



HAL
open science

Nasality overlap in French rhotics

Andres Felipe Lara, Jenifer Vega Rodriguez

► **To cite this version:**

Andres Felipe Lara, Jenifer Vega Rodriguez. Nasality overlap in French rhotics. PaPE 2025 - 6th Phonetics and Phonology in Europe, Institut de Recerca i Innovació Educativa (IRIE), Jun 2025, Palma De Majorque, Spain. pp.312 - 313, <10.5281/zenodo.15795934>. <hal-05135084>

HAL Id: hal-05135084

<https://hal.science/hal-05135084v1>

Submitted on 21 Jan 2026

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons CC BY-NC 4.0 - Attribution - Non-commercial use - International License

12. Nasality overlap in French rhotics

Andrés Felipe Lara¹ and Jenifer Vega Rodriguez^{2,3}

¹LPP, CNRS, U. Sorbonne Nouvelle, ²GIPSA lab, CNRS, U. Grenoble Alpes, ³Brasilia Univ.

Nasalization occurs when nasal airflow from lowering the velum in nasal consonants overlaps with adjacent segments, influenced by perceptual and linguistic factors [1]. Anticipatory nasalization involves greater velopharyngeal opening (VPO) than carryover nasalization, with peak VPO varying by context and reflecting nasal airflow differences [2]. Fricatives resist nasalization due to maintaining both friction and airflow, which is biomechanically and perceptually difficult, while French liquids, particularly rhotics, show more anticipatory nasalization [4]. French rhotics face unique challenges as combining nasal airflow with fricative friction is complex. Despite extensive research on French nasalization [4, 5], studies on rhotics remain sparse [3]. French nasal coarticulation is restricted, with vowels before nasals typically remaining oral, and nasalization arising from physiological timing rather than deliberate articulation [1, 5]. While nasalization is more prominent in vowels, rhotics may display subtle nasalization patterns requiring further study. This study hypothesizes that rhotic nasalization is unintentional [3] and shaped by phonetic contexts, following the nasalization continuum proposed by [2]: *oral sounds* < *contextually nasal vowels* < *nasal consonants* < *nasal vowels* < *pauses*.

Three native French speakers (1 male, 2 female) from Paris participated in this study. Two corpora were designed words: (1) three repetitions of nasal vowels /ã, ê, õ/ and oral vowels /a, i, o/ in P \tilde{V} and PVP context respectively to determine a nasalization threshold, and (2) 16 words repeated three times with /ʁ/ in different phonetic contexts (# \mathfrak{B} V, V \mathfrak{B} #, \mathfrak{B} VN, V \mathfrak{B} N, $\mathfrak{B}\tilde{V}$, NV $\mathfrak{B}\tilde{V}$) where V and \tilde{V} include /i, a, o, ã, ê, õ/, and N is /m/. Three channels were recorded synchronously using an EGG D800 (Laryngograph Ltd.): nasal airflow (NAF), oral airflow (OAF), and acoustic (WAV). Praat, Matlab, and Python were used for data segmentation, processing, and statistical analyses.

Nasal rate (*NR*) was calculated as $NR = NAF / (NAF + OAF)$ to establish nasality thresholds for oral vowels ([i, o, a], $NR = 19.5\%$) and nasal vowels ([ê, õ, ã], $NR = 31.4\%$) within the same context (/p_p/). Figure 1 shows that higher vowels in both nasal and oral categories exhibited higher *NR* values. The nasality threshold was set at 20%, consistent with the French threshold established by [6]. Figure 2 illustrates a nasalization continuum for [ʁ], with the lowest nasalization observed in oral contexts (# \mathfrak{B} V, \mathfrak{B} V#) at $14\% \pm 9.4\%$, followed by nasal non-adjacent contexts (\mathfrak{B} VN) at $18\% \pm 8.1\%$. Nasal-adjacent contexts exhibited progressively higher nasalization: $\mathfrak{B}\tilde{V}$ (20.3%), V \mathfrak{B} N (27%), and NV $\mathfrak{B}\tilde{V}$ (30%). A significant difference in *NR* across contexts was found for [ʁ] ($p \approx 2.53 \times 10^{-13}$). Figure 3 compares *NR* values for [ʁ] in the $\mathfrak{B}\tilde{V}$ context, showing vowel-specific effects: [õ] had higher nasalization than [ã] or [ê]. This contradicts [5] and aligns with findings by [7], who reported a weak correlation between nasal airflow (NAF) and tongue height, suggesting the nasalization continuum may not fully capture all contributing factors. Figure 4 plots individual productions across contexts. Speaker M1 demonstrated clear distinctions between # \mathfrak{B} V, V \mathfrak{B} #, \mathfrak{B} VN, and $\mathfrak{B}\tilde{V}$, NV $\mathfrak{B}\tilde{V}$, with the most variability in $\mathfrak{B}\tilde{V}$. Speakers F1 and F2 separated oral and nasal contexts, with greater F1 variability in # \mathfrak{B} V and \mathfrak{B} V#, and greater F2 variability in # \mathfrak{B} V and V \mathfrak{B} N. No significant differences were observed between speakers ($p = 0.22$). Interestingly, the observed *NR* continuum differed from predictions [2], with $\mathfrak{B}\tilde{V}$ showing lower nasalization than V \mathfrak{B} N. The revised continuum for rhotics is as follows: # \mathfrak{B} V < \mathfrak{B} V# < \mathfrak{B} VN < $\mathfrak{B}\tilde{V}$ < V \mathfrak{B} N < NV $\mathfrak{B}\tilde{V}$. Preliminary results suggest greater anticipatory nasal overlap near nasal consonants but are based on a small speaker sample. Further research is needed to confirm coarticulatory trends and explore potential language-specific nasalization patterns

