪk]
unpack	[ʌnpeɪk]	[ʌnpɛk]	[ŭpɛk]
include	[ĩklud]	[ɪklud]	[ɪnklud]
consult	[konsul]	[konsult]	[konsul]

Nasal unstressed in the second syllable

	Participant 4	Participant 5	Participant 6
broken	[broken]	[broʊkĕ]	[broʊkən]
children	[tʃɪldrən]	[tʃɪldrən]	[tʃɪldrĕ]
open	[opən]	[opə]	[opən]
woman	[wuman]	[wuman]	[wumən]
chicken	[tʃɪtkə]	[tʃɪtken]	[tʃɪtken]
kitchen	[kɪtʃən]	[kɪtʃən]	[tʃikən]*
happen	[hɛpən]	[hɛpən]	[hæpən]
lemon	[lemon]	[lemŏ]	[lemon]
bacon	[beɪkən]	[beɪko]	[beɪkŏ]

Sentences produced by the Brazilian participants 7, 8 and 9.

/ m̃/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
Tim a	[tĭa]	[tĭə]	[tĭa]
gym everyday	[dʒĭeverideɪ]	[gĭevrideɪ]	[dʒievrideɪ]
rim of	[rĭof]	[rĭof]	[rĭofɪ̯]

Following context: consonant

	Participant 7	Participant 8	Participant 9
him twice	[hĭtwaɪs]	[hĭtwais]	[hĭtwais]
slim girl	[slĭgərl]	[islĭgʌl]	[slĭgarl]
trim her	[trĭhər]	[trĭher]	[trĭhər]

No following context

	Participant 7	Participant 8	Participant 9
dim	[dĭ]	[dĭ]	[dĭ]
grim	[grĭ]	[grĭ]	[grĭ]

brim	[brɪ]	[brĭ]	[brĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
clam is	[klăis]	[klamis]	[klemɪs]
jam is	[dʒɛ̆is]	[dʒæ̆ɪz]	[dʒɛmis]
tram arrived	[trɛ̆araɪved]	[tramaraɪved]	[træmarɪved]

Following context: consonant

	Participant 7	Participant 8	Participant 9
ham today	[hă̆tudeɪ]	[hă̆tudeɪ]	[hɛmtudeɪ]
cam has	[kɛ̆hɛs]	[kæ̆hɛs]	[kæ̆hæsu]
swam for	[swɛ̆for]	[swæ̆for]	[sɛ̆for]

No following context

	Participant 7	Participant 8	Participant 9
spam	[spæ̆]	[spă]	[spæ̆]
gram	[græm]	[græ̆]	[græ̆]
ram	[ră]	[rʌ̆]	[rɛm]

Previous vowel: /ʌ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
sum of	[sʌ̆of]	[sʌ̆of]	[sʌmof]
swum across	[swumiakros]	[swʌmakros]	[swŭakros]
scum along	[skŭaloŋ]	[skʌmaloŋ]	[skŭaloʊŋ]

Following context: consonant

	Participant 7	Participant 8	Participant 9
rum together	[rŭtugedər]	[rŭtugedər]	[humtugedər]
hum softly	[hŭsoftlɪ]	[hʌ̆softli]	[hʌmsoftlɪ]
drum for	[drŭfor]	[drʌ̆fɔr]	[drʌ̆fɔr]

No following context

	Participant 7	Participant 8	Participant 9
gum	[gʌ̆]	[gʌ̆]	[gʌ̆]
slum	[slʌ̆]	[slʌm]	[slʌm]

bum	[bun]	[bʌm]	[bŭ]

Previous vowel: /i/

Following context: vowel

	Participant 7	Participant 8	Participant 9
scream at	[skrĭət]	[skrimət]	[skrĭət]
beam of	[bĭof]	[bĭof]	[bĭof]
gleam of	[glĭof]	[glĭov]	[glĭof]

Following context: consonant

	Participant 7	Participant 8	Participant 9
seem to	[sĭtu]	[sĭtə]	[sĭtə]
team played	[tĭpleɪed]	[timpleɪed]	[tĭpleɪed]
deem necessary	[dĭnesesæri]	[dĭnesesəri]	[dĭnesesæri]

No following context

	Participant 7	Participant 8	Participant 9
cream	[krĭ]	[krim]	[krim]
dream	[drĭ]	[drĭ]	[drim]
ream	[rĭ]	[rĭ]	[rim]

/ ɲ/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
tin away	[tĭaweɪ]	[tɪnaweɪ]	[tɪnaweɪ]
pin is	[pĭɪs]	[pɪnɪs]	[pinɪs]
bin out	[bɪnaʊt]	[bɪnaʊt]	[bɪnaʊt]

Following context: consonant

	Participant 7	Participant 8	Participant 9
win the	[wɪnðə]	[wɪnðə]	[wĭðə]
thin crack	[tɪnkræk]	[θɪnkræk]	[tĭkræk]
twin brother	[twɪnbrɔder]	[twĭbrɔðər]	[twɪnbrɔðer]

No Following context

	Participant 7	Participant 8	Participant 9
gin	[dʒĭ]	[dʒɪn]	[dʒin]

skin	[skɪn]	[iskɪn]	[skĭ]
sin	[sɪn]	[sĭ]	[sɪn]

Previous vowel: /æ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
can of	[kænof]	[kænof]	[kænof]
ran out	[hʊnoʊt]	[rænaʊt]	[rʌnaʊt]
fan of	[fænof]	[fænof]	[fænov]

Following context: consonant

	Participant 7	Participant 8	Participant 9
man told	[mentold]	[mæntoʊld]	[mæntold]
van to	[væntu]	[væntu]	[væntu]
flan for	[flɛ̃for]	[flʌnfor]	[flænfor]

No following context

	Participant 7	Participant 8	Participant 9
plan	[plæn]	[plɛn]	[plæ]
gran	[grɛn]	[græ]	[græ̆]
bran	[brɛ̃]	[bræ]	[brɛn]

Previous vowel: /ʌ/

Following context: vowel

	Participant 7	Participant 8	Participant 9
bun is	[bʌnis]	[bʌnis]	[bʌnis]
stun everybody	[stʌneverɪbodɪ]	[stʌneverɪbədɪ]	[stʌnevrɪbodɪ]
sun is	[sʌ̌ɪs]	[sʌnɪs]	[sʌnɪs]

Following context: consonant

	Participant 7	Participant 8	Participant 9
run to	[rʌ̌tʊ]	[hʌntu]	[rʌntə]
fun going	[fʌngoiŋ]	[fʌngoiŋ]	[fʌngoiŋ]
spun the	[spʌ̆ndə]	[spʌnðə]	[spʌndə]

No following context

	Participant 7	Participant 8	Participant 9
gun	[gʌ̌]	[gʌn]	[gʌn]
nun	[nʌn]	[nʌ̌]	[nʌn]
dun	[dʌ̌]	[dŭ]	[dʌn]

Previous vowel: /i/

Following context: vowel

	Participant 7	Participant 8	Participant 9
green eyes	[grinaɪs]	[grinaɪs]	[grinaɪs]
seen it	[siːt]	[sinit]	[sinit]
dean of	[dinɔf]	[dinɔf]	[dinɔv]

Following context: consonant

	Participant 7	Participant 8	Participant 9
been living	[binliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mintʊ]	[mintə]	[mintʊ]
keen to	[kintu]	[kintʊ]	[kintə]

