**Adam Mickiewicz University, Poznań**

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# Developmental acquisition of stops by multilingual speakers
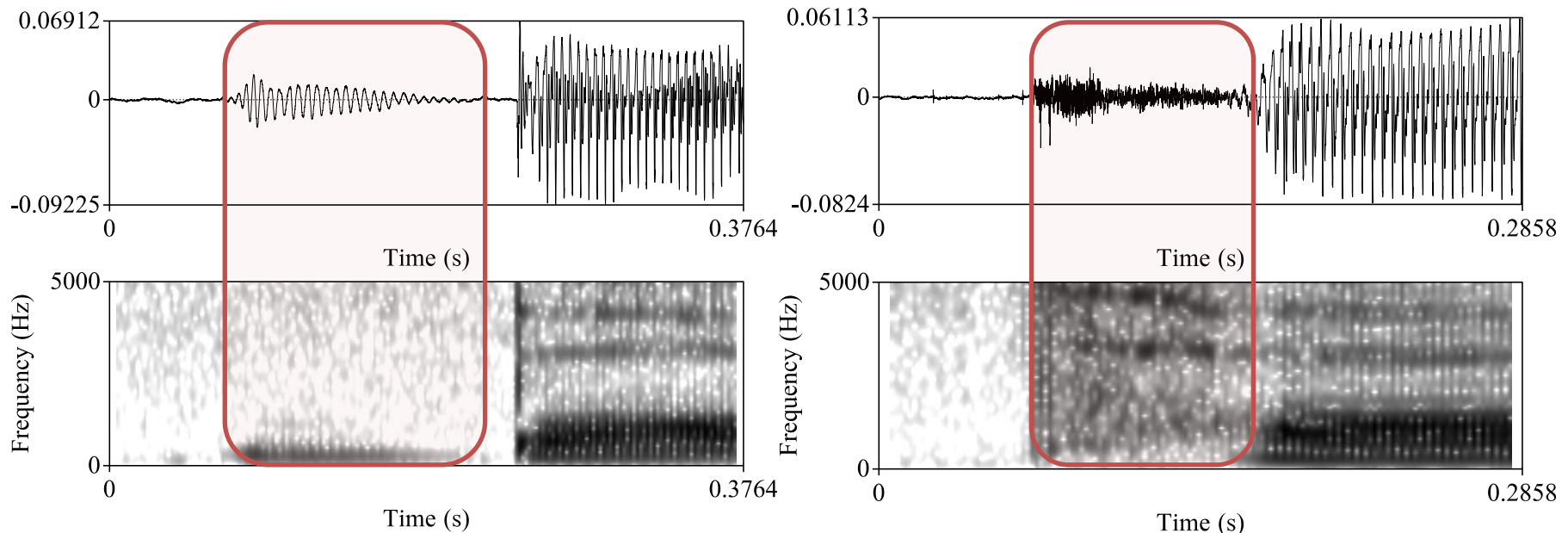
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# Voice onset time (VOT)

- An acoustic measure of the interval of time between the release of the oral constriction in a stop consonant and the onset of subsequent voicing (Lisker and Abramson 1964)

# Introduction

**L2 acquisition:**

- High pre-voicing rates in the speech of very proficient Polish learners of English (Schwartz and Dzierla 2017, Dzierla 2019)

- Polish speakers have problems supressing pre-voicing, but converge with aspirated /ptk/ (Zając 2015)

**Effect on L1:**

- Drift effects observed in L1 Polish realisations of /bdg/, but not /ptk/ (Wojtkowiak 2022)

- Expats living in Czechia produce pre-voiced /bdg/, but do not show much shortening in /ptk/ productions (Sučková 2018)

# Introduction

**L3 acquisition:**

- Voiceless series researched more often
  (e.g., Sypiańska 2013, Wrembel 2015, Llama & Lopez-Morelos 2016)

  – Trilinguals maintain language-specific phonological categories in their L1, L2 and L3 (Amengual 2021)

- Both categories of stops:

  – More target-like production of /ptk/ than for their voiced counterparts /bdg/ (Gabriel et al. 2018)

  – Regressive CLI in both L1 and L2 (Nelson 2020)

  – In Italian heritage speakers in Germany with L3 English: separate VOT patterns for all three languages (Geiss et al. 2021)

  – Possible CLI between L1 Polish vs. L3 Norwegian; voiced series more vulnerable to CLI (Cal and Wrembel, New Sounds 2022)

# Introduction

- To the best of our knowledge there is no such study that would tackle all of the following:
  – Both series of stops – voiced and voiceless
  – Holistic approach – analysis of all three/more languages
  – Longitudinal analysis

  ➢ Thus, the three-fold novelty of the present contribution

# Aim

➢ To analyse the production of both series of plosives:

  ➢ by L1 Polish – L2 English – L3 Norwegian speakers

  ➢ at the early stages of L3 learning

  ➢ throughout three testing times

  ➢ in all three languages

# VOT: Polish vs. English vs. Norwegian

- **Polish** – true voicing language (prevoicing in /bdg/ and short-lag VOT in /ptk/) (e.g., Keating et al. 1981)

- **English** – aspirating language (partially voiced /bdg/ and aspiration in /ptk/) (e.g., Lisker and Abramson 1964)

- **Norwegian** – prevoicing in /bdg/ (in most cases) and aspiration in /ptk/ (e.g., Ringen and van Dommelen 2013, Czarnecki 2016)

- Reference values (VOT in ms):

| | p | t | k | b | d | g |
|---|---|---|---|---|---|---|
| **Polish** (Keating et al. 1981) | 21.5 | 27.9 | 52.7 | -88.2 | -89.9 | -66.1 |
| **English** (Lisker and Abramson 1964) | 58 | 70 | 80 | 1 | 5 | 21 |
| **Norwegian** (Ringen and van Dommelen 2013) | 50 | 52 | 53 | -80 | -72 | -73 |

# Research questions

- (1) How does acquisition of VOT in trilinguals change over time?

