Compensation for coarticulation in lexically unstressed syllables

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20 speakers of Standard German participated in two experiments:

INTRODUCTION

- Misperception of coarticulatory patterns as the driving force for sound change (Ohala, 1993), e.g. diachronic /u:/-fronting in RP (Harrington et al., 2008)

- Sound change occurs frequently in lexically unstressed syllables (Beckman et al., 1992), e.g. Old English *muneceas* → present-day English *monks*

- Transconsonantal coarticulation is the source for the frequently occurring sound change *Umlaut*

- Research question

  Do listeners undercompensate for a higher degree of transconsonantal V_2-on-V_1 coarticulation in lexically unstressed syllables?

Predictions

1. There is more V_2-on-V_1 coarticulation in unstressed syllables (cf. Cho, 2004; Fowler, 2005).

2. Listeners compensate perceptually for the effect of V_2-on-V_1 coarticulation (cf. Mann & Repp, 1980).

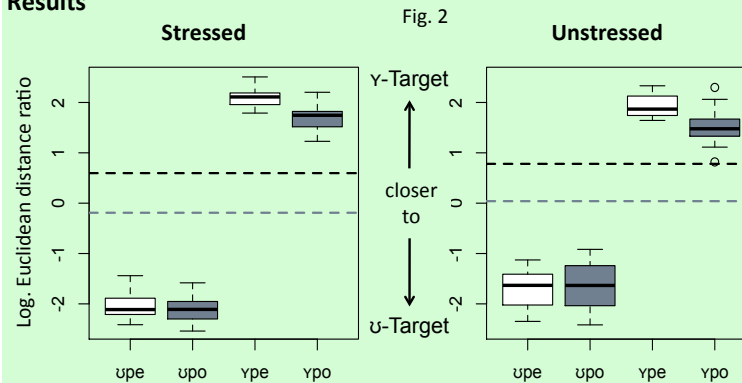3. Listeners compensate less for V_2-on-V_1 coarticulation in unstressed syllables.

Fig.1 — Stressed / Unstressed — Spectral curvature [mel] vs Spectral slope [mel]
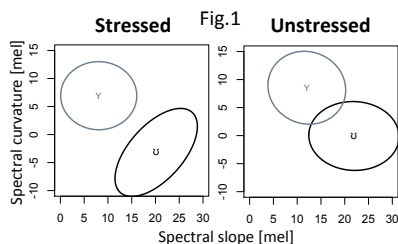
PRODUCTION EXPERIMENT

Method

- Target pV_1pV_2l words produced with lexical stress either on V_1 or V_2
- V_1 = /ʊ, ɣ/ and V_2 = /e:, o:/
- Spectral slope x curvature based on FFT (see Fig. 1)
- ɣ-Target = $T_ɣ$ = speaker-specific mean across all /ɣ/ before /e/; ʊ-Target = T_U = speaker-specific mean across all /ʊ/ before /o/
- Log. Euclidean distance ratio: relative proximity of each /ʊ/ and /ɣ/ to T_U or $T_ɣ$, resp.

Results

Fig. 2 — Stressed / Unstressed — Log. Euclidean distance ratio; ɣ-Target, closer to, ʊ-Target; categories ʊpe, ʊpo, ɣpe, ɣpo

Prediction 1: NO

- V_2-context only affects /ɣ/ but not /ʊ/
- The amount of V_2-on-/ɣ/ coarticulation in unstressed and stressed syllable was about the same
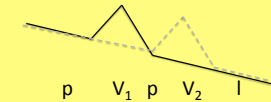
BUT

- there was more target undershoot in unstressed than in stressed /ʊ/
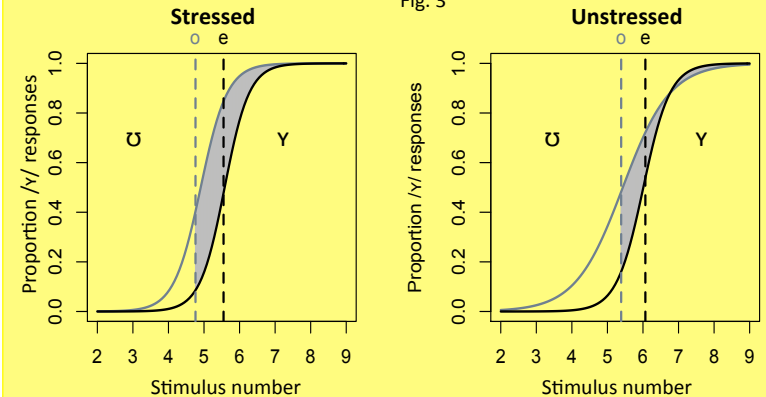
PERCEPTION EXPERIMENT

Method

- /pɣp -pʊp/-continuum spliced into /e:l/ and /o:l/-context and embedded in carrier phrase "Ich habe pV_1pV_2l gesagt"
- Lexical stress either on V_1 or V_2

p V_1 p V_2 l

- The same subjects also participated in a 2AFC identification test

Results

Fig. 3 — Stressed / Unstressed — Proportion /ɣ/ responses vs Stimulus number; ʊ, ɣ regions; o e markers

Prediction 2: YES

- More V_1 = /ʊ/-responses in V_2 = /e/-context, i.e. listeners compensated for V_2-on-V_1 coarticulation

Prediction 3: YES

- Response curves in the area of /ɣ/-perception closer together in unstressed than in stressed condition, i.e. listeners compensated less for coarticulation in unstressed syllables

DISCUSSION & CONCLUSION

- Stress-dependent mismatch between coarticulation and categorization
- Listeners compensated less for coarticulation or were more uncertain about /ɣ/-classifications
- The uncertainty in perceptual classifications may come about because the increase of target undershoot in /ʊ/ shifts the categorizations in production towards the /ɣ/ space in which V_2-on-V_1 coarticulation has its greatest effect.
- Consistent with a model of sound change as non-teleological