No following context

	Participant 7	Participant 8	Participant 9
clean	[klin]	[klin]	[klĩ]
bean	[bin]	[bin]	[bin]
screen	[skrin]	[skrin]	[skrin]

/ m̥/ Disyllables

Nasal stressed in the first syllable

	Participant 7	Participant 8	Participant 9
samples	[sĕpləs]	[sæmpls]	[sæmpls]
number	[nʌmbər]	[nʌ̆bər]	[nʌmber]
symbol	[sĭbol]	[sĭbol]	[sĭbou]
empire	[ĕpaɪər]	[ĭpaɪri]	[empaɪri]
member	[membər]	[membər]	[membər]
campus	[kăpus]	[kampus]	[kăpus]
scramble	[skrăĕbl]	[skræmbou]	[skrembl]
compass	[kompas]	[kompas]	[kŏpas]
simple	[sɪmpl]	[sĭplə]	[sɪmpl]

Nasal stressed in the second syllable

	Participant 7	Participant 8	Participant 9
esteem	[ɪstĭ]	[ɪstĭ]	[ɪstĭ]
proclaim	[prokleĭ]	[prokleɪm]	[proklæm]

acclaim	[aklem]	[aklĕ]	[aklæm]
reclaim	[reklaɪ]	[riklem]	[riklæm]
declaim	[dekleĭ]	[deklɛĭ]	[deklɛm]
redeem	[rɪdĭ]	[rɪdim]	[rɪdim]
exam	[egzem]	[egzæm]	[ɪgzam]
salaam	[sală]	[sală]	[salam]
kaboom	[kebŭ]	[kabŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 7	Participant 8	Participant 9
compete	[kŏpit]	[kŏpit]	[kompɛt]
compare	[kompɛr]	[kŏper]	[kompar]
compose	[kompoʊz]	[kŏpoʊz]	[kompoʊz]
improve	[ĭpruv]	[ɪmprouv]	[ɪmpruv]
compress	[kompres]	[kŏprɛs]	[kompres]
impose	[ĭpʊz]	[ĭpoʊz]	[ĭpoʊz]
comply	[kŏplei]	[komplai]	[komplai]
embrace	[embreɪs]	[imbrɛɪs]	[ɪmbreɪs]
bamboo	[bambu]	[băbu]	[bambu]

Nasal unstressed in the second syllable

	Participant 7	Participant 8	Participant 9
problem	[prɔbləm]	[problĕ]	[prɔbləm]
system	[sɪstĕ]	[sɪstĕ]	[sɪstĕ]
seldom	[seldŏ]	[seldəm]	[seldom]
poem	[poəm]	[poĕ]	[poəm]
freedom	[frɪdŏ]	[frɪdŏ]	[frɪdŏ]
bottom	[bɔtŏ]	[bɔto]	[bɔtŏ]
custom	[kostŭ]	[kostŭ]	[kustum]
victim	[viktĭ]	[viktĭ]	[viktim]
madam	[mædəm]	[madă]	[madă]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 7	Participant 8	Participant 9
laundry	[laʊndrɪ]	[laʊndri]	[laʊndrɪ]

country	[kountri]	[kauntri]	[kauntri]
under	[ʌndər]	[ʌndər]	[ʌndər]
cancel	[kænsəl]	[kɛnsel]	[kænsel]
handle	[hændle]	[hændel]	[hændl]
candle	[kændle]	[kændl]	[kændl]
candy	[kændi]	[kændi]	[kændi]
window	[wɪndoʊ]	[wɪndoʊ]	[wĭdoʊ]
enter	[entər]	[ĕtər]	[entər]

Nasal stressed in the second syllable

	Participant 7	Participant 8	Participant 9
explain	[ekspleĭ]	[ekspleɪn]	[ekspleɪn]
remain	[rɪmeɪ]	[remeĭ]	[rɪmæn]
between	[bɪtwi]	[bɪtwin]	Not recorded
begin	[begɪn]	[begɪn]	[begɪn]
again	[agen]	[agən]	[agən]
balloon	[balu]	[balŭ]	[balun]
cartoon	[kartu]	[kartun]	[kartŭ]
obtain	[obteɪ]	[obteɪn]	[obtən]
domain	[doʊmeĭ]	[domeĭ]	[domən]

Nasal unstressed in the first syllable

	Participant 7	Participant 8	Participant 9
confess	[konfes]	[konfes]	[kŏfes]
control	[kontrol]	[kontrəl]	[kontrol]
invite	[ĭvaɪt]	[ɪnvaɪt]	[ĭvaɪt]
increase	[ɪnkraiz]	[ɪnkris]	[inkrɪz]
enjoy	[endʒɔɪ]	[endʒɔɪ]	[endʒɔɪ]
unlike	[ʌnlaɪk]	[ʌnlaɪk]	[ʌ̆laɪk]
unpack	[ʌnpɛk]	[ʌnpæk]	[ʌnpæk]
include	[ɪnklud]	[ĭklud]	[ɪnklud]
consult	[kŏsult]	[konsult]	[konsul]

Nasal unstressed in the second syllable

	Participant 7	Participant 8	Participant 9
broken	[broken]	[broʊkən]	[broʊken]
children	[tʃɪldrĕ]	[tʃɪldrən]	[tʃɪldren]

open	[opən]	[opən]	[opən]
woman	[wumă]	[wumă]	[wuman]
chicken	[tʃɪtkə̆]	[tʃɪtken]	[tʃɪtken]
kitchen	[kɪtʃĕ]	[kɪtʃən]	[kɪtʃən]
happen	[hɛpən]	[hɛpən]	[hæpən]
lemon	[lemən]	[lemən]	[lem]*
bacon	[beɪkən]	[beɪkon]	[beɪk]*

Sentences produced by the Brazilian participants 10, 11 and 12.

/ m̩/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
Tim a	[tĭa]	[timə]	[tĭa]
gym everyday	[dʒɪmevrideɪ]	[dʒɪmevrideɪ]	[dʒĭevrideɪ]
rim of	[rimof]	[rɪmof]	[riov]

Following context: consonant

	Participant 10	Participant 11	Participant 12
him twice	[hitwis]	[hĭtwais]	[hĭtwis]
slim girl	[slĭgɪrl]	[slimgʌrl]	[slĭgarl]
trim her	[trmhər]	[trmher]	[tř̩hər]

No following context

	Participant 10	Participant 11	Participant 12
dim	[dim]	[dĭ]	[di]
grim	[grĭ]	[grɪm]	[grĭ]
brim	[brɪm]	[brɪm]	[brĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
clam is	[klæmis]	[klamis]	[klemɪs]
jam is	[dʒɛmis]	[dʒæmɪz]	[dʒɛɪs]
tram arrived	[træmarɪved]	[træmaraɪv]	[treĭmaraɪv]

Following context: consonant

	Participant 10	Participant 11	Participant 12
ham today	[hɛmtudeɪ]	[hʌæmtudeɪ]	[hæmudeɪ]
cam has	[kæmhəs]	[kæmhɛs]	[kæ̆həs]
swam for	[swɛ̆for]	[swɛ̆for]	[swŭfor]

No following context

	Participant 10	Participant 11	Participant 12
spam	[spæm]	[spæ̆]	[spʌ̆]
gram	[græm]	[græ̆]	[græ]
ram	[ræm]	[ræm]	[rɛ]

