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Identification of highly reduced words by differential segmental lengthening

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Introduction

- “Segmental reduction is a prime characteristic of casual speech” (Engstrand and Krull 2001:26)
- Highly reduced word forms can become phonetically very similar (or identical?) to other - less reduced - ones
- German:
 - [vɪsmɑ] → „*willst du mal*“ (‘do you want’), „*Wismar*“ (German city)
- Dutch:
 - [ɛɪk^h] → „*eigenlijk*“ (‘actually’), „*eik*“ (‘oak tree’)



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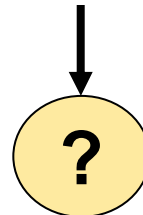
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Introduction

- Assumption underlying reduction: it creates problems for the decoding of speech
 - It leads to a huge amount of variants within phonological categories
 - It reduces the (number of) acoustic cues and hence the distinctness of linguistic forms



- Or are the/some cues just shifted, e.g., to the prosodic level?
(= **recoding**, examples of Klaus Kohler this morning)

Research question: Do the highly reduced forms show FPD that differentiates them from the phonetically less reduced forms?



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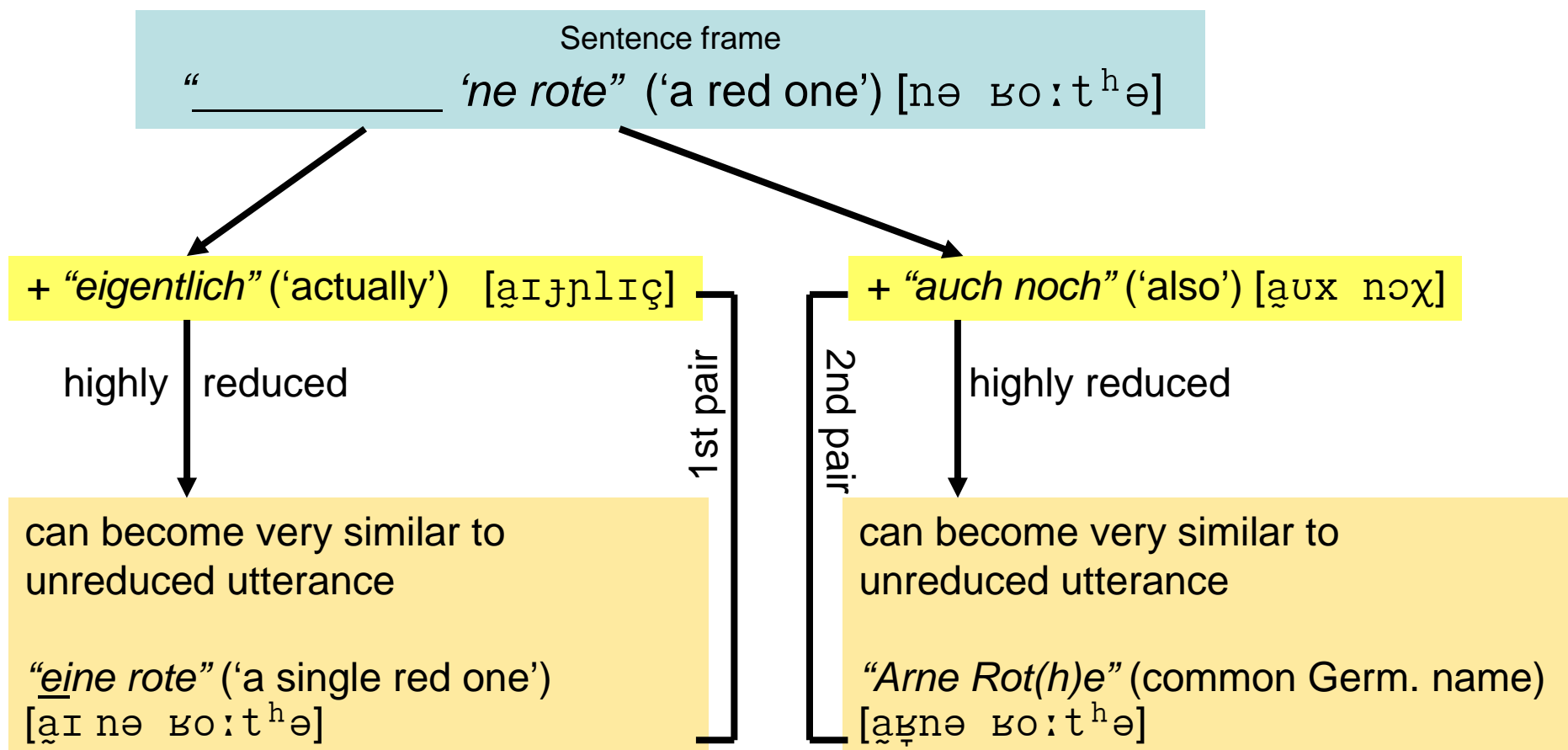
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Introduction

