The production of French nasal vowels by advanced Japanese and Spanish learners of French: a corpus-based evaluation study

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ABSTRACT

In the past, few studies have investigated the production of French nasal vowels by non-native speakers, and none of these – as far as we know – have been corpus-based. In this study, productions of /ɑ̃/, /ɔ̃/ and /ɛ̃/ by Japanese and Spanish advanced learners of French, collected from the multitask IPFC corpus (*InterPhonology of Contemporary French*), have been assessed in a three-step process: 1) a non-expert native assessment of the vowel quality through a lexical identification task and a goodness task; 2) an expert native assessment of the postvocalic excrescences of the learners' productions; 3) an acoustic analysis of the postvocalic excrescences on a subset of productions. The results are discussed in light of the psycholinguistically distinct processes involved in the different tasks.

Keywords: L2 production, French nasal vowels, interphonology of contemporary French, multitask oral corpus, Japanese and Spanish learners of French

1. INTRODUCTION[1]

In the field of L2 phonetics and phonology, corpus-based studies have been rather scarce. However, in recent years, a number of studies have emerged: e.g. for L2 Dutch (Neri et al. 2006), Polish (Cylwik et al. 2009), German, and English in Europe (Gut 2009) and Asia (Visceglia et al. 2009). In the case of L2 French, the project *InterPhonologie du Français Contemporain* (IPFC) was launched in 2008 in order to create a large phonological corpus of oral data collected from speakers of various L1s using a single methodological protocol (Detey and Kawaguchi 2008; Racine et al. to appear; Detey et al. to appear; Detey et al. to appear). The protocol was designed after the one used in the project *Phonologie du Français Contemporain* (Phonology of Contemporary French) for native speakers (Durand et al. 2009, http://www.projet-pfc.net). The IPFC protocol consists of 5 tasks: reading aloud and repetition of a word list, text reading, formal interview with a native speaker, and semi-formal interaction between two learners. Beyond its role as a primary data provider for perceptual experiments and phonetico-phonological analyses, IPFC also aims at raising methodological issues about the articulation between psycholinguistically-oriented interphonology studies and modern corpus linguistics. The data used in the study reported here were all drawn from the IPFC corpus, more specifically from Japanese and Spanish advanced learners of French.

Among the phonological characteristics of French that non-native speakers have to learn are the nasal vowels. Even though the nasal feature [+nasal] can be found in the consonantal systems of Japanese and Spanish, and despite the existence of nasal spreading through phonetic coarticulation and assimilation processes in both languages, nasal vowels are always difficult to learn for Japanese and Spanish learners of French. So far, few studies have tackled the issue of nasal vowel learning in French as a Foreign Language: see for example Takeuchi and Arai (2009) for Japanese learners and Montagu (2002) or Garrott (2006) for American learners. This apparent lack of interest may partly be explained by the complexity of the relationship between the articulatory, acoustic and auditory properties of nasal vowels in French (Delvaux et al. 2002; Montagu 2007).

In our study, the analysis of the nasal vowels (/ɛ̃/, /ɑ̃/, /ɔ̃/) was performed according to a three-step procedure: first a non-expert perceptive assessment through both a lexical identification task and a goodness

task; second, an expert perceptive assessment of the postvocalic excrescence (degree of presence of a postvocalic consonant (Johnson et al. 2007)) and third, an acoustic analysis of postvocalic excrescences. The general purpose of our study is to assess the *quality of realization*[2] of the French nasal vowels produced by non-native speakers.

2. NON-EXPERT PERCEPTIVE ASSESSMENT OF THE NASAL VOWELS

2.1. Method

Participants: The speakers were 5 Japanese learners of French (3 males and 2 females; all were students at Tokyo University of Foreign Studies and came from the Tokyo metropolitan area) and 5 Spanish learners of French (2 males and 3 females; all were students at the University of Geneva and came from Spain). They were selected from the IPFC corpus on the basis of their proficiency level in French (B2-C1 according to the Common European Framework of Reference for Languages (CEFRL)). In the perceptual experiments, 32 native listeners were used (half for the lexical identification task and half for the goodness task).

