Intonational Consequences of Varying the Accent Location

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ABSTRACT

An experiment was carried out to investigate the effect of varying the location of the (unique) sentence accent on the concrete melodic behavior of that accent. More specifically, we measured the onset, the duration and the size of both the rise and the fall on the so-called 'pointed hat' on the accent. The main finding was that accents are getting smaller the later they occur in the sentence.

INTRODUCTION

In natural speech, pitch accents can be realized in many different ways. In Dutch, a common realization of a pitch accent is the so-called *pointed hat*: a sudden pitch rise on the accented syllable, immediately followed by a sudden fall ('t Hart et al., 1990). Yet, this pointed hat can vary a lot with respect to the range and the duration of both pitch movements, as well as with respect to its location in the syllable. The present study has investigated the melodic behavior of single pitch accent in short, monophrasal Dutch utterances. Previous studies have pinpointed the notion of *converging declination lines* (Terken, 1993). This notion states that consecutive pitch movements become smaller the later they occur in the phrase, so that one could interpret them as being realized between two converging declining lines: the baseline and the topline. We were interested in looking if this notion also holds in utterances with but *one* accent. To do so, we measured the onset, duration and size of both the rise and the fall constituting the pointed hat used to mark the unique sentence accent.

METHODOLOGY

In order to check for the influence of the accent location on the concrete melodic realization of the pointed hat, a set of utterances was recorded, all containing only one sentence accent[1]. The data base consisted of several readings of an utterance

[1]The construction criteria for the materials were imposed by the COST-233 project 'Prosodics in Synthetic Speech'.

containing monosyllabic words ('Een laag dal zag een man' (A low valley saw a man)), and an utterance containing disyllabic words ('De lieve dame gooide een ballon' (The lovely lady threw a balloon)).

Accents could fall either in initial, medial or final position: on the first noun, on the verb or on the second noun. Two speakers were asked to utter the sentences: one male (SL) and one female (YH). Every utterance was spoken eight times. Totally this equals: 2 lengths (short, long) x 3 accent locations (I, M, F) x 2 speakers x 8 replications (eight recordings) = 96 recordings.

The readings with the desired accent structure were elicited by appropriate questions. E.g. to get the answer 'The lovely lady threw a *balloon*', the (oral) question was '*What* did the lovely lady throw?'.

The original pitch contours were replaced by so-called 'close copies' (i.e. straight-line approximations of the original pitch contour without any audible difference with the original ones, cf. 't Hart et al, 1990). On the 96 close copies, the numerical values of the pointed hats were measured. More exactly, we measured the onset (relative to vowel onset, in cs), duration (in cs) and excursion size (in semitones) of both rise and fall constituting the pointed hat.

RESULTS

Results for speaker 1 (SL)

The results for speaker SL are shown in the following table. The eight replications for every recording were pooled.

Table 1. *Speaker 1: mean onset, duration and excursion size for rise and fall in pointed hats as a function of the location of the accented syllabe (I(nitial), M(edial) or F(inal)).*

sent. length	accent loc.	rise onset (cs)	rise dur (cs)	rise exc.size (ST)	fall onset (cs)	fall dur (cs)	fall exc.size (ST)
short	I	-11.62	16.25	6.60	12.12	15.87	6.28
	M	- 9.75	16.62	5.35	8.37	17.12	5.65
	F	- 7.37	11.50	4.31	8.75	11.87	4.75
long	I	- 6.50	18.25	6.11	13.50	16.87	5.59
	M	- 7.87	16.50	5.32	13.62	14.12	5.56
	F	-10.12	14.37	4.52	9.00	13.00	4.99

The most striking effect in this table clearly is the reduction in excursion size as a function of the accent location, and this both for the rise and the fall. Accents realized in initial position (on the first noun) have larger excursions than accents in medial position (on the verb), which are in turn larger than those in final position (on the second noun). For mean values see also table 3. An ANOVA with sentence length and accent location as main effects show that these effects are statistically significant (for the exc.size of the rise: $F < .001$, and for the exc.size of the fall: $F = .002$).

