1. Introduction

Intonation has meaning (cf. Ladd 1996:39). For example, in many languages it is possible to change a statement into a question by executing a pitch rise at the end of the utterance (Bolinger 1978, 1989). In fact, form categories postulated in intonation models are largely based on (supposed) similarities and differences in the meanings expressed by the various melodic shapes. Furthermore, there are a number of (theoretical) analyses of the meaning of intonation available (e.g. Brazil, Coulthard and Johns 1980, Ladd 1980, Gussenhoven 1984, Bolinger 1986, 1989, Pierrehumbert and Hirschberg 1990, all for English). It seems logical to try and verify available hypotheses about the meaning of melodic shapes in an experimental way. So far, however, experimental support backing the postulated meanings attributed to the various intonational form categories has never been provided. One important reason for this conspicuous lack of independent empirical support is that it is extremely difficult to test meaning hypotheses of non-lexical categories experimentally (cf. Kirsner, van Heuven and van Bezooijen 1994). According to some experts the job just cannot be done (Cutler 1977).

The present investigation is a continuation of earlier work on the meaning of intonation (Caspers 1997, 1998a, 1998b), focusing on two Dutch melodic shapes: the default pitch accent or ‘pointed hat’ (‘1&A’) and the accent-lending fall (‘A’).

1.1 Melodic forms and meanings

We have turned to the Grammar of Dutch Intonation (’t Hart, Collier and Cohen 1990) for an inventory of surface form categories. Instead of the abstract pitch levels assumed in the autosegmental approach to intonation (e.g. Pierrehumbert 1980, Gussenhoven 1984, Ladd 1983), the GDI regards pitch movements as the basic building blocks. The phonetic definition of the movements exploits four dimensions: direction (rise or fall), rate of change (abrupt or gradual), size (full or half) and timing with respect to syllable boundaries (early, late or very late);
the inventory of perceptually relevant pitch movements includes five different rises (‘1’–‘5’) and five different falls (‘A’–‘E’). Pitch movements can be combined to a limited set of configurations; for example, the combination of a rise ‘1’ and a fall ‘A’ on one syllable results in the very frequent pitch accent ‘1&A’ (or ‘pointed hat’).

The GDI makes a distinction between accent-lending and boundary-marking pitch configurations, but refrains from further statements regarding the function of intonation. This means that some pitch configurations play a role in the cueing of focus, while other configurations are involved in the marking of boundaries, but the grammar does not indicate what the differences are between e.g. various types of pitch accent.

Keijsper (1984) supplied the GDI with a further meaning component. She postulated eight form-meaning units (types I to VIII). Five of these units share the meaning of accent (“the speaker communicates what he is and is not thinking about”), while the type of accent adds something to this basic meaning. For example: a type II pitch accent signifies that the speaker thinks of the focused information; at the same time the next thought is announced, and this next thought is necessary for deciding whether the focused information ‘exists’ or not. A type III pitch accent, on the other hand, expresses that the speaker knew that the referent existed before the moment of speaking.

The present investigation seeks to provide independent experimental verification of the abstract meanings postulated by Keijsper (1984) for the pointed hat (‘1&A’) in final position, and for the accent-lending fall (‘A’):

\[
\text{type I} \quad \frac{\text{1&A}}{\wedge} \quad \text{“the existence of the referent is introduced”}
\]

\[
\text{type III} \quad \frac{\text{A}}{\text{1&A}} \quad \text{“the existence of the referent was projected before the moment of speaking”}
\]

1.2 Previous experimental work

In a series of experiments Caspers (1997, 1998a, 1998b) tested meanings proposed for four Dutch pitch accents types. The results bore out the meanings set up for two of the four pitch accent types (‘1(2)’ and ‘1&E’), but for ‘1&A’ and ‘A’ the results were not in line with the predictions.

From the abstract meanings formulated by Keijsper (see above) the following hypotheses were derived: ‘1&A’ marks the focused information as new, whereas ‘A’ indicates that the focused information was already known. To test the
viability of these meaning hypotheses, proper names were chosen as stimulus utterances, and a series of contexts were created with the aim of characterizing the referent of the proper name as either new or given. The contexts were designed such that uttering the proper name constituted the addition of new information to the background shared between speaker and listener in the former case, whereas in the latter case uttering the proper name constituted a selection from the proper names present in the background shared between speaker and listener.¹

The contexts and the melodic versions of the proper names were presented to subjects who had to either select the melodic version best fitting the presented context or select the context best fitting the presented melodic version of the proper name. Results showed a preference for the ‘I&A’ pitch accent in both context types, whereas both types of context proved equally acceptable for the two pitch accent types. This means that the experiments did not reveal a positive association between the two pitch accent types and the two types of background presented in the contexts.