Material: Nine monosyllabic words from the word lists in the IPFC protocol were selected: 3 containing the vowel /ɛ̃/, 3 /ɑ̃/ and 3 /ɔ̃/. Each vowel appeared in 3 different contexts: VC (i.e. *Inde* "India"), CVC (i.e. *tante* "aunt") and CV (i.e. *pont* "bridge"). All 9 words were produced twice by each learner: in a repetition task and in a reading task. The final stimulus set consisted of 180 words.

Procedure: In the lexical identification task, participants were instructed to listen to individual words and write them down. In case of hesitation (with heterographic homophones, i.e. *pense* "think" for *panse* "belly"), they were asked to write the first word that occurred to them. Each word was presented twice. If they were not able to identify a French word, they were asked to indicate it by checking an appropriate "Unknown word" field. For the goodness task, in order to avoid lexical influence and to force the participants to focus on the vowel, they were instructed to listen to syllables or parts of individual words (i.e. *–ban*, 2nd syllable of *ruban* "band") and to judge the vowel of each stimulus for its goodness as a member of a given category (/ɛ̃/, /ɔ̃/, /ɑ̃/) using a 1-5 rating scale (1 = very good exemplar; 5 = other vowel): the better the exemplar, the lower the number.

Data analysis: For the lexical identification task, a correct nasal vowel identification rate[3] was calculated as a function of learners' population, nasal vowel and production task. The correct vowel identification rate was calculated on the basis of the number of answers excluding those indicated as "Unknown word". For the goodness task, a mean goodness ratings was calculated as a function of learners' population, nasal vowel and task.

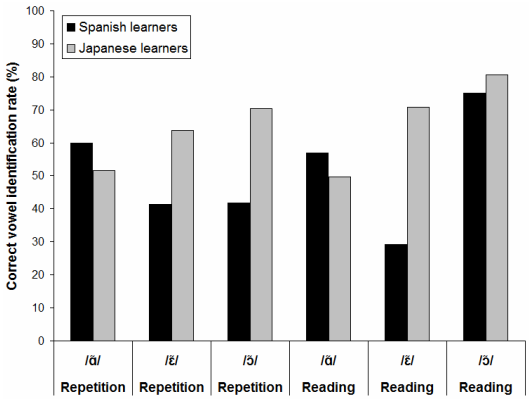
2.2. Results

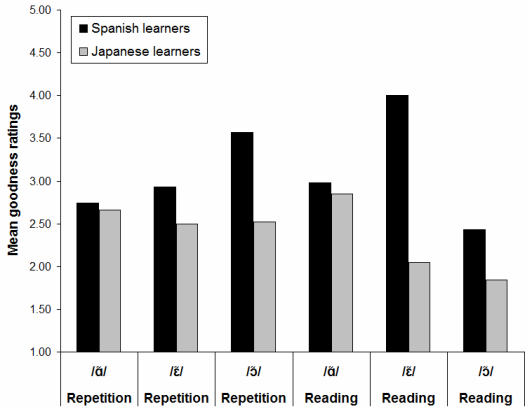
As can been seen in Figure 1 (on the left), which presents the mean correct nasal vowel identification rate (in percentage) for productions by Spanish and Japanese learners as a function of nasal vowel and production task, the correct identification rate is higher for Japanese learners' productions (64.50%) than for Spanish ones (50.72%). The analysis of variance confirms this pattern. There is a main effect of population ($F1 (1, 15) = 71.03$, $p<0.001$; $F2 (1, 6) = 6.83$, $p<0.05$). There is also a main effect of task: the correct identification rate is higher for words produced in the reading task (60.42%) than for those produced in the repetition task (54.78%) (by participants only: $F1 (1, 15) = 17.43$, $p<0.001$[4]). There is also a main effect of nasal vowel: /ɔ̃/ is better identified (67.02%) than /ɑ̃/ (54.53%) and /ɛ̃/ (51.27%) (by participants only: $F1 (2, 30) = 7.16$, $p<0.01$).