Since the phenomenon of decreasing excursion size as a function of accent location holds for both the rise and the fall, we can look at the correlation between these two parameters via a regression analysis. Following figure shows how these two parameters are correlated.

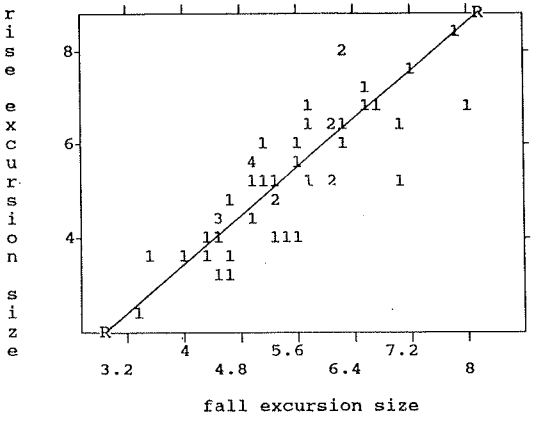

Figure 1. *Speaker 1: Correlation plot of excursion size rise with excursion rise fall (Correlation Coefficient = .817, R^2 = .668).*

A second observation for speaker SL concerns the duration of both the rise and the fall. Both rise and fall become shorter the later the accent falls. This can be seen in table 3 on the following page.

Results for speaker 2 (YH)

The results for speaker YH are shown in the following table. The eight replications for every recording were pooled.

Table 2. *Speaker 2: mean onset, duration and excursion size for rise and fall in pointed hats as a function of the location of the accented syllabe (I(nitial), M(edial) or F(inal)).*

sent. length	accent loc.	rise onset (cs)	rise dur (cs)	rise exc.size (ST)	fall onset (cs)	fall dur (cs)	fall exc.size (ST)
short	I	-14.87	23.87	6.07	13.87	26.75	7.67
	M	-16.75	26.50	4.82	13.25	15.62	6.10
	F	-10.00	14.62	4.51	6.50	12.00	5.57
long	I	-8.00	23.50	5.56	19.25	13.75	6.46
	M	-12.37	21.87	5.26	16.75	13.87	6.26
	F	-11.50	15.62	3.69	4.87	15.00	5.86

Just as in the measurements for SL, the most obvious effect of varying the accent location is the reduction in the excursion size of the movements. Both the rise and the fall get smaller excursions the later they occur in the sentence. Here as well, an ANOVA gives significant F-values for the excursion size of the rise and the fall ($F < .001$ for the first, and $F = .003$ for the latter).

For speaker YH, a regression analysis between the size of the rise and the size of the fall yields the following result: Correlation Coefficient = .753, $R^2 = .567$

Following table shows the mean excursion size and duration of both the rise and the fall for speaker SL, and the mean excursion size of both the rise and the fall for speaker YH. The data for the short and the long sentence are pooled, since the ANOVA shows that the only main effect influencing these variables is the accent location and there are no significant interactions.

Table 3. *Mean excursion size of rise and fall for both speakers, and mean duration of the rise and fall for speaker SL, pooled over the two sentences.*

accent loc.	speaker 1 (SL) rise exc.size	fall exc.size	rise dur.	fall dur.	speaker 2 (YH) rise exc.size	fall exc.size
I	6.36	5.94	17.25	16.37	5.82	7.07
M	5.34	5.61	16.56	15.62	5.04	6.18
F	4.42	4.87	12.94	12.44	4.10	5.72

CONCLUSION

For both speakers, the same main observation is found. The later the unique sentence accent occurs, the smaller both the rise and the fall constituting the pointed hat. This finding strengthens the observation in Terken, 1993. He has found that pitch accents tend to be realized between two converging declination lines: a baseline and a topline. In case of only *one* accent, it is problematic to draw a topline[2]. However, we have found that the principle of convergence still holds in this case. Unique pointed hats seem to be realized between two hypothetical declination lines as well.

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REFERENCES

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[2]Normally, base- and topline are drawn by interpolating the valley pitch values or the top pitch values, respectively. Cf. Cohen et al., 1982.