

Final devoicing in German is incomplete – but the mental lexicon has to agree

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Theoretical background

Final devoicing

- Contrast between voiced [b d g v z] and voiceless [p t k f s] obstruents is lost in word or syllable final position → in favor of the voiceless series (Brockhaus, 2012)
- Observable through alternations in a word's morphological paradigm
- alternation: [tsvɛɪk] ~ [tsvɛɪgə], no alternation: [vɛɪk] ~ [vɛɪkə]
- $\left[\begin{array}{c} -\text{sonorant} \\ +\text{voice} \end{array} \right] \rightarrow [-\text{voice}] / _ \#$

Incomplete Neutralization

- The contrast between two sounds is not entirely lost → differences in phonetic detail are still present
- For stops: Difference in closure duration, burst duration, voicing-into-closure and **duration of the preceding vocalic portion** (Fourakis & Iverson, 1984; Port & O'Dell, 1985)
- Longer duration of vocalic portion before voiced stops (relative to before voiceless ones)
- Contradictory findings in the literature – though more recent studies support incomplete neutralization (Fourakis & Iverson, 1984; Port & O'Dell, 1985; Roettger & Baer-Henney, 2019; Roettger et al., 2014; Winter & Roettger, 2011)

Analogy

- Phonological word forms affect each other within and across morphological paradigms
- e.g. speakers base the underlying voicing specification of neutralized final obstruents on the basis of phonological similarity (Ernestus & Baayen, 2001, 2003, 2004)
- Dutch speakers assume that a final obstruent is underlyingly voiced, if many voicing alternations take place in the obstruent's phonological environment

Research Question

Do voiced and voiceless final stops only show incomplete neutralization in contexts where voicing alternations often take place?

Corpus study

Subset of the German CELEX Corpus (Baayen, Piepenbrock, & Gulikers, 1995) used (7011 words). Word forms annotated for final rhyme and whether the final stop in a word's morphological paradigm alternates or not (e.g. [hʊnt]~[hʊndə]) vs. [bʊnt]~[bʊntə])

Figure 1: Rhymes with more alternations

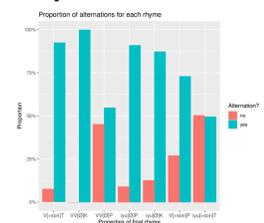
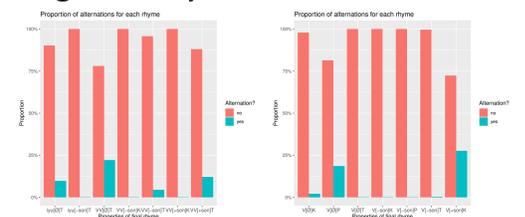


Figure 2: Rhymes with less alternations



Production study

Run in Praat (Boersma & Weenink, 2021)

- 34 plural pseudoword minimal pairs differing only in the voicing of the final stop (e.g. /mi:bə/ vs. /mi:pə/)
 - 12x labial, 12x alveolar, 10x velar
- Half of the minimal pairs constructed with rhymes that alternate more often
 - More often: 6x labial, 6x alveolar, 4x velar
 - Less often: 6x labial, 6x alveolar, 6x velar
- Reverse wug-test: Plural forms were presented auditorily → singular forms elicited
- /mi:bə/ → [mi:b̥], /mi:pə/ → [mi:p]

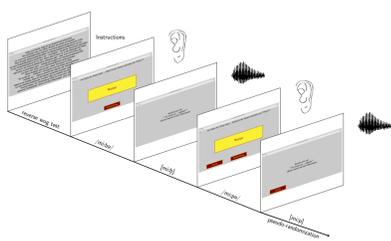


Figure 3: Experimental procedure

Hypotheses

- H₀: Durational differences between underlying voiced and voiceless stops will be the same in both *more alternations*- and *less alternations*-conditions (either showing a difference or not)
- H₁: Durational differences between underlying voiced and voiceless stops will differ between *more alternations*- and *less alternations*-conditions: **Significant difference expected only in more alternations-condition**

Acoustic analysis

13 German native speakers ($\bar{x} = 34.77$ years)

- Participants' singular productions were recorded in an anechoic chamber (sampling rate = 44,100 Hertz, 16 bit)
- The duration of the preceding vocalic portion was measured in Praat (Boersma & Weenink, 2021)
- Onset: Begin of the vowel, indicated by a clear formant structure (+ voice bar)
- Offset: End of the clear formant structure
- 712 data points (327 more often alternating, 385 less often)

Discussion

Results indicate that final devoicing is indeed incomplete – but only in environments where more German words show voicing alternations

- Neutralization of the contrast between two sounds is resisted in contexts where maintaining a opposition is supported by the mental lexicon
- German speakers extend the mental lexicon and with it their knowledge of phonotactic properties to novel words
- Results support the role of analogy within phonology (Ernestus & Baayen, 2004)
- Contradictory findings in the incomplete neutralization literature may be explainable through taking phonotactic properties and the mental lexicon in general into account

Results

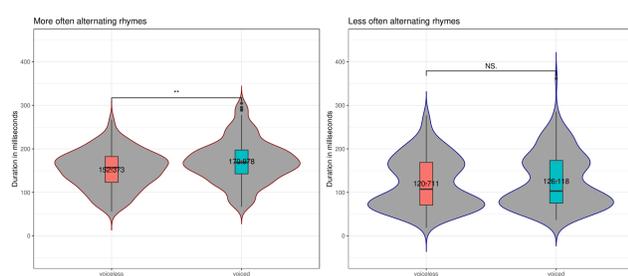


Figure 4: Durations for more often alternating rhymes (left) and less often alternating rhymes (right)

- Linear Mixed Effects-Models with random intercepts for *item* and *participant* in R (R Core Team, 2021)
- Significant effect of **voicing type (voiceless vs. voiced)** on duration for **more alternations-condition** ($p = 0.0217$), but no effect for **less alternations-condition** ($p = 0.5856$)

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