Affrication Patterns and Perceptual Tendencies in Canadian and European French

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Presentation Overview

- Preliminary results from two perception experiments involving Canadian French affrication patterns.
- Tested multiple populations:
  - Primary interest: Canadian French speakers.
  - Secondary interest: European French speakers living in Quebec - for insight into the effect of dialect exposure.
  - Tertiary interest: English speakers - as a control group.
Presentation Overview

- Experiment 1 looks at **phonotactic rareness**.
  - Speakers are biased against perceiving sound sequences that are impossible in their language (Massaro & Cohen 1983, Dupoux et al. 1999).
  - What about sound sequences that are rare but still possible?

- Preliminary results in Exp 1 suggested that listeners are biased against perceiving phonotactically rare sequences.

- **But** later unexpected results with English speakers on the same French stimuli put this finding into question.
Presentation Overview

- Experiment 2 looks at **partial allophony** and categorical perception.
  - Speakers perceive less of a “middle ground” between sound pairs that are contrastive than sound pairs that are non-contrastive (Liberman et al. 1957).
  - What about cases of partial allophony, where the *same two sounds* can be contrastive or non-contrastive depending on the environment?
- Preliminary results in Exp 2 suggest categorical perception differences when comparing the same sound pairs in different environments (that affect contrastive status).
Canadian French affrication
Canadian French affrication

- In most dialects of Canadian French, coronal stops affricate before high front vowels and the corresponding glides.
  - /t, d/ → [ʦ, ʣ] before /i, y/ and /j, u̯/
  - Examples:
    - *Canadien* “Canadian” as [kanadʒɛ̃]
    - *tigre* “tiger” as [ʦɪɡʁ]
    - *difficile* “difficult” as [ʣɪfɪsɪl]
Canadian French affrication

- Non-allophonic affricates are also possible. They lack the environmental restrictions, but they are rare:
  - *tsé* “y’know” (from *tu sais*) [tse]
  - *mouche tsé-tsé* “tse-tse fly” [muʃ tse tse]
  - *tsigane* “gypsy” [tsigan]
  - *tsoin-tsoin* (an onomatopoeia) [tswɛ̃ tswɛ̃]
  - *tsar* “tsar” [dʒaʁ]
Canadian French affrication

- This gives us two key phenomena.
- First: a state of phonotactic rareness.
  - Affricates are usually followed by high front vowels. Other vowels are possible, but quite rare.
Canadian French affrication

- This gives us two key phenomena.
- Second: a state of partial allophony.
  - Whether stops and affricates contrast depends on the environment.
  - Before most vowels (all other than high front vowels), stops and affricates are always contrastive.
  - Before high front vowels, they are almost always non-contrastive (dialectal variants of the same phoneme).
    - (Only “almost always” because at least one word has a non-allophonic affricate before a high front vowel: tsigane “gypsy”.)
Canadian French affrication

- Within Canada, affrication is found in:
  - Quebec French (Friesner 2010) (85% of Canada’s ~7 million francophones)
  - Ontario French (Durand 1992)
  - Manitoba French (Bérubé et al. 2015)

- But not generally found in:
  - Acadian French (King 2000, Cichocki 2012) (though Acadian varieties variably have their own form of affrication that’s different in multiple ways.)
Experiment 1 - Vowel Continuum
Experiment 1 - Vowel Continuum

**Hypothesis:** Because affricates are usually followed by high-front vowels, hearing an affricate should bias listeners towards perceiving the following vowel as high-front.

**Rationale:** This is designed to gain insight into whether listeners are sensitive to phonotactic rareness, in addition to actual phonotactic restrictions.
Experiment 1 - Vowel Continuum

Initial Participants (French-speaking)
- 13 speakers of Canadian French in Montreal or Toronto.
- 6 speakers of European French in Montreal (1-4 years living in Quebec).