Previous vowel: /ʌ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
sum of	[suməv]	[sʌmof]	[sʌ̆of]
swum across	[swŭakros]	[swumakros]	[swŭakros]
scum along	[skŭaloʊŋ]	[skʌaloŋ]	[skŭaloʊŋ]

Following context: consonant

	Participant 10	Participant 11	Participant 12
rum together	[rŭtugeðər]	[rʌ̆mtəgeðər]	[rŭtugedər]
hum softly	[hʌ̆softlɪ]	[humsɔftlɪ]	[hŭsoftlɪ]
drum for	[drʌ̆for]	[drumfor]	[drŭfor]

No following context

	Participant 10	Participant 11	Participant 12
gum	[gʌ̆]	[gʌ̆]	[gŭ]
slum	[slʌ̆]	[slʌ̆]	[slŭ]
bum	[bʌ̆]	[bʌm]	[bŭ]

Previous vowel: /i/

Following context: vowel

	Participant 10	Participant 11	Participant 12
scream at	[skrimət]	[skrimət]	[skrĭət]
beam of	[bĭɔf]	[bĭəf]	[bĭof]
gleam of	[glimof]	[glimov]	[glimof]

Following context: consonant

	Participant 10	Participant 11	Participant 12
seem to	[simtu]	[simtə]	[sĭtu]
team played	[timpleɪed]	[timpleɪed]	[timpleɪed]
deem necessary	[dĭnesesæri]	[dimneseseri]	[dĭnesesæri]

No following context

	Participant 10	Participant 11	Participant 12
cream	[krim]	[krim]	[krɛ]
dream	[drĭ]	[drim]	[drim]
ream	[him]	[rim]	[rim]

/ ɲ/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
tin away	[tĭaweɪ]	[tɪnaweɪ]	[tɪaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]	[pĭnɪs]
bin out	[bɪnaʊt]	[bɪnaʊt]	[bĭaʊt]

Following context: consonant

	Participant 10	Participant 11	Participant 12
win the	[wĭðə]	[wɪnðə]	[wĭðə]
thin crack	[tɪnkræk]	[tɪnkræk]	[ɵɪnkræk]
twin brother	[twĭbrɔder]	[twɪnbroðər]	[twɪnbroðer]

No following context

	Participant 10	Participant 11	Participant 12
gin	[dʒin]	[dʒɪn]	[dʒĭ]
skin	[skĭ]	[iskɪn]	[ski]
sin	[sɪn]	[sɪn]	[sɪn]

Previous vowel: /æ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
can of	[kænof]	[kænof]	[kænov]
ran out	[rʌaʊt]	[rænaʊt]	[rænaʊt]

fan of	[fænoʊ]	[fænof]	[fænoʊ]

Following context: consonant

	Participant 10	Participant 11	Participant 12
man told	[mentoʊld]	[mæntoʊld]	[mæntoʊld]
van to	[vătu]	[vʌæntu]	[væntu]
flan for	[flanfɔr]	[flænfor]	[flɛnfər]

No following context

	Participant 10	Participant 11	Participant 12
plan	[plæn]	[plɛ̃]	[plæn]
gran	[grɛn]	[græ̃]	[grɛ]
bran	[brɛn]	[brẵ]	[brɛ]

Previous vowel: /ʌ/

Following context: vowel

	Participant 10	Participant 11	Participant 12
bun is	[bʌnis]	[bʌnis]	[bʌnis]
stun everybody	[stʌ̃everɪbɔdɪ]	[stʌneverɪbədɪ]	[stuneverɪbodɪ]
sun is	[sʌnɪs]	[sʌnɪs]	[sunɪs]

Following context: consonant

	Participant 10	Participant 11	Participant 12
run to	[rʌntə]	[rʌntu]	[rŭtə]
fun going	[fʌngoiŋ]	[fʌngoiŋ]	[fʌngoiŋ]
spun the	[spʌndə]	[spʌnðə]	[spŭdə]

No following context

	Participant 10	Participant 11	Participant 12
gun	[gʌ̃]	[gʌ̃]	[gu]
nun	[nʌ̃]	[nŭ]	[nun]
dun	[dʌ̃]	[dʌn]	[dun]

Previous vowel: /i/

Following context: vowel

	Participant 10	Participant 11	Participant 12
green eyes	[grinaɪs]	[grinaɪs]	[griaɪs]
seen it	[sinit]	[sinit]	[sinit]

dean of	[dinəv]	[dinof]	[dinof]

Following context: consonant

	Participant 10	Participant 11	Participant 12
been living	[binliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mĭtʊ]	[mintə]	[mintʊ]
keen to	[kintu]	[kintə]	[kintə]

No following context

	Participant 10	Participant 11	Participant 12
clean	[klin]	[klin]	[klin]
bean	[bĭ]	[bin]	[bin]
screen	[skri]	[skrin]	[skrin]

/m/ Disyllables

Nasal stressed in the first syllable

	Participant 10	Participant 11	Participant 12
samples	[sæmpləs]	[ǽepls]	[sĕple]
number	[nʌmber]	[nʌmbər]	[nʌmber]
symbol	[sĭbl]	[sɪmbl]	[sĭbl]
empire	[epaɪr]	[ĕpaɪri]	[ĕpaɪr]
member	[membər]	[membər]	[membər]
campus	[kæmpus]	[kæmpus]	[kampus]
scramble	[skrembl]	[skræmbl]	[skræmbl]
compass	[kompas]	[kompas]	[kompes]
simple	[sĭplə]	[sĭplə]	[sĭpl]

Nasal stressed in the second syllable

	Participant 10	Participant 11	Participant 12
esteem	[ɪstĭ]	[ɪstĭ]	[ɪstim]
proclaim	[prokleɪm]	[prɔklɛm]	[proklɛm]
acclaim	[akleĭ]	[aklem]	[aklɛm]
reclaim	[rɪkleɪm]	[reklem]	[riklem]
declaim	[dekleɪm]	[dekleɪm]	[dɪklɛm]
redeem	[rɪdĭ]	[rɪdĭ]	[rɪdim]
exam	[egzam]	[egzem]	[ɪzam]
salaam	[salam]	[sală]	[salam]

kaboom	[kabŭ]	[kebŭ]	[kabu]

Nasal unstressed in the first syllable

	Participant 10	Participant 11	Participant 12
compete	[kŏpɛt]	[kompit]	[kompit]
compare	[kompar]	[kŏper]	[kompɛr]
compose	[kŏpoʊz]	[kopoʊz]	[kompoʊz]
improve	[ĭpruv]	[ɪmpruv]	[ĭprov]
compress	[kŏpres]	[kŏprəs]	[kompres]
impose	[ĭpoʊz]	[ĭpʊz]	[ĭpoz]
comply	[kompli]	[kŏpli]	[kŏpli]
embrace	[ɪmbreɪs]	[embreɪs]	[ĭbras]
bamboo	[bambu]	[băbu]	[băbu]

Nasal unstressed in the second syllable

	Participant 10	Participant 11	Participant 12
problem	[prɔbləm]	[prɔbləm]	[prɔbləm]
system	[sɪstəm]	[sɪstəm]	[sɪstəm]
seldom	[seldəm]	[seldă]	[seldŏ]
poem	[poəm]	[poəm]	[poem]
freedom	[frɪdŏ]	[frɪdom]	[frɪdŏ]
bottom	[butəm]	[bɔtŏ]	[butŏ]
custom	[kustəm]	[kʌstəm]	[kustəm]
victim	[viktim]	[viktɪm]	[viktim]
madam	[mædəm]	[madam]	[mædă]