The results of the goodness task are quite similar[5]. As can been seen in Figure 2 (on the right), which presents the mean goodness ratings for productions by the two learners' populations as a function of nasal vowel and production task, the ratings are better for Japanese learners' productions (2.41) than for the Spanish ones (3.11). The analyses of variance confirm this pattern. There is a main effect of population ($F1 (1, 15) = 147.03$, $p<0.001$; $F2 (1, 6) = 13.83$, $p<0.01$). There is also a main effect of task: the goodness ratings are better for words produced in the reading task (2.69) than for those produced in the repetition task

(2.82) (by participants only: F1 (1, 15) = 14.81, p<0.01). In this task, /ɔ̃/ obtains the best rating (2.59), followed by /ɑ̃/ (2.81) and /ɛ̃/ (2.87), although in a marginal way (by participants: F1 (2, 30) = 2.86, p = 0.07)[6].

Figures 1 and 2: Mean correct nasal vowel identification rate (Fig. 1, on the left) and mean goodness ratings on a scale of 1 (= very good exemplar) to 5 (= other vowel) (Fig. 2., on the right) for productions by Spanish learners (in black) and Japanese learners (in grey) as a function of nasal vowel (/ɑ̃/, /ɛ̃/ and /ɔ̃/) and task (repetition and reading).





3. EXPERT PERCEPTIVE EVALUATION AND ACOUSTIC ANALYSIS OF POSTVOCALIC EXCRESCENCES

3.1. Method

Participants: The speakers were 11 Japanese learners of French (3 males and 8 females) and 8 Spanish learners of French (2 males and 6 females). The experts were 4 linguists, native speakers of French.

Material: Twelve monosyllables from the word lists used in the IPFC protocol were selected for this study, each of them containing a nasal vowel in an open syllable CV or in a closed syllable VC or CVC. The final stimulus set consisted of 456 words (192 for the Spanish learners and 264 for the Japanese learners; 24 productions for each learner).

Procedure: The degree of postvocalic excrescence was assessed by the experts using a 3-point scale (1 = absence of postvocalic excrescence; 3 = clear evidence of postvocalic excrescence).

Data analysis: The experts' scores were first analyzed to determine inter-rater reliability[7]. An ICC coefficient of 0.72 (p<0.001) was obtained, which indicates high reliability. We then calculated a mean degree of postvocalic excrescence as a function of learners' population, nasal vowel and production task.

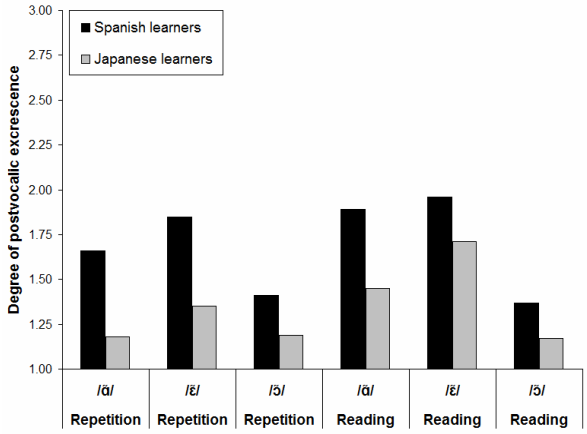
3.2. Results

As can been seen in Figure 3, which presents the mean degree of postvocalic excrescence in the productions of Spanish and Japanese learners as a function of nasal vowel and task, the degree of postvocalic excrescence is higher for Spanish learners' productions (1.69) than for Japanese ones (1.34). The analysis of variance confirms this pattern. There is a main effect of population (F1 (1, 17) = 10.10, p<0.01; F2 (1, 9) = 17.34, p<0.01). There is also a main effect of task: the degree of postvocalic excrescence is higher for the words produced in the reading task (1.69) than for those produced in the repetition task (1.44) (F1 (1, 17) = 7.75, p<0.05); F2 (1, 9) = 5.14, p<0.05). There is also a main effect of nasal vowel: the degree of postvocalic excrescence is lower for /ɔ̃/ (1.29) than for the two other vowels (/ɑ̃/: 1.55 and /ɛ̃/: 1.72) (by participants only: F1 (2, 34) = 23.52, p<0.001)[8].

In order to check the reliability of the perceptual analysis, we carried out an acoustic analysis on 2 items (38 productions of *tant* "so much" and 38 productions of *tante* "aunt"). Acoustic measures were performed by 2 phoneticians[9] using Praat (Boersma and Weenink 2009) on the basis of spectrograms. The occurrences with and without postvocalic consonant were counted after examination of the formant configuration, the formant values and the amplitude difference.