Later Participants (English-speaking)
- 7 speakers of Canadian English in Toronto (low in Fr. ability)
Experiment 1 - Vowel Continuum

Stimuli

- French CVCV pseudo-words.
- Started with either [na] or [fo] as the first CV.
- Then either a stop [t, d] or an affricate [tʃ, dʒ] (4 options).
- The final V is a 10-step vowel continuum from [e] to [i].
- (Expectation: participants will hear continuum as [i] more often after an affricate, but as [e] more often after a stop.)
Experiment 1 - Vowel Continuum

Stimuli

- 80 total stimuli items (2 initial frames × 4 consonants × 10 vowels).
- Examples: [fote] ... [foti], [fotse] ... [fotsi].
- All made in Praat.
  - Downsampled to 16Khz, normalized to 70dB SPL.
  - Vowel continuum made with a formant-editing script making use of linear predictive coding (LPC) and FormantGrid.
Experiment 1 - Vowel Continuum

Procedure

- Designed and run in OpenSesame (Mathôt, Schreij, & Theeuwes 2012).
- Participants identified whether they heard “é” or “ï” by pressing “e” or “i” on the keyboard.
- 400 trials (80 items × 5 repetitions), after 8 practice trials.
Experiment 1 - Vowel Continuum

Results - Canadian French (n=13)

- Looked at likelihood of identifying hearing [e].
- Effect of preceding consonant was highly significant (repeated measures ANOVA): F(1,12)=51.28, p<0.001.
- They were much less likely to hear [e] after an affricate (25.06%) than after a stop (58.41%), as expected.
Experiment 1 - Vowel Continuum

Results - Canadian French (n=13)
Experiment 1 - Vowel Continuum

Results - European French in Quebec (n=6)

- The Europeans also much less likely to hear [e] after an affricate (20.29%) than after a stop (75.55%).
- (But note the small sample size.)
Experiment 1 - Vowel Continuum

Results - European French in Quebec (n=6)
Experiment 1 - Vowel Continuum

Results - Canadian English (n=7)

- The Canadian **English** speakers also less likely to hear [e] after an affricate (33.42%) than after a stop (50.00%).
- *(Note the small sample size.)*
Experiment 1 - Vowel Continuum

Results - Canadian English (n=7)
Experiment 1 - Vowel Continuum

**Summary & Discussion**

- Canadian French participants had the effect of phonotactic rareness. Expected, since they have affrication in their own dialect.
- European French participants also had the effect. Not surprising, since they’re exposed to affrication.
Experiment 1 - Vowel Continuum

Summary & Discussion

- Canadian English speakers also had the effect. Unexpected!
- They should have no awareness of the association between affricates and high front vowels.
- Creates a conundrum and puts the other results in question.
Experiment 2 - Consonant Continuum
Experiment 2 - Consonant Continuum

Participants (French-speaking)

- 13 speakers of Canadian French living in Montreal or Toronto.
- 6 speakers of European French living in Montreal (1-4 years living in Quebec).

Later Participants (English-speaking)

- 7 speakers of Canadian English in Toronto (low in Fr. ability)
Experiment 2 - Consonant Continuum

Background: Categorical Perception

- A continuum is perceived as being less gradual when it crosses a phoneme boundary than when it does not.
Experiment 2 - Consonant Continuum
Experiment 2 - Consonant Continuum

**Hypothesis:** Because stops and affricates are non-contrastive before high front vowels, but contrastive elsewhere, perception of an affricate-stop continuum should be less categorical before high front vowels.

**Rationale:** This is designed to gain insight into whether categorical perception effects can be found between environments in a state of partial allophony.
Experiment 2 - Consonant Continuum

Stimuli

- Stimuli in Exp 2 resemble those from Exp 1, but the location of the continuum is different.

