IS GERMAN STRESS-TIMED? A STUDY ON VOWEL COMPRESSION

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ABSTRACT

Vowel and syllable compression due to syllabic composition of stress feet is shown to be relativlely weak in German. The effect rather works at the word level as proposed in the model of Lindblom & Rapp [5].

INTRODUCTION

The languages of the world can be divided into different types depending on what units tend to be equally spaced in the time course of an utterance [1, 6]: "stress-timed" if this unit is the stress foot, "syllable-" or "mora-timed" if these respective units have a tendency towards isochrony. Although in quite a number of experimental investigation no clear isochrony could be found, there are several effects that can differentiate between the different types of languages [3]
Vowel and syllable compression due to the syllabic composition of rhythmic feet as reported for English can be taken as evidence for stress-timing. As German also is considered to be stress-timed, we constructed an experiment parallel to one of Fowler's ([2]; exp. 7), in which she demonstrated changes in the duration of the stressed vowel due to this factor (working within and across word boundaries) in sets of sentences like the following (relevant stress feet marked by underlining):

The fact started the argument
The factor started the argument
The fact restarted the argument
The factor restarted the argument
The factory started the argument
The fact has restarted the argument.

METHOD

Analogously, in our German material we varied the syllabic composition of the testword and the foot by introducing different prefixes and suffixes ("'Trakt", "'Traktor", "Ver'trackte", "Ver'trackteste"; stress position marked by an apostrophe) as well as two different verbs ("'gab" vs. "er'gab") the testword being used both in utterance-initial and utterance-final position (relevant stress feet marked by underlining):

Der Trakt gab den Ausschlag
Der Trakt ergab den Ausschlag
Der Traktor gab den Ausschlag
Der Traktor ergab den Ausschlag
Der Vertrackte gab den Ausschlag
Der Vertrackte ergab den Ausschlag
Der Vertrackteste gab den Ausschlag
Der Vertrackteste ergab den Ausschlag

Den Ausschlag gab der Trakt
Den Ausschlag ergab der Trakt
Den Ausschlag gab der Traktor
Den Ausschlag ergab der Traktor
Den Ausschlag gab der Vertrackte
Den Ausschlag ergab der Vertrackte
Den Ausschlag gab der Vertrackteste
Den Ausschlag ergab der Vertrackteste

The sentences were uttered twice in randomized order at a - individually chosen - normal rate of speech by five native German speakers (middle bavarian). The durations of the vowel /a/, the syllable /trak(t)/, the rhythmic feet and the entire utterances were measured on the oscillogram using an inkwriter output at a paper speed of 100mm/sec.

RESULTS

The results are show in the following table and, for the vowel measurements only, in Fig. 1.

In contrast to the English data the analyses of variance only showed a weak tendency of German towards stress-timing. In the following, the different effects are discussed individually.

Stress Foot Duration

Two-factorial analysis of variance shows a significant effect of the testitem ($F(7,144) = 32.7$; $p < .001$), of position ($F(1,144) = 15.4$; $p < .001$), and a significant interaction ($F(7,144) = 4.73$; $p < .001$) on the duration of the stress foot. The simple main effects show a tendency for compression only in those items where the syllabic variation takes place within the testword (the most complex one, "Vertrackteste", is not compressed). For the sentence-initial stress feet we get the following order in duration (shortest first; the items that are not significantly different in one line; $p < .05$):

Trakt, Vertrackte, Traktor
Trakt er_
Vertrackte er_, Vertrackteste, Traktor er_
Vertrackteste er_

Parallelly, in final position only "Vertrackteste" is significantly longer than the other items. As to be expected the duration of the stress foot correlates with the duration of the entire utterance (initial $r = .829$; final $r = .683$; in both cases $p < .001$), weaker in the final stress feet ($p < .05$), because the variation in the verb is independent of the stress foot.

Syllable Duration

Syllable duration also shows no effect across word boundaries: There is a significant effect of the testword in initial and final position ($Fs(2,54) = 4.52, 3.66$; $p < .05$): only "Vertrackteste" has shorter syllable durations.

Vowel Duration

Vowel duration (see Fig.1) is not affected by variation of stress foot duration beyond the boundaries of the testword either. There is a significant testword effect in initial and final feet ($Fs(3,72) = 7.43, 7.32$; $p < .001$), but due only to the vowel always being significantly longer for the testword "Trakt". Interestingly, in general the vowel duration was longer for the initial items ($F(1,144) = 4.$; $p < .05$).