- (2) What sources of CLI can be traced for VOT patterns in the three languages?

- (3) Do voiced and voiceless plosives exhibit similar trends across languages in the multilinguals' repertoire?

# Predictions

**RQ 1: How does VOT acquisition in trilinguals change over time?**

- VOT durations should become more target-like with time in L3 Norwegian (-> emerging system)

- L2 English may remain stable over time (-> more established system)

- Potential L1 drift effect as a result of L2/L3 frequency of use

# Predictions

**RQ2: What sources of CLI can be traced for VOT patterns in the three language?**

- Typological proximity
  - English and Norwegian more related → more CLI between L2 and L3

- L2 status effect (Bardel and Falk 2007)
  - more CLI between L2 and L3, due to similar settings and routes of acquisition

- Phonological similarity:
  - Voiced series /bdg/: more similarities between L1 Polish and L3 Norwegian → more CLI between L1 and L3
  - Voiceless series /ptk/: more similarities between L2 English and L3 Norwegian → more CLI between L2 and L3

# Predictions

**RQ 3: Do voiced and voiceless plosives exhibit similar trends across languages in the multilinguals' repertoire?**

- In relation to previous research (e.g. Wojtkowiak (2022), Cal & Wrembel (New Sounds 2022))
    - Separate patterns of acquisition in voiceless stops
    - Voiced series /bdg/ more vulnerable to CLI than voiceless /ptk/

# Participants

- L1 Polish – L2 English – L3 Norwegian speakers
- N=12 (with full data set T1-T3), but originally N=24 at T1
- Mean age = 20
- 8 females; 4 males

- First-year university students of Norwegian Studies at two Polish universities (Poznań and Szczecin)

- L2 English proficiency (LexTale) approx. at B2
- L3 Norwegian proficiency – placement test (A1)

- LHQ (Zhang et al. 2014)

# Procedure

- **Stimuli**: 3 separate word lists for each language with stop tokens in stressed onset positions controlled for vocalic context
- Word tokens presented on a computer screen

- Recordings conducted in the recording studio and a quiet room (using Marantz PMD661 MKIII recording device)

- Recordings were force-aligned using WebMAUS (Kisler et al. 2017)
- VOT boundaries were manually corrected in Praat (Boersma & Weenink 2021)
- VOT durations extracted with the use of Praat script (Lennes 2002)

# Procedure

- Three testing times:

**T1**
- December
- eight weeks after starting Norwegian programme

**T2**
- March
- after one semester of studying L3

**T3**
- June
- at the end of the second semester

- Separate recording sessions for each language to avoid language mixing effects (Grosjean 2004)

# Analysis

Generalised Linear Mixed Model
- Dependent variable: **VOT**
- Fixed factors: **Session, Language, Sound**
- Interaction effect: **Session*Language*Sound**
- Random effects: **Participant, Item**

Separately for voiced and voiceless series

# Analysis

## Number of analysed tokens:

|  | /ptk/ | /bdg/ | Total |
|---|---|---|---|
| **English** | **863** | **660** | **1523** |
| T1 | 288 | 245 | 533 |
| T2 | 287 | 214 | 501 |
| T3 | 288 | 201 | 489 |
| **Norwegian** | **1230** | **993** | **2223** |
| T1 | 412 | 357 | 769 |
| T2 | 409 | 319 | 728 |
| T3 | 409 | 317 | 726 |
| **Polish** | **576** | **550** | **1126** |
| T1 | 192 | 186 | 378 |
| T2 | 192 | 179 | 371 |
| T3 | 192 | 185 | 377 |

# Results: VOT measures (in ms)

**Polish**

|  | p | t | k | b | d | g |
|---|---|---|---|---|---|---|
| T1 | 46.8 | 48.7 | 72.0 | -103.3 | -98.3 | -86.2 |
| T2 | 45.0 | 55.0 | 71.5 | -99.3 | -88.2 | -77.0 |
| T3 | 46.9 | 52.5 | 73.6 | -93.1 | -82.5 | -74.5 |

**English**

|  | p | t | k | b | d | g |
|---|---|---|---|---|---|---|
| T1 | 55.4 | 69.6 | 82.7 | -102.6 | -87.5 | -82.7 |
| T2 | 59.9 | 64.3 | 88.2 | -86.5 | -85.4 | -75.9 |
| T3 | 58.4 | 66.8 | 88.5 | -82.3 | -80.5 | -72.6 |

**Norwegian**

|  | p | t | k | b | d | g |
|---|---|---|---|---|---|---|
| T1 | 45.4 | 65.0 | 79.3 | -104.7 | -98.9 | -85.3 |
| T2 | 49.5 | 67.3 | 73.0 | -85.8 | -90.5 | -81.8 |
| T3 | 53.6 | 69.2 | 78.6 | -81.2 | -87.6 | -68.5 |