- Investigated by means of **perception experiments**
- Based on **2 pairs** of utterances:





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Introduction

- Among the potential phonetic (prosodic) means that might disambiguate between the pairs of utterances, **duration** is very likely to be involved
 - It plays a role in the production and perception of assimilation / elision ('compensatory lengthening', Kavitskaya 2002; Kohler 2001)
 - It is a powerful marker of boundaries and number of syllables
 - It contributes to the differentiation between true and pseudo-prefixes in English (Baker, Hawkins, Smith 2007)
 - Recent acoustic analyses of German "*eigentlich*" in the 'Kiel Corpus of spontaneous speech' by Niebuhr show:
 - The relative duration of the diphthong within the word increases with decreasing overall duration of the word
 - The relative duration of the glide of the diphthong increases with decreasing diphthong duration



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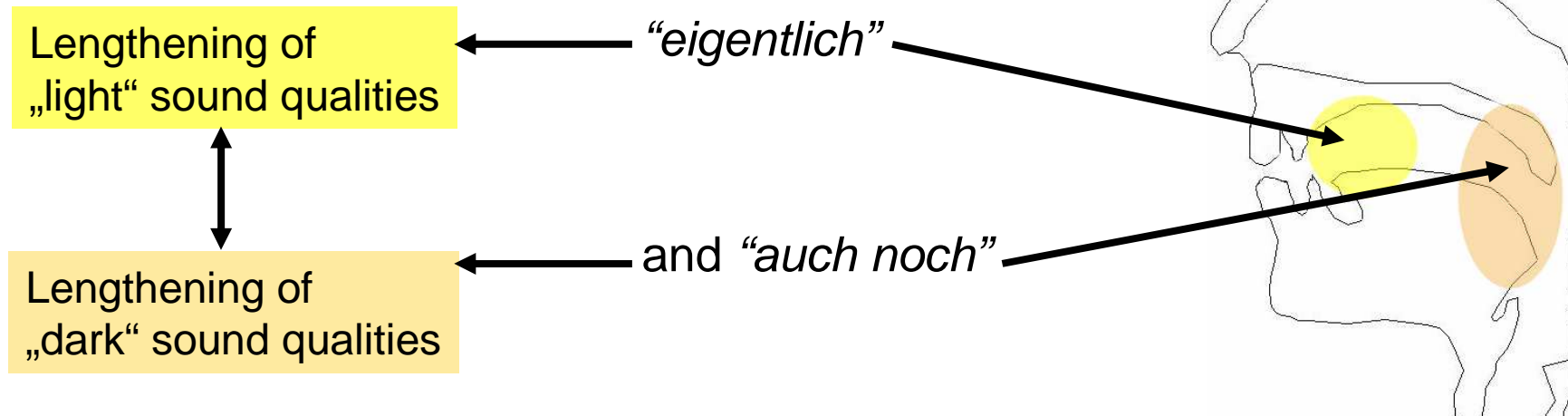
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Introduction

- **Hypotheses:**

- (1) Increasing the duration changes the subject's interpretation of the stimuli towards the reduced utterances *“eigentlich ‘ne rote”* and *“auch noch ‘ne rote”*
- (2) However, in order to achieve this change in perceptual interpretation, those phonetic sections have to be lengthened utterance-initially that mirror the global articulatory settings and the resulting global acoustic characteristics of





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Method

- First step:
 - Natural productions of (1) “*eine*” and (2) “*Arne*” as well as of (3) “*rote*” or “*Rothe*”, respectively.
- Second step:
 - 2 duration continua for (1) “*eine*” and for (2) “*Arne*” by means of ‘praat’
 - Rectangular duration window with a length of 100ms
 - Successive increase of the original duration in 7 steps of 20% (=20ms)
 - A resynthesis generated for each step
- Third step:
 - Natural production of (3) “*rote*” / “*Rothe*” attached to each resynthesis
- Fourth step:
 - Constant intonation contour created for the resulting stimuli with pitch accents on both words of the utterance: H* H* L-%.
 - Then, stimuli (again) resynthesized