DISCUSSION

In general, our data only show a weak compression effect, favouring the model of

Table I:
Mean durations (and standard deviations - in brackets) with different testwords in different positions and contexts

	duration of vowel	syllable	foot	utterance
testitem				
"Trakt"				
_ gab	131.5	389.5	398.	1484.
initial	(17.6)	(54.8)	(46.2)	(178.9)
_ ergab	123.5	385.	476.5	1537.
	(13.1)	(38.6)	(69.3)	(177.4)
_ gab	128.	463.5	463.5	1436.
final	(20.6)	(41.3)	(41.3)	(187.2)
_ ergab	121.	484.	484.	1515.5
	(18.4)	(56.2)	(56.2)	(230.8)
"Traktor"				
_ gab	111.	298.5	447.5	1533.5
initial	(10.2)	(31.4)	(54.1)	(216.2)
_ ergab	115.	297.5	578.	1646.5
	(17.6)	(39.2)	(122.8)	(254.7)
_ gab	106.5	316.	565.5	1493.5
final	(13.3)	(48.3)	(52.4)	(182.5)
_ ergab	107.5	296.	544.	1602.5
	(15.7)	(40.9)	(62.9)	(196.6)
"Vertrackte"				
_ gab	112.	292.	424.5	1659.5
initial	(14.4)	(31.4)	(37.5)	(207.6)
_ ergab	110.	289.5	534.	1745.
	(15.8)	(44.3)	(77.3)	(243.4)
_ gab	104.5	305.	517.	1594.5
final	(12.6)	(41.8)	(45.2)	(199.6)
_ ergab	107.	304.	519.5	1699.
	(17.7)	(43.2)	(41.4)	(232.6)
"Vertrackteste"				
_ gab	106.	264.5	572.5	1780.5
initial	(11.3)	(34.4)	(62.8)	(224.1)
_ ergab	110.	268.	685.5	1878.5
	(11.5)	(26.7)	(103.8)	(271.2)
_ gab	103.	276.	678.5	1780.5
final	(18.)	(37.1)	(37.3)	(193.7)
_ ergab	103.	274.5	663.	1812.
	(10.3)	(29.5)	(46.2)	(202.1)

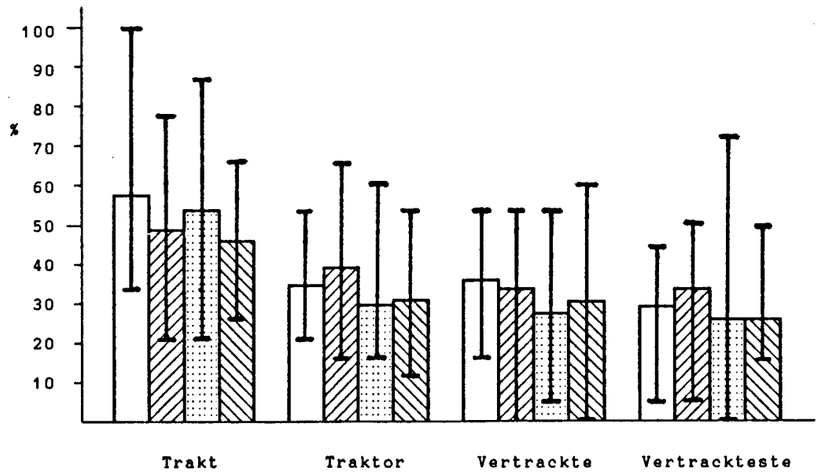

Fig.1: Mean vowel duration (and range) in percent total variation in vowel duration (100% = 170 msec; 0% = 85 msec) in the different testwords in different positions and contexts (open: initial _gab; upward hatch: initial _ergab; dotted: final _gab; downward hatch: final _ergab)

Lindblom & Rapp [5], where this effect is assumed to work at the word level.

As Huggins [4] and Fowler [2] report that the compression effect is only seen at relatively fast rates of speech we reanalyzed our results, omitting the data of the one subject who produced the utterances at a noticeable slower rate of speech than the others. This reanalysis however showed exactly the same effects as before.

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