# Results: /ptk/ over time
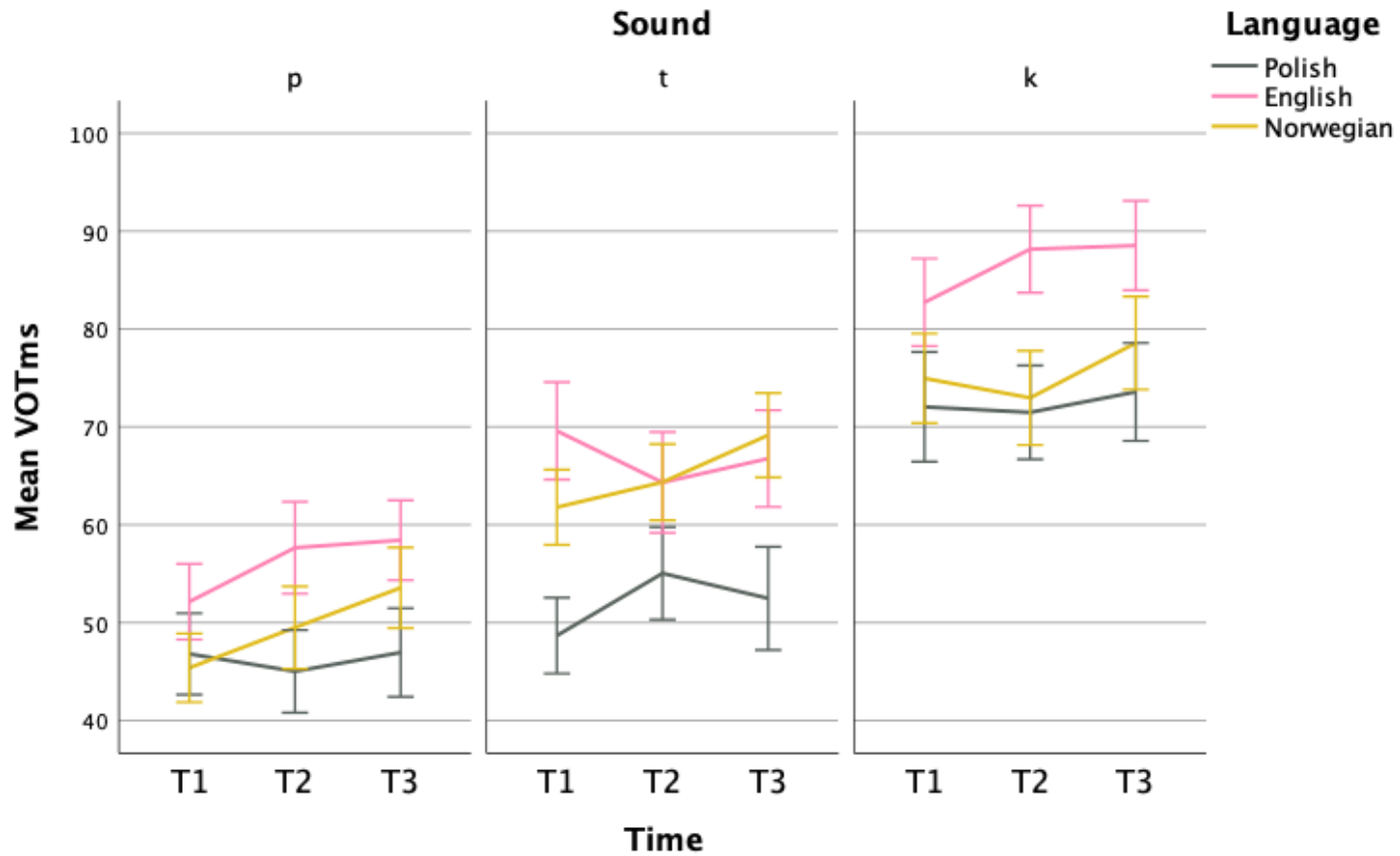


Error bars: 95% CI

