

## DECLINATION IN DUTCH AND DANISH: GLOBAL VERSUS LOCAL PITCH MOVEMENTS IN THE PERCEPTUAL CHARACTERISATION OF SENTENCE TYPES

*Charlotte Gooskens (1) and Vincent J. van Heuven*

*Department of Linguistics/Phonetics, Leiden University, The Netherlands  
(1) Now at Department of Linguistics, Nijmegen University, The Netherlands*

### ABSTRACT

This research deals with the question whether Standard Dutch and Standard Copenhagen Danish have systematically different speech melodies for interrogative, non-final, and declarative utterances. Rate of declination and local pitch movements were investigated. The Danish model developed by Thorsen [1] could be confirmed in its use of different rates of declination for different sentence types. The Dutch model [2] proved too simple in so far as it uses a uniform declination for all utterances of the same length: in Dutch, too, there is an effect of sentence type on declination rate.

According to the models, the two languages differ in their use of local pitch movements as cues to sentence type. The Danish model recognizes only one kind of local pitch movement (an accent, not a boundary tone), whereas several local pitch movements are distinguished by the Dutch model. The results of our experiments perceptually confirm that in Dutch, but not in Danish, a local final pitch rise is used in combination with declination rate to signal sentence type.

### INTRODUCTION

The Dutch intonation grammar [2] claimed that the Dutch sentence melody, whether in statements or in questions, is characterized by a general downtrend of fundamental frequency (F0) over the course of the utterance (declination). The difference between sentence types such as statement and question is coded in the final portion of the sentence melody only, where F0 remains high after the

last accent-lending rise or where a non-accent-lending terminal rise is executed when the last accent is a fall. These configurations may occur at the end of a sentence as well as at the edge of a non-terminal clause, in which case they signal continuation.

According to Thorsen [1], Danish intonation in terminal statements is comparable to Dutch; in both languages the same type of declination applies. However, non-terminal statements in Danish are characterised by a more gradual declination. Moreover, declination is claimed to be absent from Danish (echo) questions. The Danish model of intonation does not distinguish between different kinds of pitch movements.

Our first aim is to establish whether Danish differs from Dutch by using various degrees of declination (full, half and no declination for 'statement', 'continuation' and 'question' respectively), whereas Dutch does not employ declination as a parameter, or whether the intonation research for Dutch has overlooked functional contrasts in the declination parameter.

Our second aim is to establish whether indeed final rise cannot be used in Danish, as opposed to Dutch, to signal a difference between statement and continuation/question.

### EXPERIMENT I

#### Method

The aim of this experiment was to investigate the importance of declination and pitch movements for the perceptual discrimination of sentence type in Danish and Dutch. Declination and pitch move-

ments of the Dutch and the Danish models of intonation were systematically combined, imposed onto a Danish and a Dutch utterance and presented to Dutch and Danish listeners.

The two test utterances used in this experiment were the Danish and the Dutch translations of the sentence "(There are) many busses out of Tiflis". Only the last four words were used in order to deprive the respondents of syntactic clues to sentence type.

Dutch accents were implemented as an early rise followed by a gradual fall, i.e. configuration 1D in [2]. Additionally the interrogative and non-final utterances had a rise 2 on the last word. Declination slopes were generated on the basis of the formula in [2].

Danish stress groups were generated on the basis of Thorsen's model [1]. Declination slopes were estimated from both the model and sample utterances provided (for details see [3]).

Since there is no difference between 'question' and 'continuation' in the Dutch intonation model, we end up with nine pitch contours, which were applied to the Dutch and the Danish sentences:

declin.	rise	stat.	cont.	quest.
DK	DK	#1	#2	#3
NL	NL	#4	#5	
DK	NL	#6	#7	#8
NL	DK	#9		

Experiment I consisted of three parts. In the first two parts 20 Dutch and 17 Danish respondents listened to the nine versions of the sentence in their own language presented randomly. Their task was to decide for each utterance whether it expressed question, continuation or final statement. In part II they judged the naturalness of each utterance on a scale from 1 (least natural) 10 (most natural). In part III pairs of versions were presented to the subjects, who selected

the member of each pair which they thought sounded more natural.

## Results

*Part I.* The respondents had to decide whether each of the utterances expressed question, non-final or final statement. The results are presented in the left half of Table 1.

*Table 1. Results of part I and II for the Dutch respondents (NL) and the Danish respondents (DK). Horizontally the possible answers: question (?), continuation (,) and final statement (.). Vertically the nine different versions of the utterance. The results of part I are in %. The results of part II are mean judgments on a scale from 1 to 10. The 'correct' answers are underlined.*

stimuli	responses in % part I						responses part II	
	NL listeners			DK listeners			NL	DK
	?	,	.	?	,	.		
#1	<u>69</u>	20	10	<u>85</u>	10	5	5.1	6.0
#2	21	<u>55</u>	24	26	<u>68</u>	6	5.2	4.9
#3	13	33	<u>55</u>	9	68	<u>24</u>	5.1	5.3
#4	<u>5</u>	<u>70</u>	25	<u>6</u>	<u>38</u>	56	7.2	4.8
#5	0	30	<u>70</u>	12	0	<u>88</u>	7.0	5.9
#6	<u>73</u>	28	0	<u>76</u>	18	6	7.0	5.1
#7	51	<u>46</u>	3	47	<u>44</u>	9	6.6	3.8
#8	3	40	<u>58</u>	6	18	<u>76</u>	6.2	4.3
#9	8	28	64	3	26	71	5.7	5.8

Clearly, the Thorsen model is confirmed: in Danish, the declination slope is very important for the recognition of sentence type. The question type has no declination (stim. #1, 85%) and the final statement has a rather steep declination slope (stim. #5, 88%). The continuation type should have a slope in between that of the question and the statement type (stim. #2, 68%).