/ ɲ/ Disyllables

Nasal stressed in the first syllable

	Participant 10	Participant 11	Participant 12
laundry	[laŭdrɪ]	[laʊndri]	[laʊndrɪ]
country	[kaŭtri]	[kaʊntri]	[kʌntri]
under	[ʌndər]	[ʌndər]	[ʌndər]
cancel	[kænsəl]	[kansel]	[kăsəl]
handle	[hændl]	[hændl]	[hændl]
candle	[kandl]	[kădl]	[kændlə]
candy	[kændi]	[kændi]	[kændi]

window	[wɪndoʊ]	[wɪndoʊ]	[wĭdoʊ]
enter	[entər]	[entər]	[entər]

Nasal stressed in the second syllable

	Participant 10	Participant 11	Participant 12
explain	[ekspleɪn]	[espleĭ]	[espleɪn]
remain	[rɪmeɪn]	[remen]	[remeĭ]
between	[bɪtwin]	[bɪtwĭ]	[bɪtwĭ]
begin	[bɪgin]	[begɪn]	[begɪn]
again	[agən]	[agə̆]	[agən]
balloon	[balŭ]	[balun]	[balu]
cartoon	[kartŭ]	[kartŭ]	[kartŭ]
obtain	[obteɪn]	[obteĭ]	[obteĭ]
domain	[domeĭ]	[domeɪn]	[domeɪ]

Nasal unstressed in the first syllable

	Participant 10	Participant 11	Participant 12
confess	[konfes]	[kofes]	[kŏfes]
control	[kontroʊ]	[kontrəl]	[kontrol]
invite	[ɪnvaɪt]	[ɪvaɪt]	[ɪnvaɪt]
increase	[ĭkriz]	[ɪnkriz]	[inkrɪz]
enjoy	[endʒoɪ]	[endʒoɪ]	[ɪndʒoɪ]
unlike	[ʌnlaɪk]	[ʌnlaɪk]	[ʌnlaɪk]
unpack	[ʌnpak]	[ʌnpæk]	[ʌnpæk]
include	[ɪnklud]	[ĭklud]	[ɪnklud]
consult	[kŏsult]	[konsəlt]	[kŏsult]

Nasal unstressed in the second syllable

	Participant 10	Participant 11	Participant 12
broken	[broʊkən]	[broʊkən]	[broʊke]
children	[tʃɪldrĕ]	[tʃɪldrən]	[tʃɪldrən]
open	[opən]	[opə̆]	[ope]
woman	[wumən]	[wuman]	[wumʌn]
chicken	[tʃɪtkən]	[tʃɪtken]	[tʃɪtken]
kitchen	[kɪtʃən]	[kɪtʃən]	[tʃikən]*
happen	[hæpən]	[hɛpən]	[hɛpən]
lemon	[lɛmən]	[lemon]	[lemon]

bacon	[beɪkŏ]	[beɪkŏ]	[beɪkŏ]

Sentences produced by the Brazilian participants 13, 14 and 15.

/m/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
Tim a	[tĭa]	[tĭmə]	[tĭa]
gym everyday	[dʒĭevrideɪ]	[dʒɪmevrideɪ]	[dʒĭevrideɪ]
rim of	[rimof]	[rɪmof]	[rĭov]

Following context: consonant

	Participant 13	Participant 14	Participant 15
him twice	[hɪmtwais]	[hĭtwais]	[hɪmtwais]
slim girl	[slĭgɪrl]	[slimgʌrl]	[slimgarl]
trim her	[trimhər]	[trimher]	[trĭhər]

No following context

	Participant 13	Participant 14	Participant 15
dim	[dĭ]	[dim]	[dĭ]
grim	[grĭ]	[grĭ]	[grĭ]
brim	[brɪm]	[brɪm]	[brĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
clam is	[klemis]	[klæmis]	[klăɪs]
jam is	[dʒɛmis]	[dʒæmɪz]	[dʒæmis]
tram arrived	[træmarɪved]	[træmarɪved]	[træ̆arɪved]

Following context: consonant

	Participant 13	Participant 14	Participant 15
ham today	[hɛ̆tudeɪ]	[hʌmtudeɪ]	[hæ̆tudeɪ]
cam has	[kɛmhas]	[kæmhəs]	[kæ̆həs]
swam for	[swemfor]	[swæ̆for]	[swŭ̆fɔr]

No following context

	Participant 13	Participant 14	Participant 15
spam	[spæ̆]	[spam]	[spʌ̃]
gram	[græ̆]	[græm]	[græ̆]
ram	[ræ̆]	[ram]	[ræ̆]

Previous vowel: /ʌ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
sum of	[sʌmof]	[sʌmof]	[sʌ̃of]
swum across	[swʌmakros]	[swŭakros]	[swʌ̃akros]
scum along	[skŭaloʊŋ]	[skŭaloŋ]	[skʌ̃aloʊŋ]

Following context: consonant

	Participant 13	Participant 14	Participant 15
rum together	[rʌmtugeðər]	[rŭtugeðər]	[rŭtugedər]
hum softly	[humsoftlɪ]	[humsoftlɪ]	[hʌ̃softlɪ]
drum for	[drʌmfor]	[drumfor]	[drʌ̃fər]

No following context

	Participant 13	Participant 14	Participant 15
gum	[gʌm]	[gŭ]	[gʌ̃]
slum	[slʌm]	[slŭ]	[slʌm]
bum	[bʌ̃]	[bŭ]	[bŭ]

Previous vowel: /i/

Following context: vowel

	Participant 13	Participant 14	Participant 15
scream at	[skrimət]	[skrimət]	[skrĭət]
beam of	[bĭəv]	[bĭof]	[bĭov]
gleam of	[glimof]	[glĭov]	[glĭof]

Following context: consonant

	Participant 13	Participant 14	Participant 15
seem to	[simtu]	[simtu]	[sĭtu]
team played	[timpleɪd]	[tĭpleɪed]	[tĭpleɪed]
deem necessary	[dimnesesæri]	[dimneseseri]	[dĭnesesæri]

No following context

	Participant 13	Participant 14	Participant 15
cream	[krim]	[krĭ]	[krĭ]
dream	[drim]	[drĭ]	[drim]
ream	[rim]	[rim]	[rĭ]

/ ɲ/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
tin away	[tɪnaweɪ]	[tĭaweɪ]	[tɪnaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]	[pinɪs]
bin out	[bɪnɪaʊt]	[bɪnaʊt]	[bɪnaʊt]

Following context: consonant

	Participant 13	Participant 14	Participant 15
win the	[wĭðə]	[wɪnðə]	[wĭðə]
thin crack	[tɪnkræk]	[θɪnkræk]	[fɪnkræk]
twin brother	[twɪnbroder]	[twɪnbroðər]	[twɪnbroðer]

No following context

	Participant 13	Participant 14	Participant 15
gin	[dʒin]	[dʒĭ]	[dʒĭ]
skin	[skɪn]	[iskɪn]	[skɪ]
sin	[sɪn]	[sĭ]	[sĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
can of	[kænof]	[kænof]	[kænof]
ran out	[rænoʊt]	[rænaʊt]	[rɛnaʊt]
fan of	[fænof]	[fænof]	[fæ̆ov]

