Tonal Alignment and Segmental Composition in German

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Introduction

Vowel shortening can be defined as a "process whereby vowels are shortened when preceded or followed by one or more consonants [belonging to the same word]" [1].

Generally, there are two types of vowel shortening processes discussed in the literature:

1. Vowel shortening can be induced by the addition of syllables. [2], [3]
2. Vowel shortening can be induced by the addition of onset or coda consonants. [4], [5], [6], [7]

However, no single study exists which investigates the interplay of coda induced and polysyllabic vowel shortening.

The **first aim** of this research, therefore, is to find evidence for both coda induced and polysyllabic vowel shortening, and account for their correlation.

A concept which has not yet been investigated in connection to vowel shortening is the concept of tonal alignment and scaling. Thus, the **second aim** of this study is to investigate the interaction of vowel shortening processes and tonal alignment and scaling.

Finally, the **key research question** of this study is whether or not there is an influence of vowel shortening on tonal alignment in L+H* rising pitch accents in German.

Method

Twelve native speakers of German (nine female, three male) with a mean age of 26.5 years (SD=5.5) participated in a production study.

Speech materials consisted of target words differing in vowel quality, syllable structure, and number of syllables, resulting in twenty-seven pseudowords.

C1	V1	C2	C3	W	A1	L	A2
m	i: e: a:	m	s	v	ɐ	l	ɐ
		optional coda consonants		additional syllable 1		additional syllable 2	

Target words were produced within the carrier sentence

/ʔeːɻ moeʃtə diː ʁaɪ̯zə nax [target word] maxən/

'*He wants to travel to [target word]*'

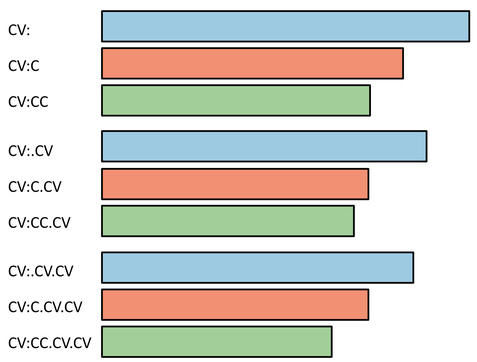
as an answer to the question

/moeʃtə tɪm diː ʁaɪ̯zə nax [filler] maxən/

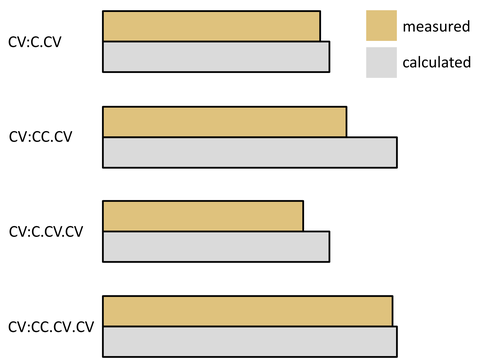
'*Does Tim want to travel to [filler]*?'.

Results

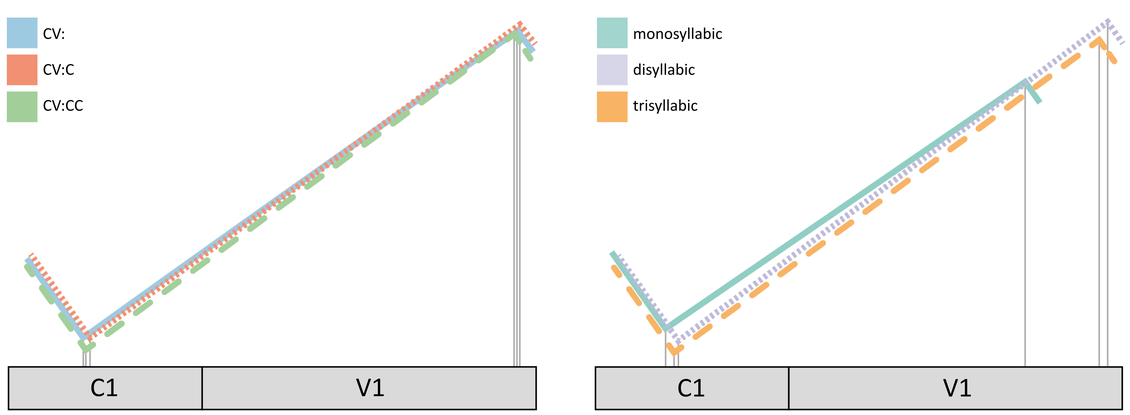
Coda Induced & Polysyllabic Vowel Shortening



Correlation of Vowel Shortening Effects



Tonal Alignment and Scaling



References

[1] Schmitz, D., Cho, H. and Niemann, H. (2018). Vowel shortening in German as a function of syllable structure. *Proceedings of the Conference on Phonetics & Phonology in German-speaking countries (P&P 13)*, Humboldt University Berlin, Berlin, 28-29 September, 181-184.