- Exp 1:
  - Initial frame: [na] or [fo]
  - Two conditions: stop [t, d] or affricate [ts, dʒ]
  - 10-step vowel continuum from [e] to [i]
Experiment 2 - Consonant Continuum

Stimuli

- Exp 1:
  - Initial frame: [na] or [fo]
  - Two conditions: stop [t, d] or affricate [ts, dz]
  - 10-step vowel continuum from [e] to [i]

- Exp 2:
  - Initial frame: [na] or [fo]
  - 10-step consonant continuum from [ts] to [t] (also one from [dz] to [d])
  - Two conditions: mid front [e] or high front [i]
Experiment 2 - Consonant Continuum

Stimuli

- 80 total stimuli items (2 initial frames × 4 consonants × 10 vowels).
- Examples: [fotse] ... [fote], [fotsi] ... [foti]
- All made in Praat.
  - Consonant continuum made by taking an affricate and then:
    - Incrementally cutting away the frication (start: 87ms or 114ms, end: 0ms)
    - adding closure duration (start: ~60ms, end: ~100ms).
  - Downsampled to 16Khz, normalized to 70dB SPL.
Experiment 2 - Consonant Continuum

Procedure

- Designed and run in OpenSesame (Mathôt, Schreij, & Theeuwes 2012).
- Participants identified whether they heard a “ts”/“dz” sound or “t”/“d” sound by pressing “f” or “j” on the keyboard.
- 400 trials (80 items × 5 repetitions).
Experiment 2 - Consonant Continuum

Results - Canadian French (n=13)

- There was an interaction between continuum step and the following vowel \((F(1,12)=2.74, p<0.001)\).
- The slope is steeper when the vowel is \([e]\), meaning that the perception of the affricate-stop continuum was more categorical when the two sounds are contrastive, as expected.
Experiment 2 - Consonant Continuum

Results - Canadian French (n=13)
Experiment 2 - Consonant Continuum

Categorical Perception Example

Percentage Identified as Sound 1

Step (Continuum from Sound 1 to Sound 2)
Experiment 2 - Consonant Continuum

Results - European French in Quebec (n=6)

- The Europeans do not seem to have the same effect.
- (But a larger sample size would be more conclusive.)
Experiment 2 - Consonant Continuum

Results - European French in Quebec (n=6)
Experiment 2 - Consonant Continuum

Results - Canadian English (n=7)

- The Canadian English participants do not seem to have the same effect (phew!).
- *(A larger sample size would make be more conclusive.)*
Experiment 2 - Consonant Continuum

Results - Canadian English (n=7)
Experiment 2 - Consonant Continuum

Summary & Discussion

- Canadian French group had differences in categorical perception depending on the environment and contrastive status.
- But the European French and Canadian English participants did not.
General Discussion
Summary & General Discussion

- Originally, both French-speaking groups had the effect of phonotactic rareness.
- This was interesting for phonotactic rareness and the effect of dialect exposure.
Summary & General Discussion

- Then the English speakers unexpectedly had the effect too, which put both previous findings into question.
- More work is needed to determine the effect of phonotactic rareness and of dialect exposure.
Summary & General Discussion

- The effect of partial allophony (on categorical perception) was more clear: it was found for the Canadian French speakers.
- But the Europeans did not, which does not suggest an effect of dialect exposure.
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References

Contact / more information

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Notes: Allophonic vs. Non-Allophonic Affricates

- Phonetic difference between allophonic affricates (e.g. in *tigre*) and non-allophonic affricates (e.g. in *tsé*)?
  - Perhaps non-allophonic affricates are phonetically stop-fricative sequences rather than affricated stops?
- Not as far as I can tell. Stop-fricative sequences are generally significantly longer (Berns 2013), but I found no length difference.
  - Informally looked at 6 allophonic and 6 non-allophonic affricates, and the means duration (closure duration, burst, and frication) were 213ms and 215ms.
Notes: Future Work on Exp1 Conundrum

- Affricates were taken from words where followed by [i].
- Perhaps traces of the vowel present in affricate?
- Solution: take an affricate from before [e] and introduce that as its own condition.
Notes: European French affrication

- Canadian French affrication is absent in European French.
- Sometimes affrication shows up in European French, but it’s of a different nature.
  - Inconsistent phonetic phenomenon (Candea et al. 2013: 1-8% in a corpus) rather than a phonological rule (Berns 2013).
  - Usually results in postalveolar [tʃ, dʒ] rather than alveolar [ts, dz].
  - But it occurs in the same environments.