Following context: consonant

	Participant 13	Participant 14	Participant 15
man told	[mæntold]	[mæntoʊld]	[mæntuld]
van to	[væntu]	[væntu]	[vʌ̆tu]

flan for	[flanfor]	[flænfor]	[flænfor]

No following context

	Participant 13	Participant 14	Participant 15
plan	[plæn]	[plɛ̃]	[plæn]
gran	[græn]	[græn]	[græn]
bran	[brɛ]	[bræ̃]	[brʌ]

Previous vowel: /ʌ/

Following context: vowel

	Participant 13	Participant 14	Participant 15
bun is	[bʌnis]	[bʌnis]	[bʌnis]
stun everybody	[stʌeverɪbodɪ]	[stʌneverɪbədɪ]	[stueverɪbodɪ]
sun is	[sʌnɪs]	[sʌnɪs]	[sʌnɪs]

Following context: consonant

	Participant 13	Participant 14	Participant 15
run to	[rʌntʊ]	[rʌ̃tu]	[rʌ̃tə]
fun going	[fʌngoiŋ]	[fʌngoiŋ]	[fʌngoʊiŋ]
spun the	[spʌndə]	[spunðə]	[spŭdə]

No following context

	Participant 13	Participant 14	Participant 15
gun	[gʌn]	[gʌn]	[gʌn]
nun	[nʌn]	[nun]	[nʌn]
dun	[dʌn]	[dŭ]	[dʌn]

Previous vowel: /i/

Following context: vowel

	Participant 13	Participant 14	Participant 15
green eyes	[grineɪs]	[grĭaɪs]	[grinaɪs]
seen it	[sinit]	[siit]	[sinit]
dean of	[dinof]	[dinov]	[dinof]

Following context: consonant

	Participant 13	Participant 14	Participant 15
been living	[bĭliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mintʊ]	[mintʊ]	[mintʊ]

keen to	[kintu]	[kintə]	[kĭtə]

No following context

	Participant 13	Participant 14	Participant 15
clean	[klin]	[klin]	[klin]
bean	[bin]	[bin]	[bin]
screen	[skrĭ]	[skrin]	[skrin]

/ɱ/ Disyllables

Nasal stressed in the first syllable

	Participant 13	Participant 14	Participant 15
samples	[sæ̆pləs]	[sĕpls]	[sæmpls]
number	[nʌmber]	[nʌmbər]	[nʌmber]
symbol	[sĭbol]	[sĭbol]	[sɪmbl]
empire	[empaɪər]	[ĕpaɪr]	[epaɪr]
member	[membər]	[membər]	[mĕbər]
campus	[kampus]	[kʌmpus]	[kampus]
scramble	[skremb]	[skrʌboʊ]	[skræmbl]
compass	[kompas]	[kŏpəs]	[kompes]
simple	[sĭplə]	[sɪmpl]	[sɪmpl]

Nasal stressed in the second syllable

	Participant 13	Participant 14	Participant 15
esteem	[ɪstim]	[ɪstim]	[ɪstĭ]
proclaim	[proklem]	[prokleɪm]	[prokleĭ]
acclaim	[aklɛm]	[akleĭ]	[aklɛ̆]
reclaim	[rɪkleɪm]	[rekleɪm]	[riklɛm]
declaim	[deklɛm]	[deklɛm]	[deklɛ̆]
redeem	[rɪdĭ]	[rɪdĭ]	[rɪdĭ]
exam	[egzæ̆]	[egzam]	[ɪgzæm]
salaam	[salam]	[salam]	[sală̆]
kaboom	[kabŭ]	[kabŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 13	Participant 14	Participant 15
compete	[kŏpit]	[kompit]	[kompit]
compare	[kompar]	[komper]	[kompɛr]
compose	[kompoʊz]	[kŏpoz]	[kompoʊz]
improve	[ɪmpruv]	[ĭpruv]	[ɪmpruv]
compress	[kŏpres]	[komprɛs]	[kŏpræs]
impose	[ĭpoʊz]	[impoʊz]	[ĭpoʊz]
comply	[kŏpli]	[kompli]	[komplai]
embrace	[embreɪs]	[embreɪs]	[embraɪs]
bamboo	[bambu]	[bambu]	[bambu]

Nasal unstressed in the second syllable

	Participant 13	Participant 14	Participant 15
problem	[probləm]	[probləm]	[prɔbləm]
system	[sɪstəm]	[sɪstəm]	[sɪstĕ]
seldom	[seldən]	[seldəm]	[seldom]
poem	[poəm]	[poĕ]	[poəm]
freedom	[frɪdəm]	[frɪdŏ]	[frɪdŏ]
bottom	[butŏ]	[botŏ]	[butŭ]
custom	[kʌstum]	[kʊstum]	[kostəm]
victim	[viktĭ]	[viktɪm]	[vikti]
madam	[mædʌ]	[madam]	[mædəm]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 13	Participant 14	Participant 15
laundry	[laʊndrɪ]	[laʊ̆dri]	[laʊndrɪ]
country	[koʊtri]	[kʌntri]	[kaʊ̆tri]
under	[ʌndər]	[ʌndər]	[ʌndər]
cancel	[kæ̆səl]	[kansel]	[kænsəl]
handle	[hændli]	[hændl]	[hændl]
candle	[kændl]	[kændl]	[kɛndlə]
candy	[kændi]	[kæ̆di]	[kændi]
window	[wɪndoʊ]	[wɪndoʊ]	[windoʊ]
enter	[entər]	[entər]	[entər]

Nasal stressed in the second syllable

	Participant 13	Participant 14	Participant 15
explain	[ekspleɪn]	[espleɪn]	[ekspleɪn]
remain	[rɪmeĭ]	[remen]	[remeɪn]
between	[bɪtwin]	[bɪtwĭ]	[bɪtwĭ]
begin	[bɪgɪn]	[begɪn]	[begɪn]
again	[agən]	[agə̆]	[agən]
balloon	[balŭ]	[balŭ]	[balŭ]
cartoon	[kartŭ]	[kartŭ]	[kartŭ]
obtain	[obtě]	[obten]	[obtě]
domain	[domɛn]	[domen]	[doman]

Nasal unstressed in the first syllable

	Participant 13	Participant 14	Participant 15
confess	[konfes]	[konfes]	[konfes]
control	[kontrol]	[kontrol]	[kŏtrol]
invite	[ɪnvaɪt]	[ĭvaɪt]	[ɪnvaɪt]
increase	[ɪnkriz]	[ĭkris]	[inkrɪz]
enjoy	[endʒoɪ]	[endʒoɪ]	[ĕdʒoɪ]
unlike	[ʌnlaɪk]	[ʌnlaɪk]	[ʌnlaɪk]
unpack	[ʌ̆pɛk]	[ʌnpɛk]	[ʌnpɛk]
include	[ɪnklud]	[ɪnklud]	[ĭklud]
consult	[konsul]	[konsult]	[konsult]

Nasal unstressed in the second syllable

	Participant 13	Participant 14	Participant 15
broken	[broken]	[broken]	[broken]
children	[tʃɪldren]	[tʃɪldrən]	[tʃɪldren]
open	[opən]	[opən]	[opən]
woman	[wumən]	[wumă]	[wumă]
chicken	[tʃɪkən]	[tʃɪken]	[tʃɪkən]
kitchen	[kɪtʃən]	[kɪtʃən]	[kɪtʃən]
happen	[hɛpə̆]	[hæpən]	[hɛpě]
lemon	[lemən]	[lemən]	[lemon]
bacon	[beɪkən]	[beɪkon]	[beɪkŏ]

Sentences produced by the Brazilian participants 16, 17 and 18.