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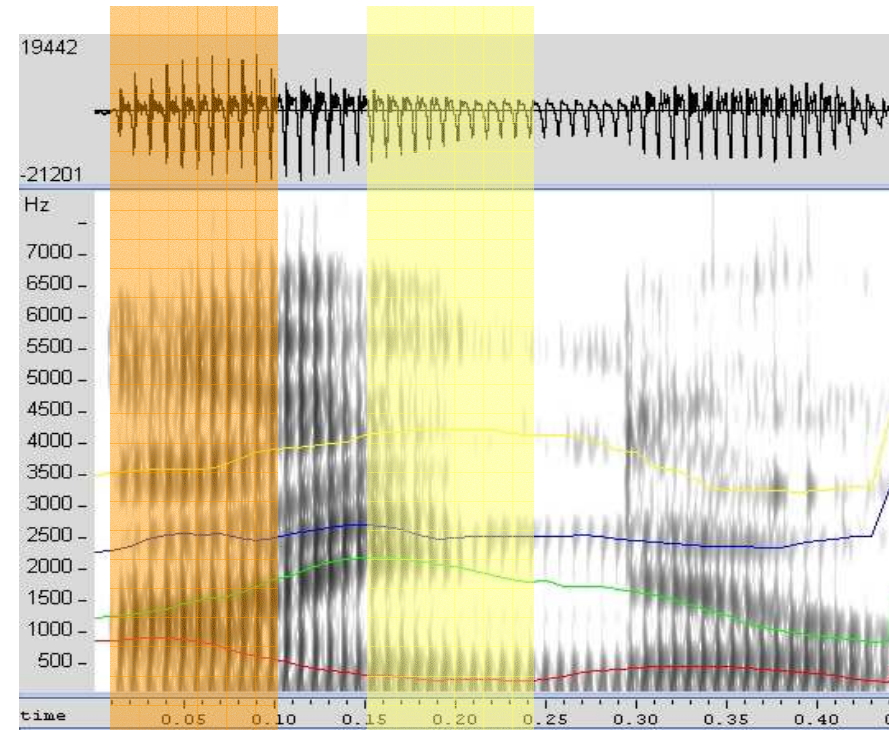


Method

- Manipulations for “eine“
- 2 stimulus series, each with 7 stimuli
- The perceptual change “eine rote“ -> “eigentlich ‘ne rote“ is solely expected for series B

Stim. series A
(dark sound)

Stim. series B
(light sound)



[a]

[ɪn]



Step #7

+120%
(...)

+120%
(...)



Step #4

+ 60%

+ 60%

Step #3

+ 40%

+ 40%

Step #2

+ 20%

+ 20%



Step #1

+ 0%

+ 0%





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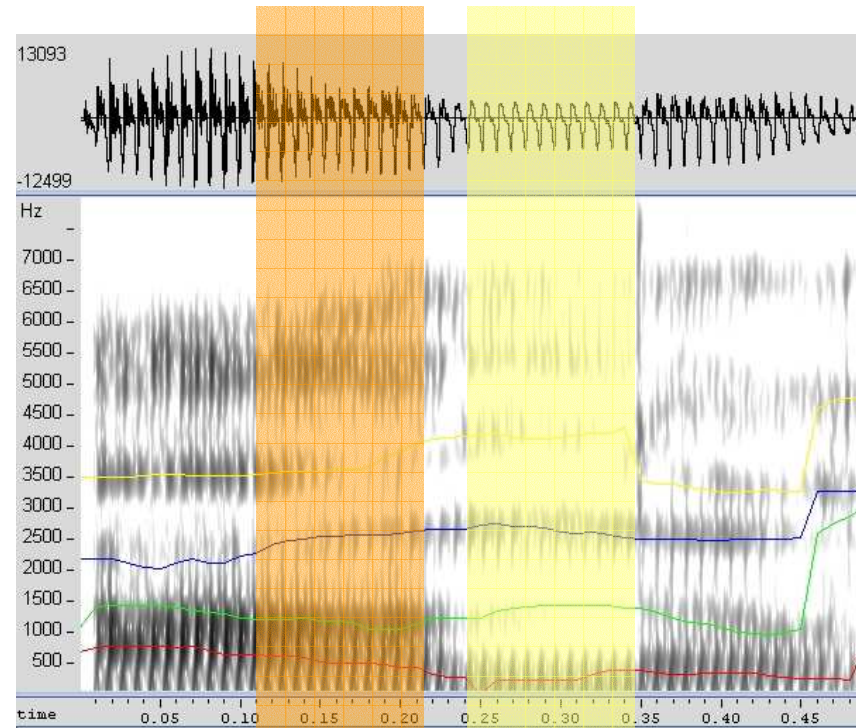