The results for acoustic analysis are convergent with the evaluation performed by experts and show two tendencies that seem to be shared by the two learners' populations. First, the degree of postvocalic excrescence is higher for the words produced in the reading task than for those produced in the repetition task. Thus, in the expert evaluation, the mean degree of postvocalic excrescence for *tante* and *tant* in the reading task is 1.88 *vs* 1.43 for the repetition task ($t(37) = 3.97$, $p<0.001$). Acoustic analyses show a similar effect: if we take into account the totality of the values ($n = 68$), a postvocalic consonant was more often present for words produced in the reading task ($n = 24$) than for words produced in the repetition task ($n = 15$) ($\chi^2 = 4.87$, $p<0.05$). Second, a postvocalic consonant was more often present for *tante* than for *tant*. In the expert evaluation, *tante* obtained a degree of postvocalic excrescence of 1.94 *vs* 1.37 for *tant* ($t(74) = 3.77$, $p<0.001$). Acoustic analysis shows the same pattern: if we take into account the totality of the values ($n = 68$), a postvocalic consonant was more often present for *tante* ($n = 26$) than for *tant* ($n = 13$) ($\chi^2 = 8.47$, $p<0.05$). A global analysis showed that the pattern observed for *tant* and *tante* can be generalized: CV words obtain the lowest degree of postvocalic excrescence. These are followed by VC or CVC words in which the last consonant is [s]. Finally, words that obtain the highest degree of postvocalic consonant are CV or CVC words in which the last consonant is a stop consonant with the same place of articulation as that of the postvocalic consonant.

Figure 3: Mean degree of postvocalic excrescence (on a scale of 1 (= absence of a postvocalic consonant) to 3 (= clear evidence of a postvocalic consonant)) in the productions of Spanish learners (in black) and Japanese learners (in grey) as a function of nasal vowel (/ɑ̃/, /ɛ̃/ and /ɔ̃/) and task (repetition on the left and reading on the right).



4. GENERAL DISCUSSION

Three global tendencies seem to emerge from our results: 1) better performance by Japanese learners as compared to Spanish learners; 2) better results in the reading task as compared to the repetition task in terms of vowel quality, but opposite results in terms of postvocalic excrescences; 3) better results for /ɔ̃/ as compared to /ɛ̃/ and /ɑ̃/.

Concerning the population effect (Japanese > Spanish), one differentiating factor that needs to be considered from a psycholinguistic viewpoint is the degree of *focus-on-form* (Ellis et al. 2002). Given the interlinguistic distance between each L1 and French, it is possible to hypothesize that the Japanese learners might have paid more attention to formal linguistic aspects of their learning than the Spanish learners. It must be borne in mind that French and Spanish differ from Japanese not only linguistically but also in their graphemic systems. The Spanish system is alphabetic with a rather shallow orthography, whereas the Japanese system is rather deep and non-alphabetic. This interlinguistic distance bears strong psycholinguistic implications for the learning process (e.g. new reading procedures and new syllabic types for the Japanese learners). Therefore, at an equal linguistic level, the attentional load may be different for the two populations: with better results for the Spanish learners on both formal and communicative dimensions in the initial stages, but better results for the Japanese learners on the formal level at a latter stage (given a constant attentional focus). Such a strong hypothesis must be tested longitudinally and the results are bound to fluctuate according to inter- and intra-learner variation.

The production task effect identified in our results must be interpreted from a psycholinguistic viewpoint, since the nature of the initial stimuli and the cognitive process at work in the reading and repetition tasks are not identical. More specifically, the repetition task involves auditory perception (and therefore possible misperception in L2, partly due to temporal constraints), whereas the reading task involves visual perception (and therefore a temporally more stable input). In the case of vowel quality, even though correct graphemic identification does not guarantee the production of a phonetically correct unit in the target language system, it seems plausible that the reading task could be more favourable to input faithfulness than the repetition task. In that case, the orthographic input would play a positive role in the identification of certain phonemic categories (Steele 2005). In terms of postvocalic excrescences on the other hand, the opposite results serve as a reminder that orthography can have an effect – a negative one here – on both suprasegmental (Detey and Nespoulous 2008) and segmental levels (Detey et al. 2005): erroneous graphemic segmentation for the first level and automatic graphophonemic activation for the second (Dijkstra et al. 1993). In the repetition task, the degree of presence of an epenthetic consonant – absent from the input – is thus unsurprisingly lower than in the reading task. If we put aside performance errors, three arguments can be put forward to explain the presence of postvocalic excrescences: 1) on a psychoacoustic or phonological level, a perceptual or interphonological reinterpretation of the nasal vowel; 2) on a psycholinguistic level, the activation of a phonological or orthographic lexical representation with a lexicalized epenthetic consonant; 3) on an articulatory level, universal or L1-transferred automatic coarticulation mechanisms.