/m̥/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
Tim a	[tĭa]	[tĭə]	[tĭa]
gym everyday	[dʒĭmevrɪdeɪ]	[dʒĭevərɪdeɪ]	[dʒimevrɪdeɪ]
rim of	[rĭof]	[rɪmof]	[riməv]

Following context: consonant

	Participant 16	Participant 17	Participant 18
him twice	[hɪmtwais]	[hĭtwais]	[hɪmtwais]
slim girl	[slĭgɪrl]	[slĭgʌrl]	[slĭgarl]
trim her	[trĭhər]	[trimher]	[trimhər]

No following context

	Participant 16	Participant 17	Participant 18
dim	[dim]	[dim]	[dim]
grim	[grĭ]	[grĭ]	[grɪm]
brim	[brĭ]	[brĭ]	[brim]

Previous vowel: /æ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
clam is	[klæmis]	[klamis]	[klamɪs]
jam is	[dʒɛmis]	[dʒæmɪz]	[dʒæmis]
tram arrived	[træ̆arɪved]	[træ̆araɪv]	[træmarɪved]

Following context: consonant

	Participant 16	Participant 17	Participant 18
ham today	[hɛmtudeɪ]	[hæmtudeɪ]	[hamtudeɪ]
cam has	[kæmhəs]	[kæ̆hɛs]	[kæmhəs]
swam for	[swɛ̆for]	[swæmfor]	[swɛ̆for]

No following context

	Participant 16	Participant 17	Participant 18

spam	[spæ̆]	[spʌ̆]	[spæ]
gram	[græm]	[græm]	[græm]
ram	[rʌ̆]	[ræ̆]	[ram]

Previous vowel: /ʌ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
sum of	[sʌmof]	[sʌmof]	[sʌmof]
swum across	[swumakros]	[swŭakrɔs]	[swŭakros]
scum along	[skʌ̆aloʊŋ]	[skŭaloŋ]	[skumaloʊŋ]

Following context: consonant

	Participant 16	Participant 17	Participant 18
rum together	[rʌ̆tugeðər]	[rŭtugeðər]	[rʌmtugedər]
hum softly	[hʌmsoftlɪ]	[hʌ̆softlɪ]	[hʌmsoftlɪ]
drum for	[drumfor]	[drʌ̆fɔr]	[drʌmfor]

No following context

	Participant 16	Participant 17	Participant 18
gum	[gʌ̆]	[gʌ̆]	[gʌm]
slum	[slŭ]	[islŭ]	[slʌ]
bum	[bʌ̆]	[bŭ]	[bʌ̆]

Previous vowel: /i/

Following context: vowel

	Participant 16	Participant 17	Participant 18
scream at	[skrĭət]	[skrĭət]	[skrimət]
beam of	[bĭof]	[bĭəf]	[bĭof]
gleam of	[glĭof]	[glimɔv]	[gliof]

Following context: consonant

	Participant 16	Participant 17	Participant 18
seem to	[sĭtə]	[sĭtu]	[simtu]
team played	[tĭpleɪed]	[timpleɪed]	[tĭpleɪed]
deem necessary	[dĭnesesæri]	[dĭneseseri]	[dĭnesesæri]

No following context

	Participant 16	Participant 17	Participant 18

cream	[krim]	[krĭ]	[krim]
dream	[drim]	[drĭ]	[drim]
ream	[rĭ]	[rĭ]	[rim]

/n/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
tin away	[tɪnaweɪ]	[tɪnaweɪ]	[tɪnaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]	[pĭnɪs]
bin out	[bɪnaʊt]	[bɪnaʊt]	[bɪnaʊt]

Following context: consonant

	Participant 16	Participant 17	Participant 18
win the	[wĭðə]	[wĭnðə]	[wɪnðə]
thin crack	[tɪnkræk]	[tɪnkræk]	[θɪnkræk]
twin brother	[twĭbroder]	[twɪnbrɔdər]	[twɪnbroðer]

No following context

	Participant 16	Participant 17	Participant 18
gin	[dʒĭ]	[dʒɪn]	[dʒin]
skin	[skĭ]	[skin]	[skɪ]
sin	[sĭ]	[sɪn]	[sĭ]

Previous vowel: /æ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
can of	[kænof]	[kænof]	[kænof]
ran out	[rænoʊt]	[rænaʊt]	[rʌnaʊt]
fan of	[fæof]	[fænəv]	[fænov]

Following context: consonant

	Participant 16	Participant 17	Participant 18
man told	[mentoʊld]	[mæntoʊld]	[mæntuld]
van to	[vʌntu]	[væntu]	[vătu]
flan for	[flanfɔr]	[flʌfɔr]	[flɛ̆fər]

No Following context

	Participant 16	Participant 17	Participant 18
plan	[plæn]	[plæn]	[plæn]
gran	[græ̆]	[græn]	[grʌ̃]
bran	[brɛn]	[bræn]	[brɛn]

Previous vowel: /ʌ/

Following context: vowel

	Participant 16	Participant 17	Participant 18
bun is	[bʌnis]	[bŭis]	[bʌnis]
stun everybody	[stʌneverɪbɔdɪ]	[stʌnevrɪbədɪ]	[stʌneverɪbodɪ]
sun is	[sʌnɪs]	[sʌnɪs]	[sʌ̃ɪs]

Following context: consonant

	Participant 16	Participant 17	Participant 18
run to	[rʌntʊ]	[rʌ̃tə]	[rʌntə]
fun going	[fʌngoiŋ]	[fʌngoiŋ]	[fʌngoiŋ]
spun the	[spʌndə]	[spʌ̃ðə]	[spʌndə]

No following context

	Participant 16	Participant 17	Participant 18
gun	[gʌn]	[gʌ̃]	[gʌ̃]
nun	[nʌn]	[nʌn]	[nʌ̃]
dun	[dʌ̃]	[dʌn]	[dʌ̃]

Previous vowel: /i/

Following context: vowel

	Participant 16	Participant 17	Participant 18
green eyes	[grineɪs]	[grĭaɪs]	[grinaɪs]
seen it	[sinit]	[sinit]	[sinit]
dean of	[dinov]	[dinov]	[dinof]

Following context: consonant

	Participant 16	Participant 17	Participant 18
been living	[binliviŋ]	[binliviŋ]	[binliviŋ]
mean to	[mĭtʊ]	[mintʊ]	[mĭtʊ]
keen to	[kintu]	[kintu]	[kintə]

No following context

	Participant 16	Participant 17	Participant 18
clean	[klin]	[klin]	[klĭ]
bean	[bĭ]	[bin]	[bĭ]
screen	[iskrĭ]	[skrin]	[skrĭ]