Method

- Manipulations for “Arne”
- another 2 stimulus series with 7 stimuli each
- But, this time perceptual change “Arne Rothe” -> “auch noch ‘ne rote” solely expected for series A

Stim. series A
(dark sound)

Stim. series B
(light sound)



[aʁ] [n]



Step #7

+120%

+120%



(...)

(...)

Step #4

+ 60%

+ 60%

Step #3

+ 40%

+ 40%

Step #2

+ 20%

+ 20%



Step #1

+ 0%

+ 0%





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Method

- Two Perception experiments for each group of series:
 - **Pairwise identification test**
 - Stimuli of series A and B with the same step numbers were paired
 - Subject were to judge which utterance of the pair was “*eigentlich ‘ne rote’*” (test 1) or “*auch noch ‘ne rote’*” (test 2) = 2AFC task
 - **Indirect identification task (semantic-match paradigm)**
 - Stimuli of series A and B paired with constant context precursor that only matches semantically with one of the possible stimulus interpretations
 - Question “*Wieviele willst du?*” (‘How many do you want?’) matches with answer “*eine rote*” not with “*eigentlich ‘ne rote’*” (test 3)
 - Question “*Sonst noch was?*” (‘Something else?’) matches with answer “*auch noch eine rote*” not with “*Arne Rothe*” (test 4)
 - Questions produced in an informal, casual manner by female speaker
 - Accordingly, subjects were instructed to judge whether question and answer did or did not match



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Method

- However, matching may not only be a matter of semantics. Hawkins (2003) assumes that reduction changes the pragmatic meaning of the utterance
 - [aɪ dəʊnt nəʊ] - [ə̃ə̃ə̃] or [gʊt^hən mɔægən] - [gũmõ]
 - Degree of reduction expresses the relationship between the dialogue partners. Therefore, does the degree of reduction in the question affect the subject's perceptual interpretation of the answer (i.e. of the stimuli)?
 - B series of “eine” and A series of “Arne” additionally paired with the a more formal, less reduced variant of the question (test 5 + 6)
- In tests 1-6: stimuli repeated three times in randomized order
- Tests 1,3,5 and 2,4,6 done separately within single sessions
- Native speakers of German served as subjects
- Judgements were made on prepared answer sheets by putting ticks into boxes



