

## The perception of the word-initial contrast in voiceless Swiss German stops

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### Outline

- The quantity contrasts in Swiss German stops
  - acoustic manifestation
  - distributional facts
- Perception experiment
  - goal of the study
  - experiment set-up
  - results
- Discussion of results
- Concluding remarks

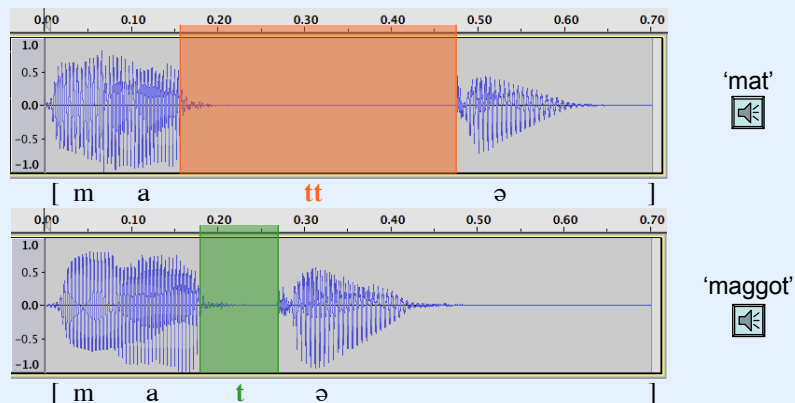
# The quantity contrast in Swiss German

(Dieth & Brunner 1943, Enstrom & Spörri-Bütler 1981, Fulop 1994, Willi 1996, Kraehenmann 2001, 2003)

	<i>bilabial</i>	<i>labio-dental</i>	<i>alveolar</i>	<i>palato-alveolar</i>	<i>velar</i>	
<b>STOPS</b>	<b>pp</b> p		<b>tt</b> t		<b>kk</b> k	med & fin & ini intersonorant
<b>FRICATIVES</b>		<b>ff</b> f	<b>ss</b> s	<b>ʃʃ</b> ʃ	<b>xx</b> x	
<b>NASALS</b>	<b>mm</b> m		<b>nn</b> n			med intervocalic
<b>LATERALS</b>			<b>ll</b> l			



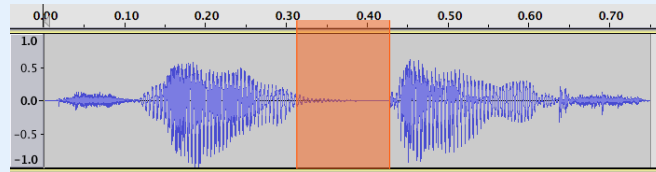
# The quantity contrast: word-medially V\_V



⇒ CD: up to 3x longer for geminates  
 ⇒ release (VOT): no duration differences

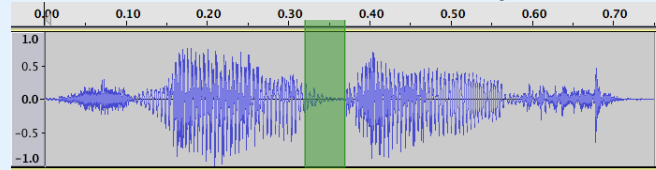


## The quantity contrast: word-initially V#\_V



'tank'

[ ts v a i tt a ŋ kx ]

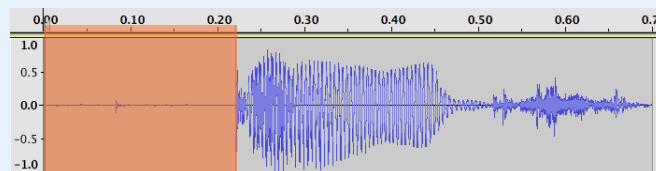


'thank'

[ ts v a i t a ŋ kx ]

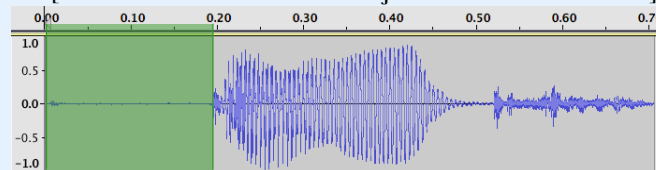
- ⇒ CD: up to 2x longer for geminates
- ⇒ release (VOT): no duration differences

## The quantity contrast: word-initially $\phi$ [#\_V



'tank'

[ tt a ŋ kx ]



'thank'

[ t a ŋ kx ]

- ⇒ CD? – Articulation up to 1.5x longer for geminates
- ⇒ release (VOT): no duration differences

## Short summary: acoustics and articulation

- As established in other studies on the quantity distinction between voiceless stops (Lahiri & Hankamer 1988, Tserdanelis & Arvaniti 2001), the **main acoustic correlate is closure duration**.
- Swiss German initial stops in particular:
  - Acoustics (Kraehenmann 2001, 2003)
    - In **intersonorant** context, **geminate CDs are significantly longer** than singleton CDs
    - After an **obstruent-final** word, geminates become shorter as well as singletons slightly longer: **phonological contrast is neutralized**
  - Articulation (Kraehenmann & Lahiri 2008)
    - In **phrase-initial** context, geminate and singleton articulations become longer, but **geminate are distinctly longer than singletons**.

## A perceptual challenge...

What do listeners do when the **main cue** for the quantity contrast is **ambiguous or not available**?

- initial stops in Pattani Malay (Abramson 1991, 1999):
  - Listeners rely on **secondary cues** in tandem:
    - rms amplitude of the first syllable
    - F0 of the vowel following the word-initial consonant
- initial stops in Cypriot Greek (Tserdanelis & Arvaniti 2001):
  - Listeners rely on **secondary cue**:
    - longer VOT for geminates, shorter VOT for singletons
- initial stops in Swiss German ??
  - Fulop (1994) found that post-release sonorant formants above F2 consistently show "increased intensity, movement and clarity" following geminates, but not following singletons.

