An acoustic analysis of the East Norwegian merger of /ʃ/ and /ç/

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FiNo 2023

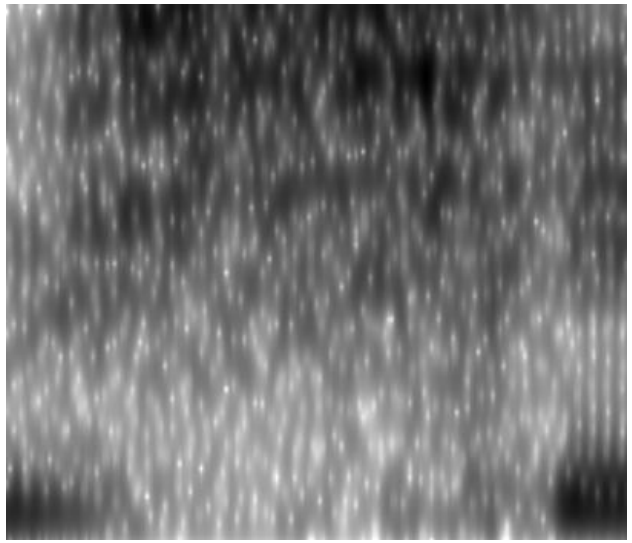
Background

- What is the motivation for sound change?
- Traditionally assumed that *articulation* is the main driving force.
- Increasingly, *perception* has been recognised as a central factor in driving sound change (Ohala, 1981; Blevins, 2004; Hayes et al., 2004).

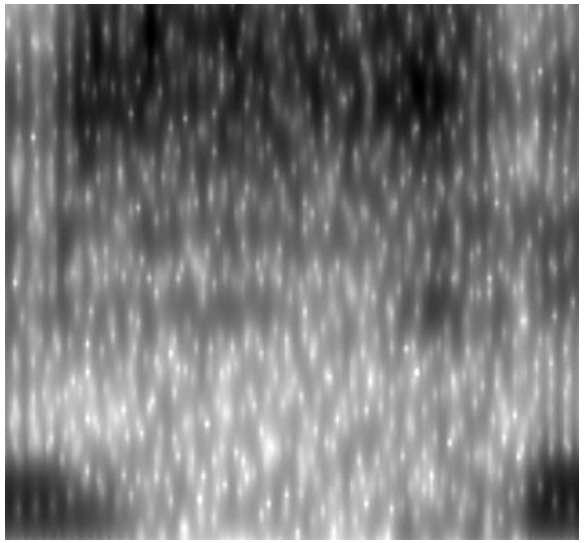
Background

- The most debated sound change in Norwegian today is the merger of /ʃ/ and /ç/.
  - /ʃin/ *skinn* ‘skin’
  - /çin/ *kinn* ‘cheek’
  - Seemingly merging as [ʃ].

Background



[ç]



[ʃ]

PhD project

- Research on the merger has mostly pointed to articulation (e.g. Papazian, 1994; Torp, 1999).
- We aim to investigate the role of perception in the merger of /ʃ/ and /ç/ in Urban East Norwegian (Kristoffersen, 2000).
- Can perception and acoustics alone explain the *motivation for* and the *outcome of* the merger?

PhD project

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- What is the motivation for the merger?
- If the merger goes in a certain direction, why?

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The contrast between /ʃ/ and /ç/

- 22 minimal pairs (Torp, 1999).
- E.g. *kjønn – skjønn, kjekk – sjekk*, *kjele – skjele*, *Kjell – skjell* etc.
- Imbalance in both phonotactic distriubtion and frequency.

The contrast between /ʃ/ and /ç/

- /ʃ/ has a broad distribution:
  - Word-initially (***sk****ip* ‘ship’)
  - Word-medially (*baga****sj****e* ‘luggage’)
  - Word-finally (*du****sj*** ‘shower’)
- Retroflexion of the sequence /rs/ (*han va****r s****å høy* ‘he was so tall’).

The contrast between /ʃ/ and /ç/

- /ç/ has a narrow distribution:
  - Only word-initially (***kj****ole* ‘dress’)
  - One exception (*bi****kkj****e* ‘dog’)
- Not the result of any phonological processes.

The merger of /ʃ/ and /ç/

- Increasingly, /ʃ/ and /ç/ are merging (e.g. Papazian, 1994; Torp, 1999).
- Noted in child language for almost a century (Papazian, 1994).
- In recent decades also found in adult language.

What is the result of the merger?

- Assumed to be [ʃ].
- Only /ç/ pronounced as [ʃ], but not /ʃ/ pronounced as [ç], has been investigated.
- Dommelen (2019) finds no /ʃ/ pronounced as [ç] based on “preliminary inspection by the author”.

What is the result of the merger?

- The fricatives can merge as both [ʃ] and [ç] in West Norwegian (Johannessen, 1983).
- Easy to find examples in East Norwegian of /ʃ/ pronounced as [ç] and both /ʃ/ and /ç/ pronounced as some sound in between (Papazian, 1994, p. 67).

What is the result of the merger?

- In principle not given that the result is [ʃ].
- Necessary to conduct an acoustic analysis of the result of the merger.
- This is the aim of the current study.

Experiment – recordings

- Recording of native Norwegian speakers:
  - Spontaneous speech.
  - Reading of a text.
  - Reading of nonce words.
- Recordings are annotated using Praat (Boersma & Weenink, 2022).

Experiment – acoustic analysis

- Establish the acoustic properties of canonical /ʃ/ and /ç/.
- Compare merged pronunciations to canonical /ʃ/ and /ç/.
- First determine which speakers are *mergers* and which speakers are *non-mergers*.