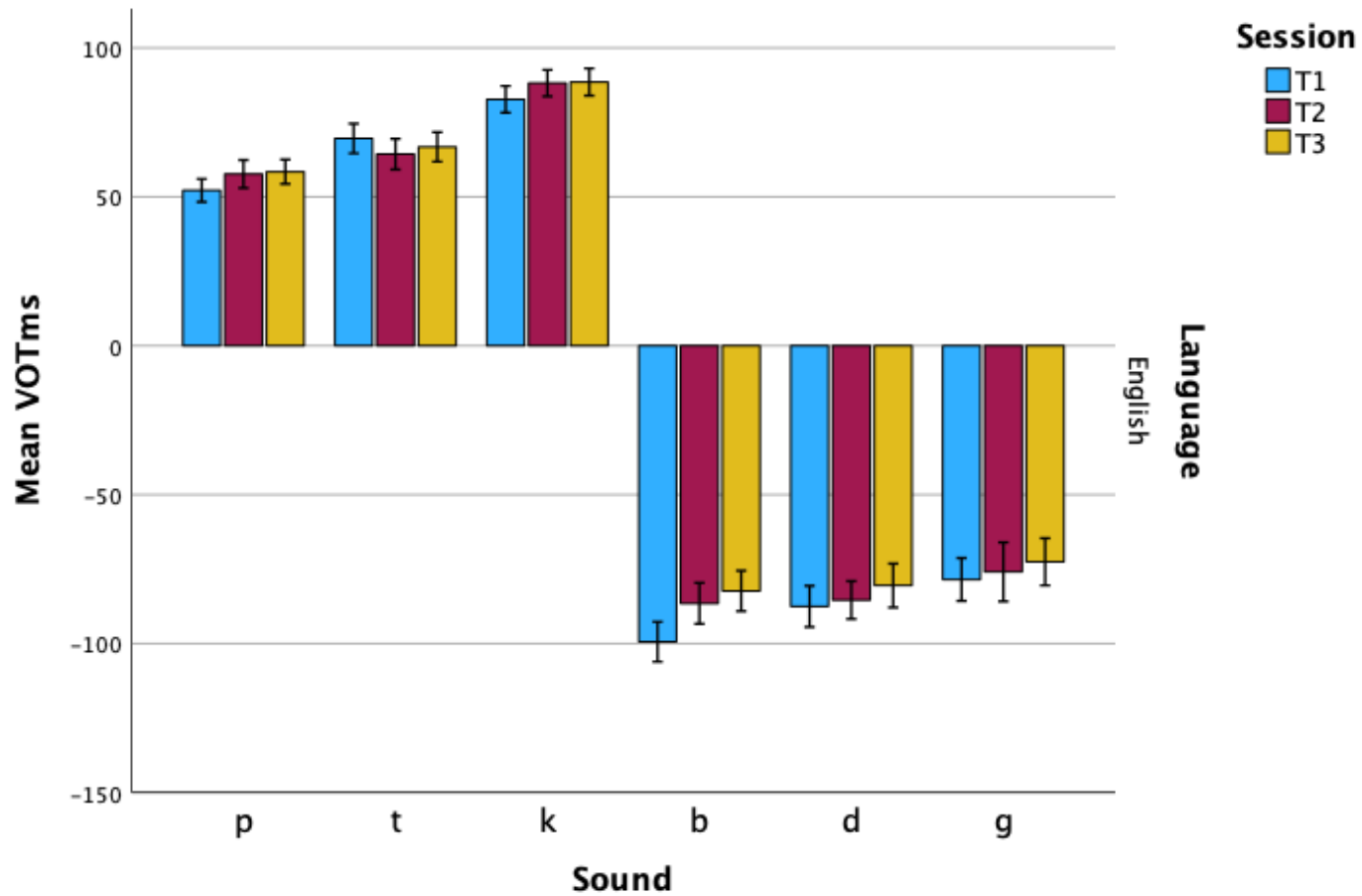# Results: /bdg/ over time
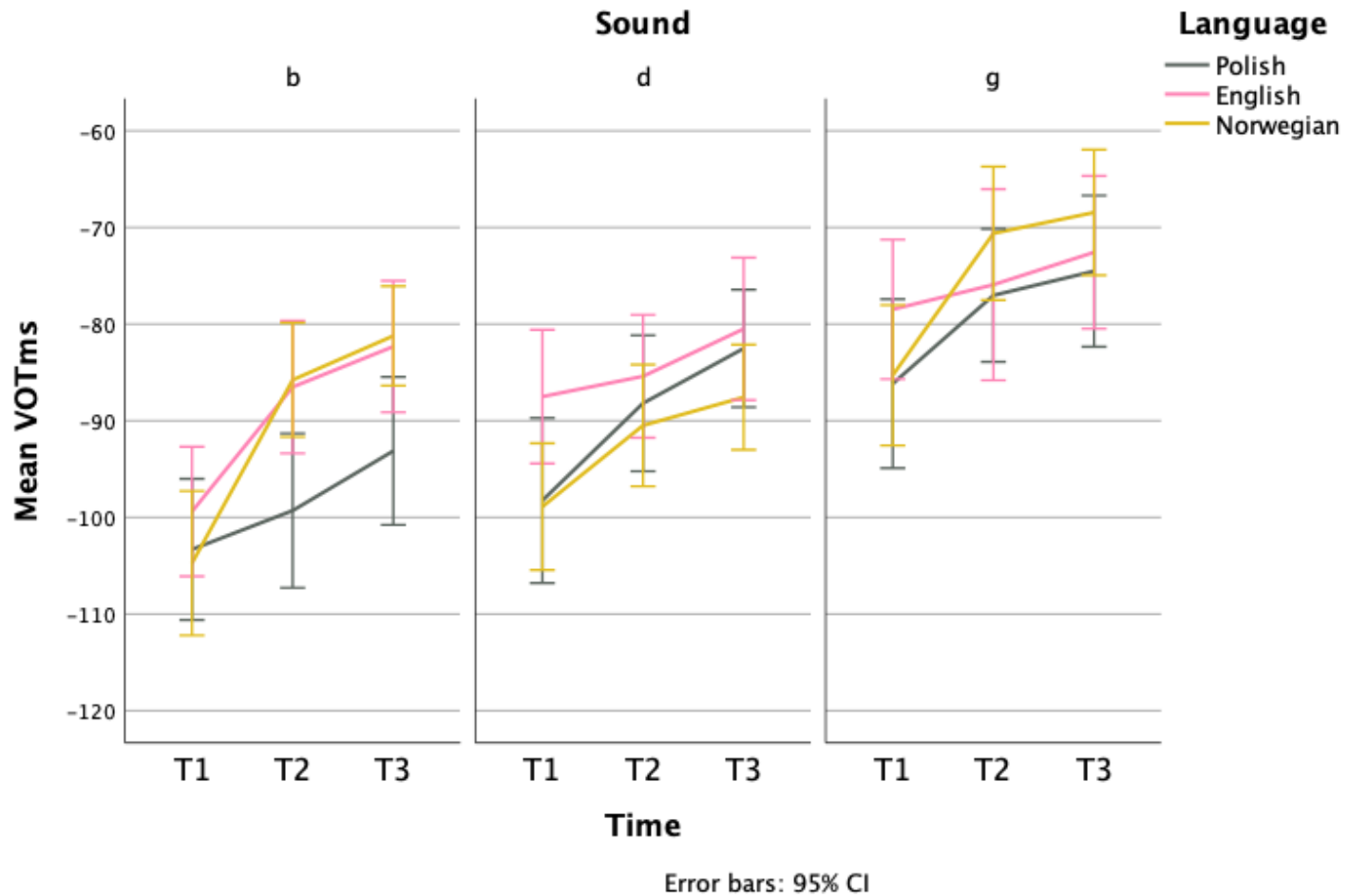