/ m̥/ Disyllables

Nasal stressed in the first syllable

	Participant 16	Participant 17	Participant 18
samples	[sɛ̆pləs]	[sɛ̆pls]	[sæ̆ple]
number	[nʌmber]	[nʌmbər]	[nʌmber]
symbol	[sĭbol]	[sĭbol]	[sĭbol]
empire	[empaɪr]	[ĭpaɪr]	[ɛ̆paɪr]
member	[membər]	[mɛ̆bər]	[mebər]
campus	[kʌmpus]	[kʌmpus]	[kʌ̆pus]
scramble	[skremb]	[skrambol]	[skræmbl]
compass	[kompas]	[kompæs]	[kompes]
simple	[sɪmplə]	[sɪmplə]	[sɪmpl]

Nasal stressed in the second syllable

	Participant 16	Participant 17	Participant 18
esteem	[ɪstĭ]	[ɪstim]	[ɪstim]
proclaim	[prokleĭ]	[proklem]	[proklaeɪm]
acclaim	[akleĭ]	[aklem]	[aklɛm]
reclaim	[rɪkleɪm]	[rɪklem]	[rikleɪm]
declaim	[dekleĭ]	[deklɛm]	[dekleɪm]
redeem	[rɪdĭ]	[rɪdi]	[rɪdim]
exam	[egzam]	[egzæm]	[ɪgzem]
salaam	[saləm]	[salam]	[sală]
kaboom	[kabŭ]	[kabŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 16	Participant 17	Participant 18
compete	[kompit]	[kompit]	[kŏpit]
compare	[kŏpɛr]	[kompɛr]	[kŏper]
compose	[kŏpoʊz]	[kŏpoz]	[kŏpoʊz]
improve	[ɪpruv]	[ɪmpruv]	[ɪmprouv]

compress	[kompres]	[komprɛs]	[kompres]
impose	[impoʊz]	[ĭpoʊz]	[ĭpoʊz]
comply	[kŏplai]	[kŏpli]	[kŏplai]
embrace	[embreɪs]	[embres]	[embraɪs]
bamboo	[bambu]	[băbu]	[băbu]

Nasal unstressed in the second syllable

	Participant 16	Participant 17	Participant 18
problem	[probləm]	[probləm]	[prɔbləm]
system	[sɪstem]	[sɪstə̆]	[sɪstəm]
seldom	[seldŏ]	[seldŏ]	[seldəm]
poem	[poəm]	[poəm]	[poəm]
freedom	[frɪdŏ]	[frɪdŏ]	[frɪdŏ]
bottom	[butŏ]	[bɔtŏ]	[bɔtom]
custom	[kustom]	[kɪʊstom]	[kustom]
victim	[viktĭ]	[viktĭ]	[viktĭ]
madam	[mædə̆]	[madă]	[mædʌ̆]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 16	Participant 17	Participant 18
laundry	[lʌndrɪ]	[laʊndri]	[laʊndrɪ]
country	[kaʊ̆tri]	[kaʊ̆ntri]	[kaʊntri]
under	[ʌ̆dər]	[ʌndər]	[ʌndər]
cancel	[kænsəl]	[kʌ̆sel]	[kʌnsəl]
handle	[hændl]	[hændl]	[hændl]
candle	[kændl]	[kændl]	[kɛ̆dlə]
candy	[kændi]	[kændi]	[kændi]
window	[wɪndoʊ]	[wɪndoʊ]	[windoʊ]
enter	[entər]	[entər]	[entər]

Nasal stressed in the second syllable

	Participant 16	Participant 17	Participant 18
explain	[ekspleĭ]	[ekspleĭ]	[ɪkspleɪn]
remain	[rɪmen]	[rɪmɛn]	[reɪmeĭ]
between	[bɪtwin]	[bɪtwin]	[bɪtwin]

begin	[begɪn]	[bɪgɪn]	[begɪn]
again	[agen]	[agən]	[agən]
balloon	[balun]	[balun]	[balun]
cartoon	[kartŭ]	[kartŭ]	[kartun]
obtain	[obtəĭ]	[obtĕ]	[obtĕ]
domain	[domeĭ]	[domen]	[domĕ]

Nasal unstressed in the first syllable

	Participant 16	Participant 17	Participant 18
confess	[kŏfes]	[konfes]	[konfes]
control	[kontrol]	[kontrəl]	[kontrol]
invite	[ɪvaɪt]	[ɪnvaɪt]	[ɪnvaɪt]
increase	[ĭkriz]	[ɪnkris]	[inkraɪz]
enjoy	[ɪndʒoɪ]	[endʒoɪ]	[endʒoɪ]
unlike	[ʌ̃laɪk]	[ʌnlaɪk]	[ʌ̃laɪk]
unpack	[ʌ̃pɛk]	[ʌnpeɪk]	[ʌnpɛk]
include	[ɪnklud]	[ɪnklud]	[ɪnklud]
consult	[kŏsult]	[kŏsult]	[konsul]

Nasal unstressed in the second syllable

	Participant 16	Participant 17	Participant 18
broken	[broʊken]	[broʊkən]	[broʊke]
children	[tʃɪldren]	[tʃɪldrən]	[tʃɪldrĕ]
open	[opən]	[open]	[oʊpe]
woman	[wuman]	[wumã]	[wumã]
chicken	[tʃɪkĕ]	[tʃɪtken]	[tʃɪken]
kitchen	[kɪtʃən]	[kɪtʃən]	[kɪtʃə̃]
happen	[hɛpən]	[hæpən]	[hɛpən]
lemon	[lemon]	[lemən]	[lemən]
bacon	[beɪkon]	[beɪkŏ]	[beɪkon]

Sentences produced by the Brazilian participants 19 and 20.

/m̃/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 19	Participant 20
Tim a	[tĭa]	[timə]
gym everyday	[dʒɪmevrideɪ]	[dʒɪmevrideɪ]
rim of	[rĭof]	[rĭəv]

Following context: consonant

	Participant 19	Participant 20
him twice	[hĭtwais]	[hĭtwais]
slim girl	[slĭgɪrl]	[slĭgʌrl]
trim her	[tra]*	[trĭher]

No following context

	Participant 19	Participant 20
dim	[dĭ]	[dĭ]
grim	[grĭ]	[grɪm]
brim	[brĭ]	[brɪm]

Previous vowel: /æ/

Following context: vowel

	Participant 19	Participant 20
clam is	[klæ̆is]	[klamis]
jam is	[dʒæ̆is]	[dʒæmɪz]
tram arrived	[træ̆arɪved]	[træ̆araɪvd]

Following context: consonant

	Participant 19	Participant 20
ham today	[hæ̆tudeɪ]	[hæ̆tədeɪ]
cam has	[kæmhɛs]	[kæmhɛs]
swam for	[swĕfor]	[sŭfɔr]

No following context

	Participant 19	Participant 20
spam	[spæ̆]	[spɑ̆]
gram	[græm]	[græm]
ram	[ræ̆]	[hʌm]

Previous vowel: /ʌ/

Following context: vowel

	Participant 19	Participant 20
	Participant 19	Participant 20

sum of	[sʌof]	[sʌməf]
swum across	[swuakɹos]	[swɪmakɹos]
scum along	[skɪumaloʊŋ]	[skŭaloŋ]

Following context: consonant

	Participant 19	Participant 20
rum together	[rŭtugeðər]	[rŭtugeðər]
hum softly	[hʌsoftlɪ]	[humsɔftlɪ]
drum for	[drumfor]	[drʌmfər]

No following context

	Participant 19	Participant 20
gum	[gʌ̃]	[gʌ̃]
slum	[slŭ]	[slʌ̃]
bum	[bŭ]	[bʌm]