[2] Fowler, C. A. (1981). A Relationship between Coarticulation and Compensatory Shortening. *Phonetica*, 38, 35-50.

[3] Vayra, M., Cinzia, A. and Fowler, C. (1999). On the phonetic bases of vowel consonant coordination in Italian: A study of stress and "compensatory shortening". *Proceedings of the International Conference on Phonetic Sciences*, San Francisco, 1-7 August, 495-498.

[4] Munhall, K., Fowler, C., Hawkins., S. and Saltzman, E. (1992). "Compensatory Shortening" in monosyllables of spoken English. *Journal of Phonetics*, 20, 225-239.

[5] van Santen, J. P. H. (1992). Contextual effects on vowel duration. *Speech Communication*, 11, 513-546.

[6] Clements, G. N. and Hertz, S. R. (1996). An Integrated Model of Phonetic Representation in Grammar. *Working Papers of the Cornell Phonetics Laboratory*, 11, 43-116.

[7] Shaiman, S. (2001). Kinematics of compensatory vowel shortening: the effect of speaking rate and coda composition on intra- and inter-articulatory timing. *Journal of Phonetics*, 29, 89-107.

[8] Niemann, H., Grice, M. and Mücke, D. (2014). Segmental and positional effects in tonal alignment: An articulatory approach. *Proceedings of the 10th International Seminar on Speech Production (ISSP)*, Cologne, Germany, 5-8 May, 285-288.

[9] Niemann, H. and Mücke, D. (2015). Effects of phrasal position and metrical structure on alignment patterns of nuclear pitch accents in German: acoustics and articulation. *18th International Congress of Phonetic Sciences*, Glasgow, UK, 10-14 August.

[10] Browman, C. P. and Goldstein, L. M. (1989). Articulatory gestures as phonological units. *Phonology*, 6, 201-251.

[11] Browman, C. P. and Goldstein, L. M. (1992). Articulatory Phonology: An Overview. In C. A. Fowler, (Ed.). *Status Report on Speech Research*. New Heaven, CT: Haskins Laboratories, 23-42.

[12] Mücke, D. (2018). *Dynamische Modellierung von Artikulation und prosodischer Struktur: Eine Einführung in die Artikulatorische Phonologie*. Berlin: Language Science Press.

Conclusions

Coda Induced Vowel Shortening

Vowel duration is longest in target words with no coda consonant, followed by target words with one coda consonant, which in turn are followed by target words with two coda consonants.

CV: > CV:C > CV:CC

Polysyllabic Vowel Shortening

Vowel duration in monosyllables is longer than in di- and trisyllabic target words.

mono > di = tri

Correlation of Vowel Shortening Effects

The effects of coda induced and polysyllabic vowel shortening add up.

$$V1_{CV:} - V1_{CV:C.CV} = (V1_{CV:} - V1_{CV:C}) + (V1_{CV:} - V1_{CV:.CV}), p = 0.78$$
$$V1_{CV:} - V1_{CV:CC.CV} = (V1_{CV:} - V1_{CV:CC}) + (V1_{CV:} - V1_{CV:.CV}), p = 0.31$$
$$V1_{CV:} - V1_{CV:C.CV.CV} = (V1_{CV:} - V1_{CV:C}) + (V1_{CV:} - V1_{CV:.CV.CV}), p = 0.69$$
$$V1_{CV:} - V1_{CV:CC.CV.CV} = (V1_{CV:} - V1_{CV:CC}) + (V1_{CV:} - V1_{CV:.CV.CV}), p = 0.97$$

Tonal Alignment

L is stably aligned at approximately twenty-five percent into the onset consonant.

H is aligned earlier in target words with less coda consonants and in target words of a mono- than of a polysyllabic structure.

Tonal Scaling

The level of **L** is unaffected by coda induced and polysyllabic shortening effects.

The level of **H** is significantly higher in polysyllabic than in monosyllabic target words, but unaffected by coda induced shortening effects.

Interaction of Vowel Shortening and Tonal Alignment

L appears to be in-phase with the C-V gestures, i.e. it starts synchronously. Thus, it is unaffected by shortening processes and shows stable alignment.

H shows two distinct phenomena:

1. It keeps a constant distance to its preceding valley.
2. It aligns more variably.

Both observations can be accounted for by features of gestures and their coordination (cf. [10], [11], [12]).

Generally, vowel gestures take a certain time to reach their vocalic targets. Now, as vowel duration is affected by shortening processes, but vocalic targets have still to be reached for the realization of the intended vowel and as the tongue cannot be infinitely accelerated, vocalic targets may be reached later, i.e. closer to the following consonant.

Assuming the results by [8] and [9] hold true, the alignment of H is triggered by the vocalic gesture. Thus, H is aligned closer to the following consonant in target words with stressed vowels shortened by both coda induced and polysyllabic shortening.