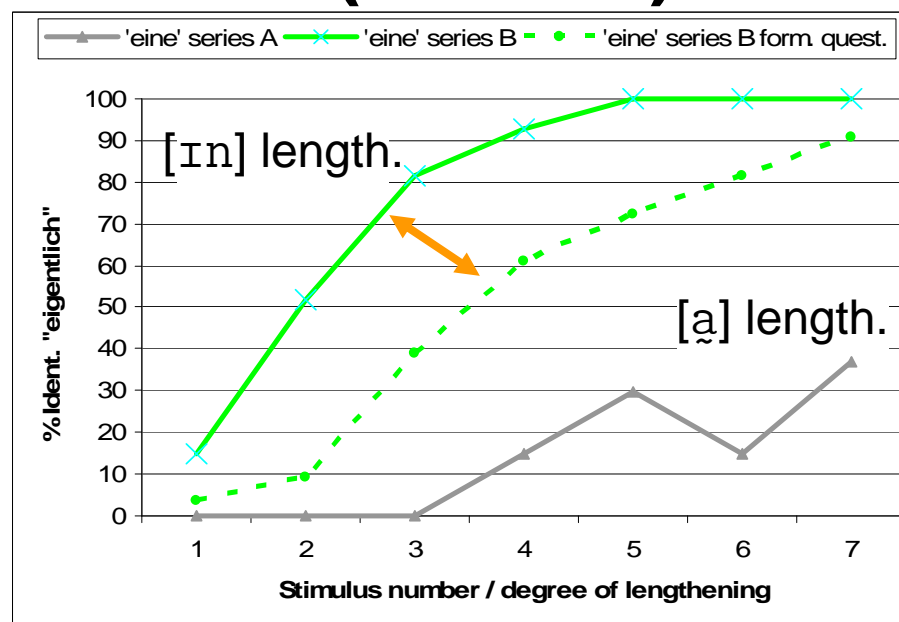
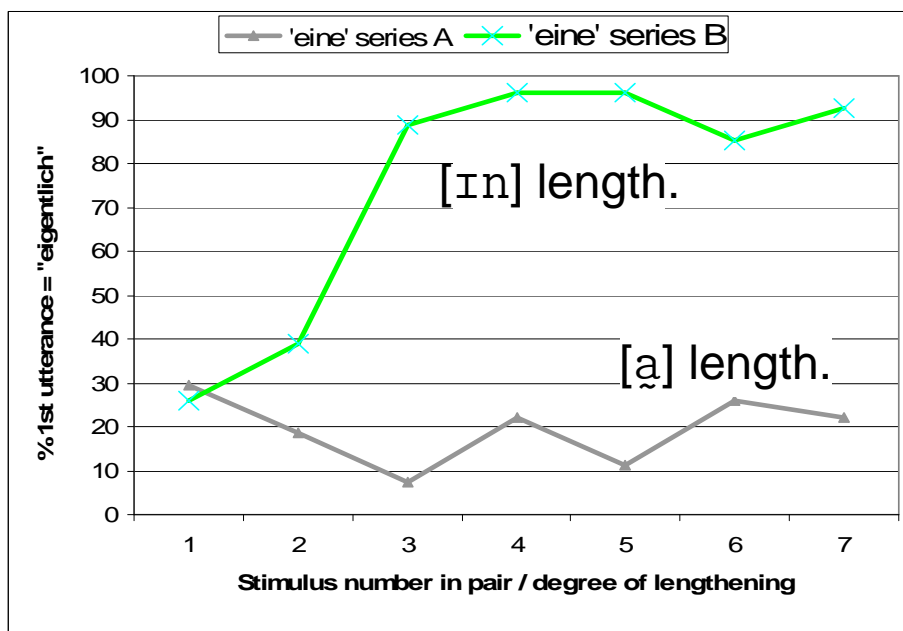
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Results 1: “eine“-based series (18 sbs.)



- Clear differentiation between the two possible interpretations of the stimuli starting from step #3 (= 60% lengthening difference between series A and B)
- Difference between curve A and B highly significant ($p < 0.001^{***}$)

- Clear increase in identification of “eigentlich ‘ne rote” just for series B
- Difference between curve A and B highly significant ($p < 0.001^{***}$)
- The more formal question significantly reduces the matching / “eigentlich ‘ne rote” judgements ($p < 0.001^{***}$)