Our results of the non-expert assessment lead to the following ranking: /ɔ̃/ > /ɑ̃/ > /ɛ̃/. If we follow the hypothesis of Paradis and Prunet (2000), according to which nasal vowels should be considered Oral vowel + Nasal consonant sequences, we must take into account the recent work of Montagu (2002, 2007), which shows that corresponding oral vowels in contemporary French are not /ɔ/, /ɑ/ and /ɛ/ respectively – as it could be assumed from the IPA symbols – but instead /o/, /ɔ/, and /a/. This points to the fact that /ɑ̃/ is the only vowel without an oral equivalent category (/ɔ/) in the L1 system (Japanese or Spanish). Yet, when we take into account the graphemic dimension, it is /ɛ̃/ that seems to be the most costly in terms of cognitive processing, as it has the highest number of graphic variants in French (as compared to /ɑ̃/ and /ɔ̃/): /ɛ̃/ was actually the only one to be represented as a trigram in the reading task (*teinte* and *teint*), and the results for /ɛ̃/ in the reading task concur with those in Garrott's work (2006). Therefore, according to our global results, /ɔ̃/ seems to be the easiest category to learn and to identify.

5. CONCLUSION

Even though a cross-task comparison including the three other tasks of the IPFC corpus (text reading and conversations) seems necessary to further our understanding of the production of the three French nasal vowels by advanced Japanese and Spanish learners, the task effect brought to light so far in our results from the words in isolation already has direct implications: on a methodological level – for research in the field of L2, and maybe even L1, phonology –, and on a pedagogical level – for oral language education. On a methodological level, multitask – and not only single- or double-task – protocols seem to be essential to build up large and multipurpose oral corpora. While this seems to be important in the case of native speakers (see for example the PFC protocol with two reading tasks and two conversation tasks), it is crucial in the study of non-native speakers, whose maturing interphonological (and interphonetic) systems are even more heavily influenced by the psycholinguistic features of each task. Ideally, both modalities (auditory and visual) should be involved, as well as both the perceptive and the productive side of the learner's interphonological system. On a pedagogical level, our results point to the necessity of providing a well-balanced learning environment in which the selected tasks allow phonetico-phonological and phonographemic skills to develop simultaneously.

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NOTES

[1] We would like to thank Helene N. Andreassen for her help with the final version of this paper.
[2] This notion must not be confused with *intelligibility* or *accentedness*, or even *comprehensibility* or *acceptability* (see Munro 2008).
[3] This was preferred to the more traditional correct lexical identification rate because it focuses on nasal vowel recognition and does not count errors of identification triggered by other factors such as surrounding consonants.
[4] The absence of a main effect by items in the analyses of variance may partly be explained by the small number of items we had in each category (only three).
[5] A correlation of 0.72 ($p<0.001$) between correct vowel identification rate and goodness ratings was obtained, which indicates high reliability between the two tasks.
[6] Moreover both tasks show several interactions, which reveal that the identification rate and the goodness ratings for each vowel vary as a function of population and task. They thus underline the complexity of the system but further analyses are required to interpret them.
[7] The inter-rater reliability coefficient measures the consistency between the assessments of the 4 raters and varies between 0 and 1 (1 indicates a perfect consistency between the raters).
[8] Moreover there is an interaction between the vowel and the task (by participants only: $F1\ (2, 34) = 3.67$, $p<0.05$), which shows that postvocalic excrescence varies as a function of the task and underlines that the variables examined are linked together.
[9] We would like to thank Naoki Marushima for his help with the acoustic measures.