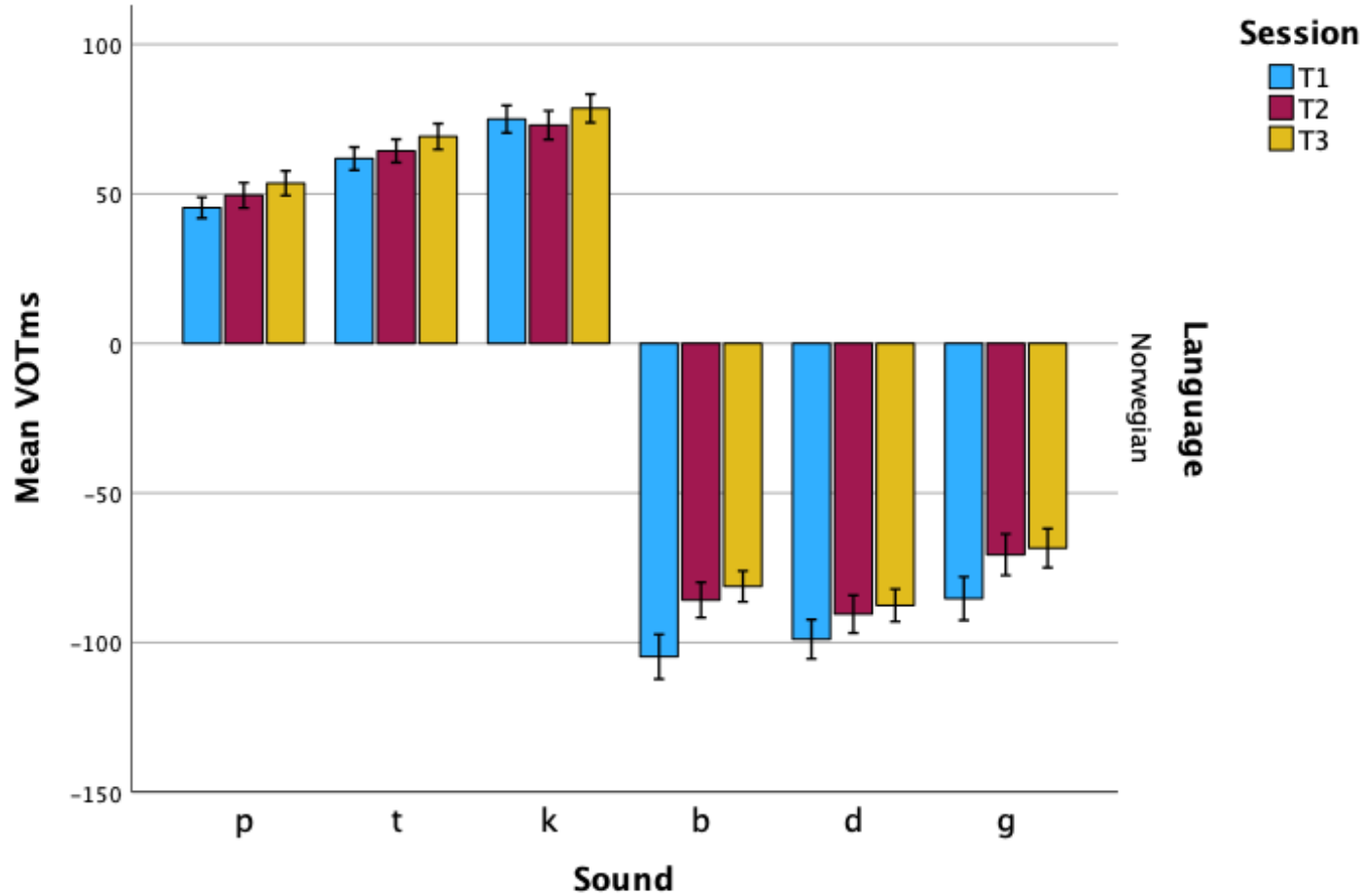Error bars: 95% CI

# Results: L1 Polish
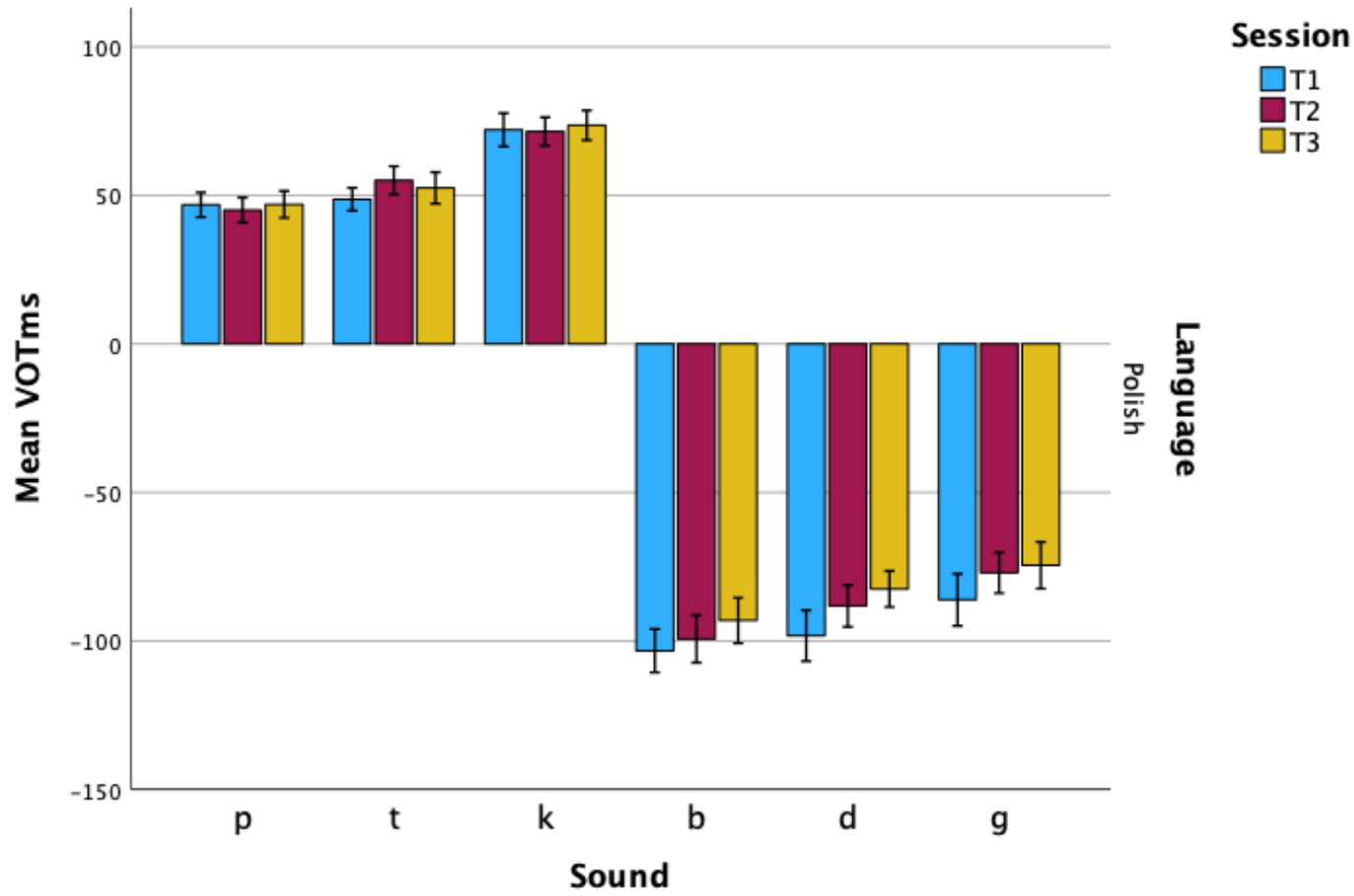


Error bars: 95% CI

# Results: L2 English



Error bars: 95% CI

# Results: L3 Norwegian



Error bars: 95% CI

# Results

% of unvoiced items

|     | POL | ENG | NOR |
|-----|-----|-----|-----|
| T1  | 3%  | 15% | 26% |
| T2  | 7%  | 26% | 34% |
| T3  | 4%  | 30% | 34% |

# Results

**Voiceless:**

- Significant main effects:
  - Language $(F=11.726, p<.001)$
  - Sound $(F=59.138, p<.001)$
  - Session $(F=7.483, p<.001)$

- No interaction effects

**Voiced:**

- Significant main effects:
  - Language $(F=3.002, p=.05)$
  - Sound $(F=29.03, p<.000)$
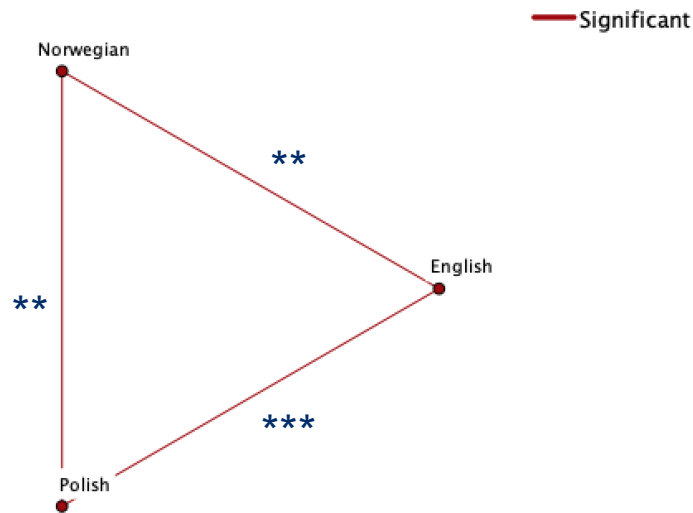  - Session $(F=29.49, p<.000)$

- No interaction effects

# Results:
## across-language comparisons

/ptk/

**Pairwise Contrasts**
**Target: VOTms**

Significant

Norwegian

**

**

English

***

Polish

The least significant difference adjusted significance level is .05.

/bdg/

**Pairwise Contrasts**
**Target: VOTms**

Not Significant
Significant
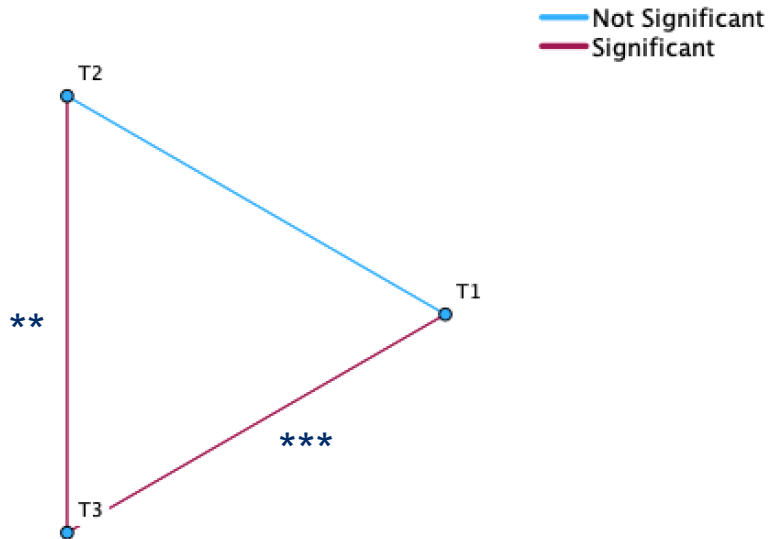
Norwegian

English

**

Polish

The least significant difference adjusted significance level is .05.

