Vowel-specific metrics of phonological nasalization in French
Canadian Linguistics Association

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Plan

1. Introduction

2. Phonetic background
   - Simple factors
   - Complex interactions

3. Experimental study

4. Discussion

5. References
Problématique

- Experimental phonological accounts & theory are only as good as their data.
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- **Case study:** Many instrumental studies on nasal coarticulation in French show high rates of nasality on high vowels (esp. Delvaux et al. 2008, Rochet & Rochet 1991, Spears 2006) . . .
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...to the point where we might consider it phonological.

But not all vowels are nasalized equal. How to fairly & accurately model nasality, then?
Goals

- Summarize the phonetic factors differentiating vowel qualities *vis-à-vis* ease of nasal coupling
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- Pilot a vowel-specific measurement of nasality for an instrumental corpus of French, and
- Compare these results against durational data to show that /i, y/ nasalization in French is phonological.
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The high > low parameter

- **Aerodynamics**: High vowels produced with high degree of intraoral pressure → greater nasal airflow (e.g., Clarke & Mackiewicz-Krassowska 1977, Shosted 2012) and less velopharyngeal opening (e.g., Al-Bamerni 1983).
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- **Acoustics:** Same amount of nasal coupling has stronger effects on high vowels (House & Stevens 1956).
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- **Acoustics:** Same amount of nasal coupling has stronger effects on high vowels (House & Stevens 1956).

- **Perception:** Low vowels require much greater nasal coupling and time to be perceived as nasal, compared with high vowels (e.g., Maeda 1982).
Simple factors

**The low > high parameter**

- **Articulation:** Inherent velic position covaries with vowel height (e.g., Henderson 1984) — though not necessarily universally (e.g., Amelot & Rossato 2006).
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Lower position on low vowels $\rightarrow$ easier to nasalize (e.g., Straka 1955)?
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- Lower position on low vowels → easier to nasalize (e.g., Straka 1955)?

- **BUT** also leads to “leakage” in oral contexts (Bell-Berti 1973, Chen & Wang 1975).
What’s the problem?

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- Conflicting factors may lead to conflicting evidence, depending on the type of instrument used — for instance, articulatory could overreport low vowels, while aerodynamic overreports high.
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- **Solution:** Let’s let each vowel quality define its own nasal threshold.
Duration favours low vowels

- Low vowels frequently longest in experimental studies (cf. Hajek & Maeda 2000 for references).
## Complex interactions

### Duration favours low vowels

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- Lower aperture may then favour nasality.
High vowels are the shortest in the same literature, and (reminder) the easiest to nasalize from most perspectives.
Complex interactions

Duration confounds high vowels
Or: Crouching tiger, hidden mechanical nasalization

- High vowels are the shortest in the same literature, and (reminder) the easiest to nasalyze from most perspectives.
- The velum as a sluggish articulator (Bell-Berti 1993, Ohala 1975), with oro-nasal transition times around 250 msec. (e.g., Bell-Berti 1980, Dalston & Seaver 1990).
Complex interactions

What’s the problem again?

- “Sloppy” articulation may then lead to inflated percentages on high vowels – unintentionally but largely nasal.
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- Reports of significant high vowel nasalization in French may be an artefact of this interaction.

- Solution: Let’s see how nasality interacts with duration, vowel by vowel (à la Solé 1992, 2007).
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    2. *la partisane_sarcastique = an#s*
    3. *le client_secret = ã#s*
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    2. *la partisane sarcastique* = an#s
    3. *le client secret* = ã#s

- **Procedure**: Self-paced reading task. List(s) randomized 3 times for each speaker.
Measurements & Calculations

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- Hypothetical example:
  - Mean nasal energy of all /i/ vowels of speaker x in non-nasal settings = 0.023 Pa²·s; sd = 0.019
  - x’s /i/ nasal threshold = 0.061
  - How many points of /i/ in /in/ exceed? Overall V length?
## Results

Average vowel nasality threshold & standard deviation

<table>
<thead>
<tr>
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<th>Threshold</th>
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<tr>
<td>/a/</td>
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<td>0.014</td>
</tr>
<tr>
<td>/e/</td>
<td>0.021</td>
<td>0.018</td>
</tr>
<tr>
<td>/ø/</td>
<td>0.032</td>
<td>0.032</td>
</tr>
<tr>
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</tr>
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- **NB:** Some speakers show greater diversity among thresholds than others.
Nasal phase duration increases only for high front vowels, suggesting gestural anchorage with respect to V, not N.
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Findings

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- Even after attempting to remove acoustic/aerodynamic bias, high (front) vowels demonstrate high levels of nasal coarticulation.
- Though on average shortest in the corpus, these vowels demonstrate a nasal phase increasing proportionately to their overall duration, suggesting a deliberate, phonological function.
Open questions

\- /i, y/ nasalization seemingly capped around 50%. Why, and does phonology need to take this into account?
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- Progressive nasalization is more pervasive and intense in French. Is it phonological as well?
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- Does syllable structure matter, e.g., what about internal /i.n/?
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References


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