Previous vowel: /i/

Following context: vowel

	Participant 19	Participant 20
scream at	[skrimət]	[skrimət]
beam of	[bĭov]	[bĭəv]
gleam of	[glĭof]	[gliməv]

Following context: consonant

	Participant 19	Participant 20
seem to	[sĭtu]	[sĭtə]
team played	[tĭpleɹed]	[timpleɹ]
deem necessary	[dĭnesesæri]	[dimneseseri]

No following context

	Participant 19	Participant 20
cream	[krim]	[krim]
dream	[drim]	[drĭ]
ream	[rĭ]	[rim]

/ n/ Monosyllables

Previous vowel: /ɪ/

Following context: vowel

	Participant 19	Participant 20
tin away	[tɪnaweɪ]	[tɪnaweɪ]
pin is	[pɪnɪs]	[pɪnɪs]
bin out	[bɪnɪaʊt]	[bɪnaʊt]

Following context: consonant

	Participant 19	Participant 20
win the	[wɪnðə]	[wɪndə]
thin crack	[sɪnkræk]	[θɪnkræk]
twin brother	[twɪnbroder]	[twĭbrɔðər]

No following context

	Participant 19	Participant 20
gin	[dʒĭ]	[dʒɪn]
skin	[skĭ]	[skɪn]
sin	[sɪn]	[sɪn]

Previous vowel: /æ/

Following context: vowel

	Participant 19	Participant 20
can of	[kænof]	[kænəf]
ran out	[ræ̆aʊt]	[rænaʊt]
fan of	[fænof]	[fʌnof]

Following context: consonant

	Participant 19	Participant 20
man told	[mæntold]	[mæntoʊld]
van to	[væntu]	[vʌntə]
flan for	[flanfor]	[flʌnfor]

No following context

	Participant 19	Participant 20
plan	[plæn]	[plæn]
gran	[græn]	[græn]

bran	[bræ̆]	[bră]

Previous vowel: /ʌ/

Following context: vowel

	Participant 19	Participant 20
bun is	[bʌ̃is]	[bʌnis]
stun everybody	[stʌneverɪbodɪ]	[stʌ̃verɪbədɪ]
sun is	[sʌnɪs]	[sʌ̃ɪs]

Following context: consonant

	Participant 19	Participant 20
run to	[rʌntʊ]	[rŭtu]
fun going	[fʌngoiŋ]	[fʌngoiŋ]
spun the	[spundə]	[spundə]

No following context

	Participant 19	Participant 20
gun	[gʌ̃]	[gʌ̃]
nun	[nʌ̃]	[nʌ̃]
dun	[dʌn]	[dʌ̃]

Previous vowel: /i/

Following context: vowel

	Participant 19	Participant 20
green eyes	[grĩaɪs]	[grinaɪs]
seen it	[sinit]	[sinit]
dean of	[dinov]	[dinəv]

Following context: consonant

	Participant 19	Participant 20
been living	[binliviŋ]	[binliviŋ]
mean to	[mintʊ]	[mintʊ]
keen to	[kintu]	[kintə]

No following context

	Participant 19	Participant 20
clean	[klin]	[klin]
bean	[bĩ]	[bin]

screen	[skrin]	[skrĭ]

/ m/ Disyllables

Nasal stressed in the first syllable

	Participant 19	Participant 20
samples	[sæmpls]	[sĕpls]
number	[nʌmbər]	[nʌmbər]
symbol	[sɪmbol]	[sĭbl]
empire	[ĕpaɪr]	[ĕpaɪr]
member	[membər]	[membər]
campus	[kæ̆pus]	[kă̆pus]
scramble	[skræ̆b]	[skræ̆bl]
compass	[kompases]	[kŏpas]
simple	[sɪmpl]	[sɪmpl]

Nasal stressed in the second syllable

	Participant 19	Participant 20
esteem	[ɪstĭ]	[ɪstim]
proclaim	[proklem]	[proklem]
acclaim	[aklĕ]	[aklem]
reclaim	[rekleɪm]	[rekleɪm]
declaim	[deklɛ̆]	[deklɛm]
redeem	[rɪdim]	[rɪdim]
exam	[egză̆]	[egzam]
salaam	[saləm]	[salam]
kaboom	[keɪbŭ]	[kabŭ]

Nasal unstressed in the first syllable

	Participant 19	Participant 20
compete	[kŏpit]	[kompit]
compare	[kŏpɛr]	[komper]
compose	[kŏpoʊz]	[kompoʊz]
improve	[ĭpruv]	[ɪmpruv]
compress	[kompres]	[kŏprɛs]
impose	[ĩpoʊz]	[ĩpoʊz]
comply	[kŏpli]	[komplai]

embrace	[embreɪs]	[ĕbraɪs]
bamboo	[bambu]	[bambu]

Nasal unstressed in the second syllable

	Participant 19	Participant 20
problem	[problem]	[prɔbləm]
system	[sɪstĕ]	[sɪstəm]
seldom	[seldŏ]	[seldŏ]
poem	[poĕ]	[poem]
freedom	[frɪdon]	[frɪdŏ]
bottom	[bɔtŏ]	[bɔtĕ]
custom	[kostum]	[kɪʊstom]
victim	[viktĭ]	[viktɪm]
madam	[mædã]	[mædam]

/ n/ Disyllables

Nasal stressed in the first syllable

	Participant 19	Participant 20
laundry	[lʌndrɪ]	[laʊndri]
country	[kaʊtri]	[kʌntri]
under	[ʌndər]	[ʌndər]
cancel	[kænsəl]	[kʌnsel]
handle	[hændl]	[rændl]
candle	[kændl]	[kændl]
candy	[kænd]	[kændi]
window	[wɪndoʊ]	[wɪndoʊ]
enter	[entər]	[entər]

Nasal stressed in the second syllable

	Participant 19	Participant 20
explain	[ekspleɪn]	[eksplen]
remain	[remĕ]	[remen]
between	[bɪtwin]	[bɪtwin]
begin	[begɪn]	[begɪn]
again	[agən]	[agən]
balloon	[balun]	[balun]

cartoon	[kartun]	[kartŭ]
obtain	[obten]	[obtě]
domain	[domeɪn]	[domě]

Nasal unstressed in the first syllable

	Participant 19	Participant 20
confess	[konfes]	[kŏfes]
control	[kŏtrol]	[kŏtrəl]
invite	[ĭvaɪt]	[ɪnvaɪt]
increase	[ɪnkrizi]	[ɪnkres]
enjoy	[endʒo]	[endʒoɪ]
unlike	[ʌnlaɪk]	[ʌnlaɪk]
unpack	[ʌnpɛk]	[ʌ̆pɛk]
include	[ɪnklud]	[ɪnklud]
consult	[kŏsul]	[kŏsɪʊt]

Nasal unstressed in the second syllable

	Participant 19	Participant 20
broken	[broʊkě]	[broʊkə̆]
children	[tʃɪldren]	[tʃɪldrən]
open	[opən]	[opən]
woman	[uman]	[umă̆]
chicken	[tʃɪkě]	[tʃɪkən]
kitchen	[kɪtʃən]	[kɪtʃən]
happen	[hɛpi]	[hapən]
lemon	[lemŏ]	[lemən]
bacon	[beɪkon]	[beɪkon]