# Results: across-time comparisons

/ptk/

/bdg/



**Pairwise Contrasts**

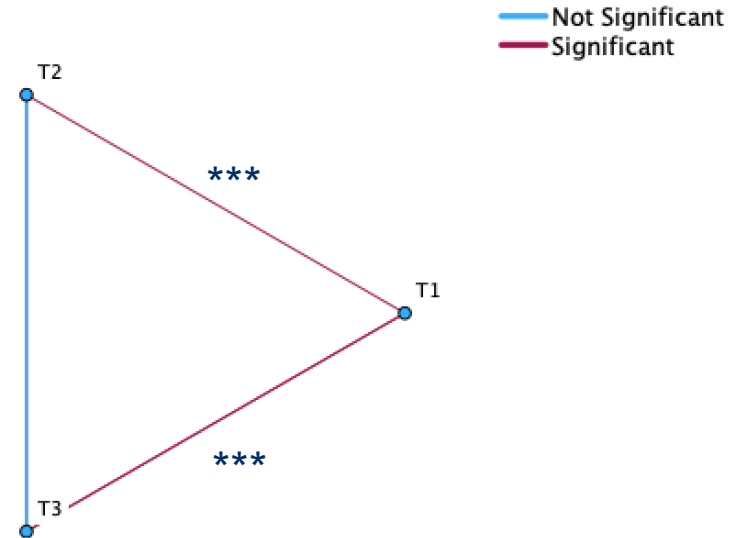**Target: VOTms**

—Not Significant
—Significant

T2

T1

**

***

T3

The least significant difference adjusted significance level is .05.



**Pairwise Contrasts**

**Target: VOTms**
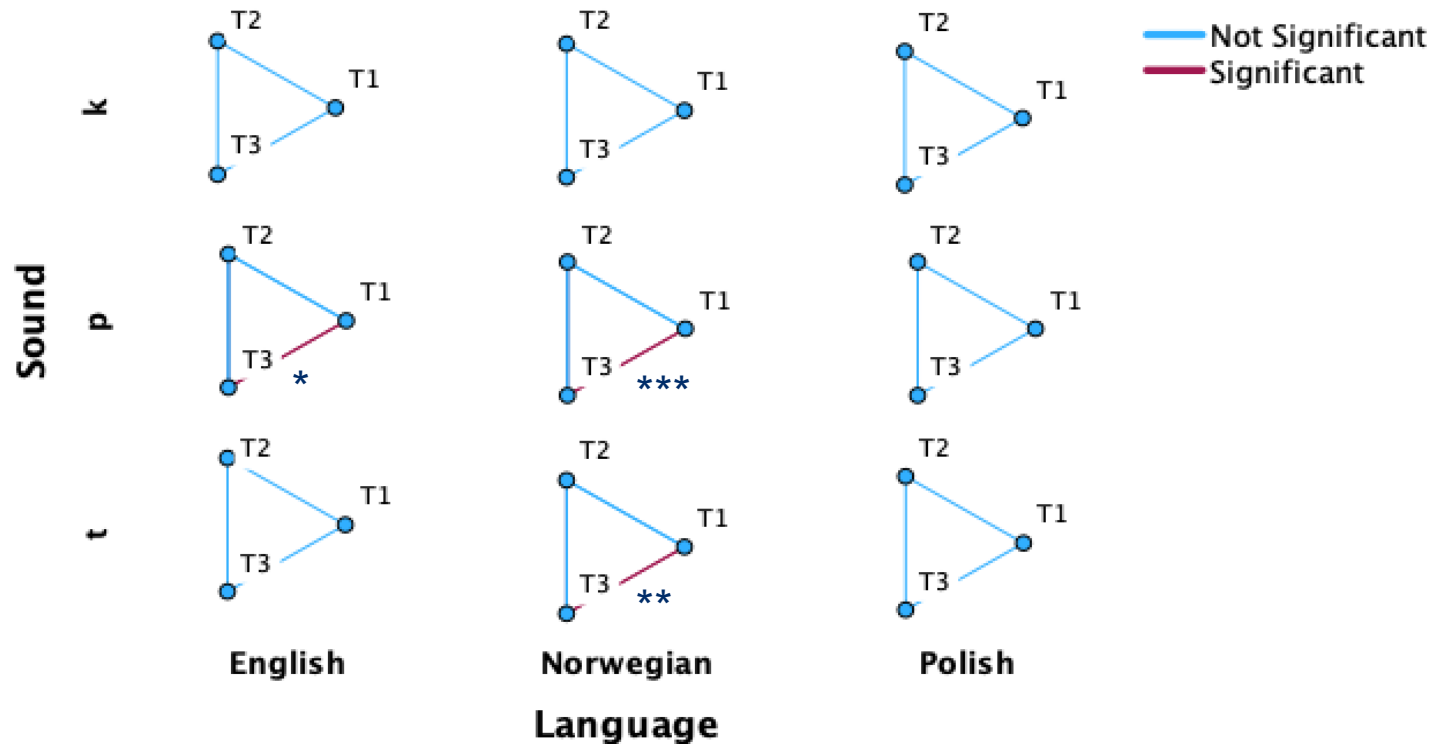
—Not Significant
—Significant

T2

***

T1

T3

***

The least significant difference adjusted significance level is .05.

# Results: /ptk/ across language and time



**Pairwise Contrasts**

**Target: VOTms**

The least significant difference adjusted significance level is .05.