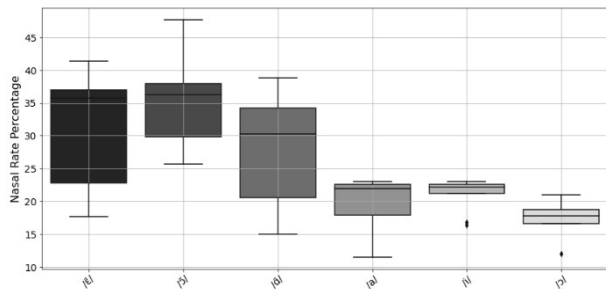


Figure 1. Nasal rate (%) for oral /a, i, ə/ and nasal vowels /ã, ê, ÿ/ in P̃ and P̃P contexts.

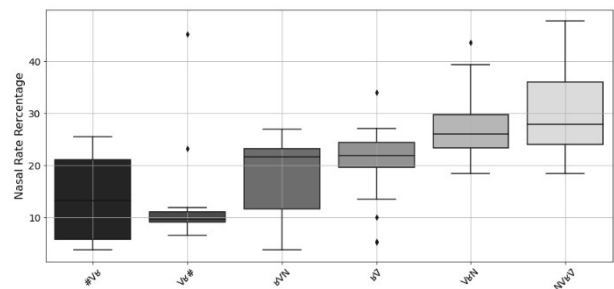


Figure 2. Nasal rate (%) for [ʋ] in different phonetic contexts (all vowels combined)

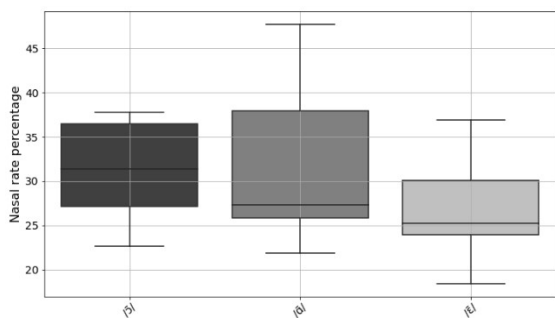


Figure 3. Nasal rate (%) for [ʋ] when preceding three vocalic contexts /ã, ê, ÿ/.

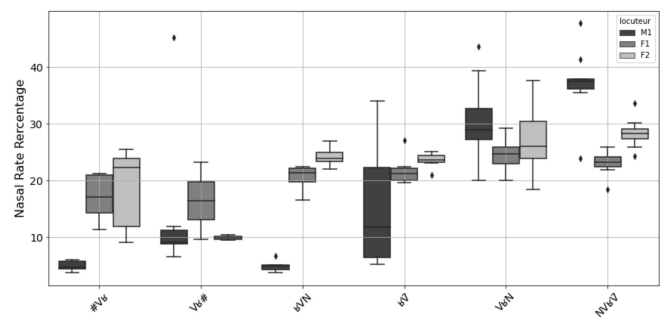


Figure 4. Speaker productions of [ʋ] across different contexts. M= male and F = female

- [1] H. Clumeck, "Patterns of soft palate movements in six languages," *Journal of Phonetics*, vol. 4, pp. 337-351, 1976.
- [2] G. De Boer, J. Islam, C. Purnomo, L. Wu, et B. Gick, « Revisiting the nasal continuum hypothesis: A study of French nasals in continuous speech », *Journal of Phonetics*, vol. 98, p. 101244, mai 2023, doi: 10.1016/j.wocn.2023.101244
- [3] M. Solé, "Aerodynamic characteristics of trills and phonological patterning," *J. Phonetics*, vol. 30, pp. 655-688, 2002.
- [4] V. Delvaux, D. Demolin, B. Harmegnies, and A. Soquet, "The aerodynamics of nasalization in French," *J. Phonetics*, vol. 36, pp. 578-606, 2008.
- [5] A.P. Benguerel, "Nasal airflow patterns and velar coarticulation in French," in *Speech Communication Seminar*, Stockholm, 1974, pp. 105-112.
- [6] A. Elmerich, A. Amelot, S. Maeda, Y. Laprie, J. F. Papon, and L. Crevier-Buchman, "F1 and F2 measurements for French oral vowel with a new pneumotachograph mask," in *ISSP 2020-12th International Seminar on Speech Production*, December 2020.
- [7] R. K. Shosted, *The aeroacoustics of nasalized fricatives*, PhD dissertation, University of California, Berkeley, 2006.