Experiment – acoustic analysis

- Analyse /ʃ/ and /ç/ according to relevant acoustic parameters (Gordon et al., 2002).
  - Centre of gravity (CoG)
  - Duration
  - Formant transitions
  - Spectral shape

Experiment – acoustic analysis

- Average values for /ʃ/ and /ç/ are calculated for each acoustic parameter for each speaker.

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	/ç/	/ʃ/	Difference
Speaker 1	4600 Hz	4100 Hz	500 Hz
Speaker 2	4100 Hz	4100 Hz	0 Hz

Experiment – acoustic analysis

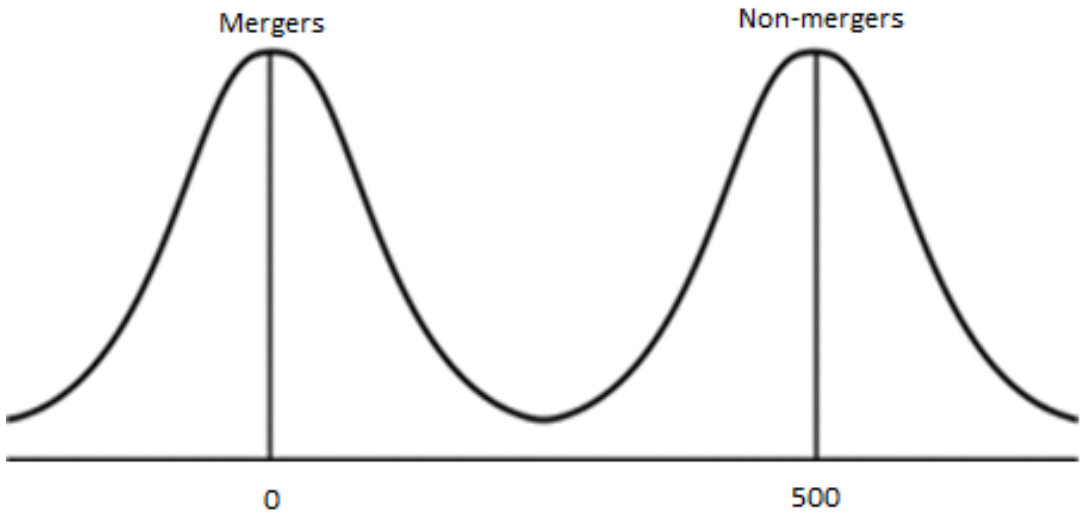
- Average values for /ʃ/ and /ç/ are calculated for each acoustic parameter for each speaker.

	/ç/	/ʃ/	Difference	
Speaker 1	4600 Hz	4100 Hz	500 Hz	← non-merger
Speaker 2	4100 Hz	4100 Hz	0 Hz	← merger

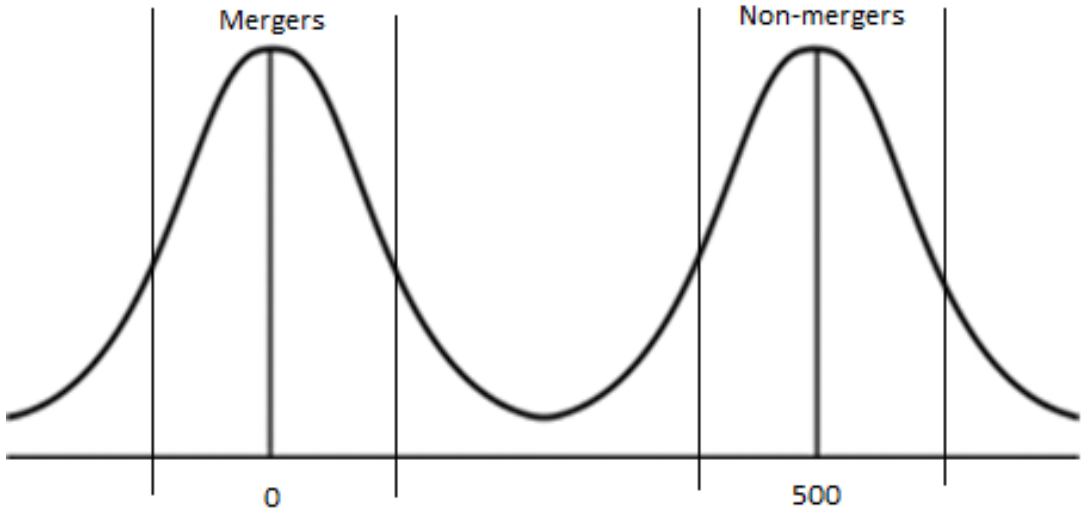
Experiment – acoustic analysis

- Speakers are expected to fall into a bimodal distribution.
- *Mergers*: the differences between /ʃ/ and /ç/ are approximately 0.
- *Non-mergers*: the differences between /ʃ/ and /ç/ average around some larger positive or negative value.

Experiment – acoustic analysis



Experiment – acoustic analysis



Experiment – acoustic analysis

- *Mergers'* productions of /ʃ ~ ç/ are compared to /ʃ/ and /ç/ produced by *non-mergers.*
- Determine whether the result of the merger is /ʃ/, /ç/, or something in between.

Conclusions

- This study fills a gap in the literature on the merger.
- Paves the way for a more informed analysis of the merger and further investigations of its motivation.
- Contributes to the debate on the driving forces behind sound change.

Questions

- What acoustic parameters are most useful in distinguishing between voiceless fricatives?
- What is a good, objective way of deciding who is a *merger* and who is a *non-merger*?
- What distance from the modal value should be the cutoff for being included as a *merger* and a *non-merger*?

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