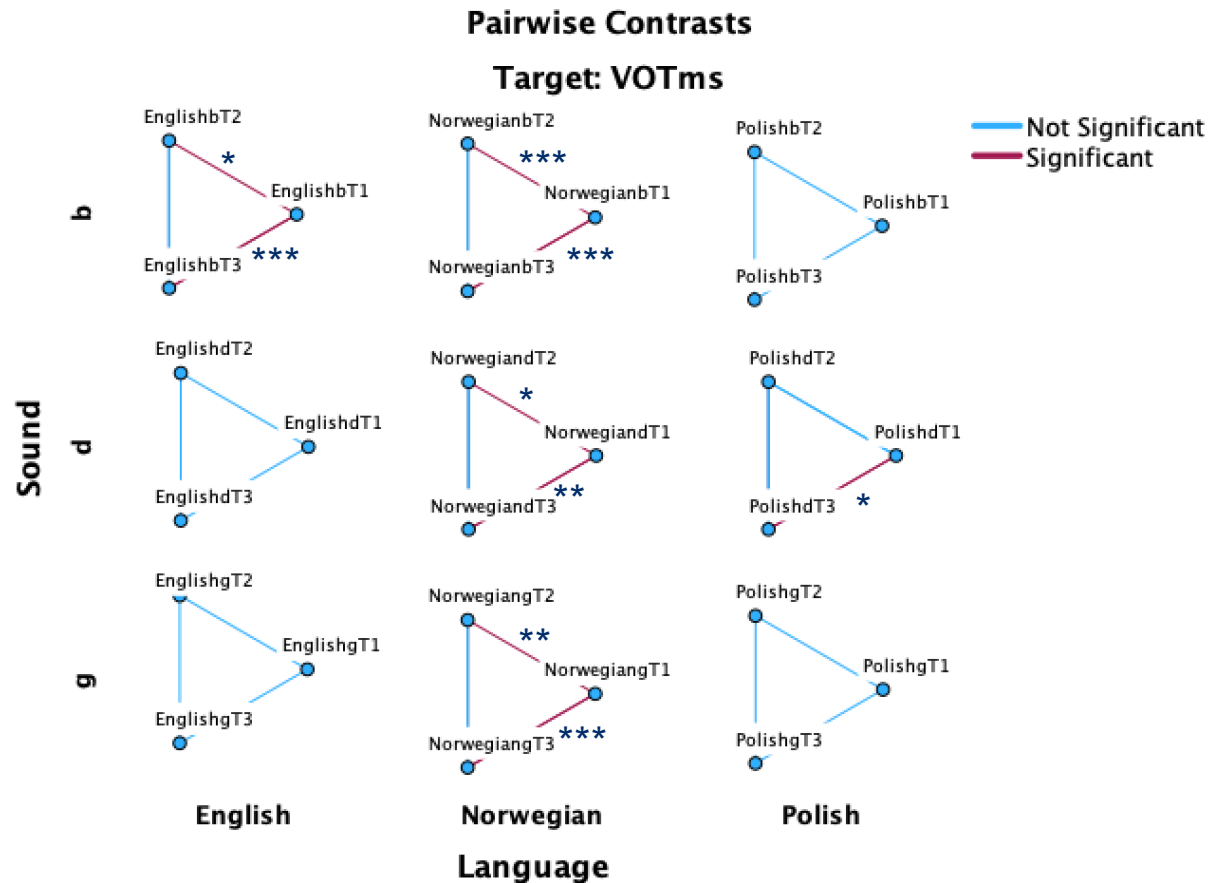# Results: /bdg/ across language and time



Pairwise Contrasts

Target: VOTms

The least significant difference adjusted significance level is .05.

# Discussion

**RQ1: How does VOT acquisition in trilinguals change over time?**

/ptk/:

- Norwegian VOT durations in-between those of L1 and L2 but, with time, are getting longer in duration (approximating L2 English values)

- L1 Polish remains stable – no L1 drift effect

- Very little effect on L2 English – VOT produced almost on a target, small change in time

/bdg/:

- Shortening of prevoicing in all three languages and greater number of unvoiced items in L2 and L3

# Discussion

**RQ2: What sources of CLI can be traced for VOT patterns in the three languages?**

/ptk/

- trilinguals maintain language-specific phonological categories in their L1, L2 and L3
- L3 Norwegian: hybrid VOT values (possible L1-driven CLI) that are getting more affected by L2 with time

/bdg/

- No interaction between L1 Polish and L2 English
- Interaction between L1-L3 and L2-L3
- Shortening of prevoicing in all three languages and greater number of unvoiced items in L2 and L3 – possible L2 status effect, and L1 drift
- But prevoicing still remains in all three languages – possible L1 influence

# Discussion

**RQ2: What sources of CLI can be traced for VOT patterns in the three languages?**

- L3 Norwegian seems to be the least stable in both categories of stops → more prone to L1/L2 influence

# Discussion

**RQ 3: Do voiced and voiceless plosives exhibit similar trends across languages in the multilinguals' repertoire?**

- Voiceless category development is language-specific in three languages (VOT values diverge)

- Cross-linguistic interactions observed in voiced series (VOT values converge)

- Voiceless series affected later in time than voiced

# Conclusions

- Differences in acquisition of two series of stops by trilinguals

- /ptk/ seem **more stable** and develop independently across three languages

- /bdg/ **more vulnerable to CLI**, especially in L3, prominent change in time, with durations becoming shorter in time

# Future plans

- Analysis of different types of prevoicing

- Comparison with more advanced learners

- Extended longitudinal design (T4, T5?)

- Cross-sectional design with larger pool of participants with VOT in different word positions of stops

# THANK YOU!