Dutch listeners also need the declination slope to recognize sentence type. For the Dutch listeners to recognize a

question there should be no declination and a rise 2 should be present (stim. #6, 73%). The continuation type is again recognized best if there is a final rise, but the declination slope has to be steep (stim. #4, 70%). The Dutch statement requires a steep declination and F0 has to end at the baseline (stim. #5, 70%).

*Part II.* In this part the respondents judged the naturalness of the utterances of part I. The conclusions of part I are confirmed in part II both for the Dutch model and for the Danish model (Table 1, right half). The utterances which were the best recognized instances of the three sentence types (#4, #5 and #6 for Dutch and #1, #2 and #5 for Danish) also obtained the highest naturalness scores.

*Part III.* In this part the respondents had to decide which of two sentences sounded more natural. The information which one gets from pairwise comparisons is generally more precise than information from categorical estimation. For lack of space no results will be presented, and we will proceed immediately to the conclusions.

For *Danish* the results from the first two parts are confirmed and thus the model of Thorsen has been confirmed in general. The *Dutch* results of part I and II are confirmed for the continuation and the final statement types, but no confirmation was obtained that the question intonation has to be without declination. The steep declination of the Dutch model is found to be more natural than no declination at all. In order to be able to draw stronger conclusions as to the importance of declination slope for the recognition of sentence type in *Dutch*, experiment II was carried out.

## EXPERIMENT II

### Method

The set-up of this experiment is very similar to that of the first. Different utterances were made for Dutch only, this time with five different declination slopes of -2, 0, 2, 4, and 6 semitones

over the course of the 235 ms utterance (cf. table 2, leftmost column). These slopes were combined (non-orthogonally) with final pitch rises of 0, 2, 4, and 6 st/150 ms. The rest of the pitch contour was generated as in experiment I. The resulting 18 utterances were presented to 15 Dutch students as in experiment I, except that the third part was subdivided into three smaller sections (3a, 3b and 3c). In 3a the subjects were instructed to consider the stimuli as questions, in 3b as continuations, and in 3c as declarative statements.

### Results

For the declarative and the continuation types the conclusions that can be drawn on the basis of the results are very similar to those of the first experiment. Again, only the results of the first two parts are presented.

As for questions, the first two parts confirm the findings of the first two parts of experiment I: questions should have an F0 that does not decline and a final rise 2 (table 2). In section 3a the subjects, however, show a (slight) preference for the utterance with both declination and a final rise, just as is prescribed in the Dutch model. The versions without declination, however, were judged almost as adequate, as long as they have the final rise. This means that Dutch listeners might use declination as a cue in the recognition of sentence type. It is also confirmed that the final rise is crucial for the recognition of a Dutch question.

### SUMMARY AND DISCUSSION

The results clearly constitute a perceptual confirmation of the Danish model of intonation: Danish indeed distinguishes different slopes of declination in order to express sentence type; one local final pitch movement cannot be used for this purpose. Interrogative utterances (echo questions) have no declination, non-final utterances have a moderate rate of

Table 2. Percent responses (part I) and mean naturalness rating (1 to 10 scale, part II) broken down for 18 stimulus types differing in global declination slope and excursion size of local end rise.

stimuli		responses in % part I			responses part II
decl. st/234 ms	exc. st. end-rise	?	,	.	
6	0	0	7	93	7.5
6	2	0	37	63	6.4
6	4	10	73	17	6.0
6	6	13	63	23	6.1
6	8	33	40	27	6.3
4	0	0	7	93	7.0
4	2	57	43	0	6.0
4	4	3	73	23	5.9
4	6	33	63	3	6.0
2	0	10	47	43	5.7
2	2	20	60	20	5.6
2	4	47	43	10	5.7
2	6	43	50	7	6.1
0	0	13	50	37	4.8
0	2	37	57	7	5.9
0	6	60	37	3	6.4
-2	6	43	50	7	6.1
-2	6	93	7	0	6.1

declination, and declination has to be steep for the declarative type.

The Dutch model of intonation, on the other hand, needs revision. According to this model, no distinction has to be made in declination slopes of different sentence types. However, the most important conclusion of this investigation is that (at least in some situations) questions should not decline in Dutch, while the declination in non-final and declarative sentences is equally steep. In contrast to Danish, however, final pitch movements are needed as well in order to distinguish between the different sentence types. Interrogative and non-final utterances

should end on a high (i.e. non-low) pitch whilst declarative sentences should end on a low pitch.

On the basis of the results of the present investigation it might be possible to draw the conclusion that the use of different rates of declination (i.e. global intonational features) as opposed to local pitch movements to distinguish sentence types is a typological parameter differentiating between e.g. Danish and Dutch. If this is indeed the case it is likely that rate of declination is used in similar ways in other languages. It would therefore be very interesting to investigate the use of declination versus local pitch movements to express sentence type in a wider variety of languages, both Indo-European and non Indo-European.

#### REFERENCES

- [1] Thorsen, N. (1980). A study of the perception of sentence intonation - Evidence from Danish. *Journal of the Acoustical Society of America*, 67, 1014-1030.
- [2] Hart, J. 't; Collier, R.; Cohen, A. (1990). *A perceptual study of intonation*. Cambridge University Press.
- [3] Grønnum, N. (1990). Prosodic Parameters in a Variety of Regional Danish Standard Languages, with a View towards Swedish and German. *Phonetica*, 47, 182-214.