⇒ How important is CD for the Swiss German listeners?

## Perception experiment: the material

Acoustic data from articulatory (EPG) study

⇒ Advantage: we also know how long the phrase-initial articulations were

Preparation of acoustic data: speech fragments

∅	φ [ /tto/	from 'roar'	<i>iso-context</i>
∅	φ [ /to/	from 'can'	
φ [ /nɔx/	φ [ /tto/	from 'after roar'	<i>C-context</i>
φ [ /nɔx/	φ [ /to/	from 'after can'	
φ [ /oni/	φ [ /tto/	from 'without roar'	<i>V-context</i>
φ [ /oni/	φ [ /to/	from 'without can'	

⇒ (preposition +) CD + VOT + 50ms of vowel

## Perception experiment: the task

Forced-choice cross-modal lexical-access task



Dose Toose

choice: the contrasting pair



⇒ *condition "direct"*

## Perception experiment: the task

Forced-choice cross-modal lexical-access task



Soose Toose

choice: the target word plus a control word



⇒ *condition "control"*

## Perception experiment: the task

Forced-choice cross-modal lexical-access task



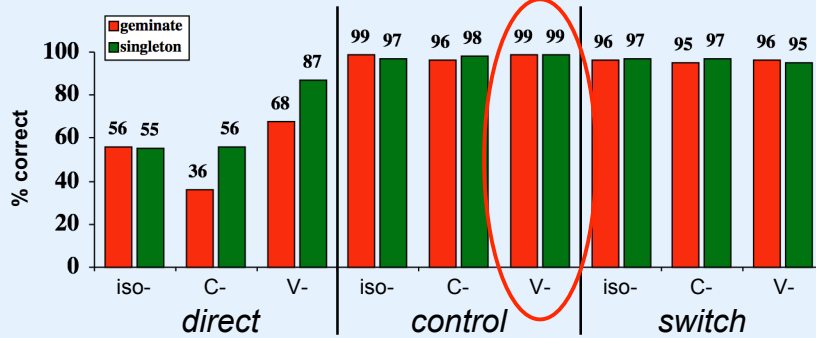
Soose Dose

choice: counterpart of target word plus a control word



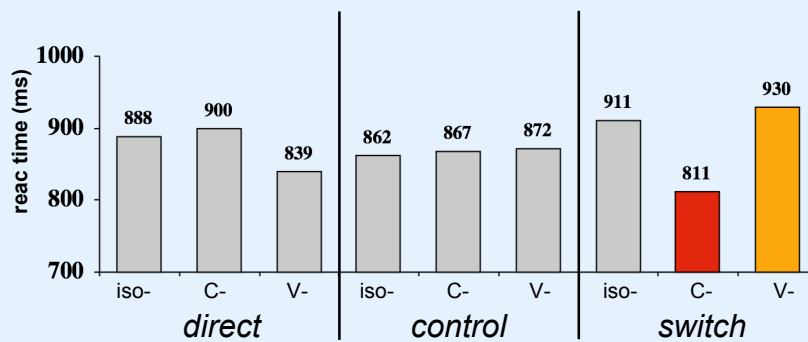
⇒ *condition "switch"*

## Perception experiment: results



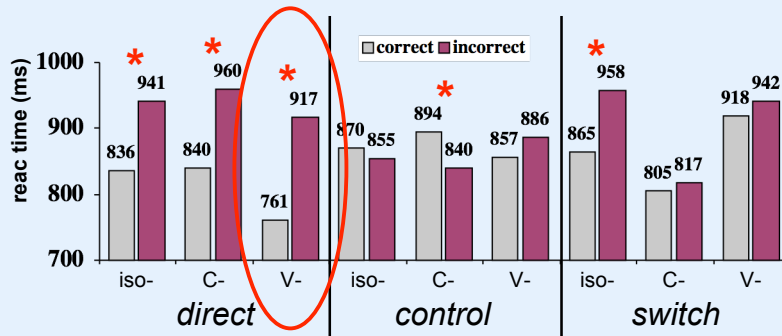
- ⇒ “control” & “switch” conditions: contrast *clearly distinguishable*
- ⇒ “direct” condition: V- context: contrast *distinguishable*  
 iso- context: random ⇒ contrast *not distinguishable*  
 C- context: singletons *random*; geminates *mistaken* for singletons

## Perception experiment: results



- ⇒ fastest values: “switch” condition, vocalic context
- ⇒ slowest values: “switch” condition, vocalic context

## Perception experiment: results



⇒ “direct” condition: all correct responses significantly faster

⇒ “control” condition: all incorrect faster, except V-context

⇒ “switch” condition: all correct faster

## Summary of results

3 types of listener responses:

- **highly accurate** and **reasonably fast** in discriminating word-initial geminates and singletons in a **vocalic context**;
  - expected
- **unable** to perceive the long-short contrast **phrase-initially**;
  - expected, given the results of the acoustic studies, but
  - unexpected, given the results of the articulatory study
- **unreliable perception** in **consonantal context** due to influence of the preceding obstruent: singletons are perceived as geminates in 44%, geminates as singletons in 64%
  - somewhat expected, given the phonetic (and phonological) neutralization

## Conclusion

The results of the experiment show that:

- obstruent consonants and phrase boundaries impede the maintenance of the phonological quantity contrast in perception;
- the **phrase boundary** causes **perceptual neutralization**: responses at chance level;
- obstruents cause geminates to take on **more singleton-like cues** than vice-versa.

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