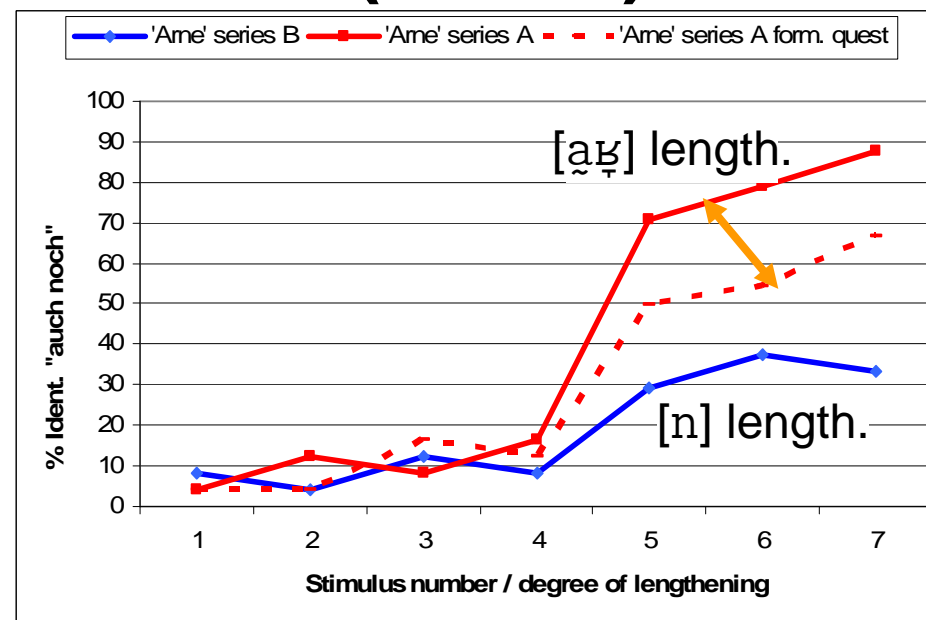
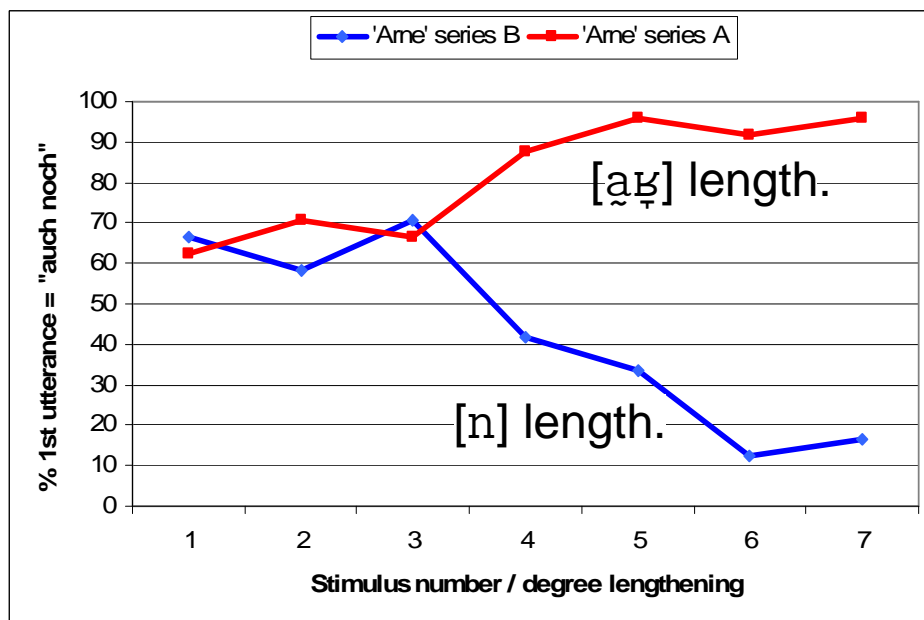
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Results 2: “Arne“-based series (8 sbs.)



- Interpretation of the stimuli in the pairs is clearly different from step #4 onwards (=80% lengthening difference)
- Difference between curve A and B highly significant ($p < 0.001$ ***)

- Results as in the case of the “eine” series, but slightly less pronounced
- = clear change for A stimuli towards “auch noch ‘ne rote”, while a small change also takes place for B stimuli (A vs. B: $p < 0.004$ **)
- “auch noch ‘ne rote” judgements reduced in A form. quest. ($p < 0.002$ **)



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Discussion 1

- **The results are in line with the hypotheses**
- In combination with the acoustic findings this suggests that the (de-)coding of highly reduced words involves lengthening, particularly of those phonetic sections that mirror the global articulatory settings of the words in their unreduced (“full”) form
- Perceptually:
 - highlighting of “light” sound = “eine” – “eigentlich ‘ne” ⇔
 - highlighting of “dark” sound = “Arne” - “auch noch ‘ne”
- However, this is surely not the only strategy. There are indications for a shift of segmental cues to the prosodic domain in the process of reduction (e.g., nasalization, lip rounding, voice quality; cf. Kohler 1990; Wesener 2000)
- Recoding of words or expressions, using *articulatory and/or phonatory prosodies*



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Discussion 2

- **Reduction changes the communicative meaning of the utterance!**
- Is the hierarchical, economically driven concept of reduction that starts from a “full” (canonical) reference form actually adequate?
- Or should we rather conceptualize the phonetic variants as structurally equivalent and resulting from different meaning layers
 - a lexical one
 - and communicative one that contributes
 - to the coding of melodic meanings
 - to the differentiation of grammatical functions
 - and that expresses the speaker’s interest in a conversation with the dialogue partner, which is perhaps related to the biological “*effort code*”, proposed by Gussenhoven (2002) ?



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Thank you for your attention