There are a number of possible explanations for these findings. First of all, the abstract meaning hypotheses may be wrong. Secondly, the contexts used in the experiments may be incorrect: the abstract notions of ‘addition’ and ‘selection’ may have been insufficiently reflected in the situational contexts. And thirdly, there may be ‘pragmatic’ problems: if the fall ‘A’ signifies that the focused information should be known by the listener, it is conceivably impolite to use this type of accent (since it could be interpreted as a sign that the speaker thinks the listener is stupid). At this moment it is impossible to choose between these three types of explanation and therefore we went back to the original analysis by Keijsper.

2. Research questions and experimental approach

Keijsper (1984:28) illustrates the abstract meaning she proposes for ‘A’ (type I and II) with examples where this pitch accent type is — supposedly — implausible:

\[
\text{(1) Mijn huis staat in brand} \quad \text{('My house is on fire')}
\]

Keijsper asserts that this combination of sentence and contour is odd, since the speaker suggests that he already knew that his house was on fire, while the situation (described in Keijsper’s context) clearly contradicts this state of affairs; the pointed hat would be a better candidate:
These impressionistic observations lead to the following questions:

(i) Is contour ‘A’ unacceptable on sentences carrying new information?
(ii) Is contour ‘1&A’ unacceptable on sentences carrying predictable information?

To find an answer to the two research questions the following approach was chosen: create sentences with typically new information, i.e., ‘unpredictable’ sentences, in which the focused information is added to the background shared between speaker and listener, cf. example (1), and sentences with typically predictable information, where the focused information is presented as already present in the background, and present these with both accent types to subjects in two types of acceptability test: an absolute rating test and a pairwise comparison test.

Two short experiments will be reported. The second experiment is an (arguably) improved version of the first.

3. Experiment 1

3.1 Materials

Sentences were devised that would typically be spoken with a single accent. Half of the sentences described an unusual event that would prompt a speaker to present the contents as spectacular (‘unpredictable’ sentences). The other sentences contain propositions that were highly predictable, through adverbs such as natuurlijk (‘naturally’, ‘obviously’) and weer (‘again’, i.e., predictable by extrapolation from past experience). Accented syllables are capitalized.

‘unpredictable’ sentences

(1) Mijn AUto staat in brand.
   my CAR is on fire
   ‘My car is on fire.’

(2) De GOUDvis is vanmorgen ontsnapt.
   the GOLDfish has this.morning escaped
   ‘The goldfish has escaped this morning.’

(3) Ik heb zojuist de koningIN gezien.
   I have just.now the QUEEN seen
   ‘I saw the queen just now.’
Mijn zus heeft vorige week de staatsloterij gewonnen.  
'My sister has won the national lottery last week.'

Mijn vader krijgt een bontjas voor zijn verjaardag.  
'My father will have a fur coat for his birthday.'

De butler zal het wel weer gedaan hebben.  
'The butler must have done it.'

De kat heeft weer gekotst.  
'The cat has thrown up again.'

Mijn broer heeft het eten weer eens laten aanbranden.  
'My brother has burned the food again.'

Ik ben als gewoonlijk de postbode tegengekomen.  
'I have met the postman, as always.'

Mijn moeder gaat natuurlijk een appeltaart bakken.  
'Of course my mother will bake an apple pie.'

A male intonologist and native speaker of Standard Dutch realized all sentences with the two types of intonation contour. Recordings were made on audio tape, using a Sennheiser MKH416 microphone, in a soundproofed studio. All sentences were digitized (16 kHz, 16 bits). Pitch (fundamental frequency or $F_0$, in Hz) was extracted using an autocorrelation method. The resulting twenty pitch curves were stylized, i.e., reduced to a minimal number of straight line segments, such that the resulting contour contained only the intended accent-lending movements and stretches of declination, and resynthesized, using Pitch Synchronous Over Lay and Add (PSOLA, cf. Moulines and Verhelst 1995).

3.2 Absolute acceptability rating

The acceptability of the twenty combinations of sentence and contour was judged by twenty subjects on a seven-points scale, running from 1 for very bad via 4 for neutral to 7 for very good. Subjects were instructed to judge the combination of speech melody and sentence. We expected the 'unpredictable' sentences to be
relatively acceptable with a ‘1&A’ contour and relatively unacceptable with an ‘A’ contour, whereas the ‘predictable’ sentences were expected to sound relatively acceptable with a fall ‘A’ and relatively unacceptable with a pointed hat contour. All subjects were students or staff of Leiden University, native speakers of Dutch, without self reported hearing deficiencies, and unpaid.

Figure 1. Acceptability scores per contour type, broken down by sentence type.

The results are presented in Figure 1, which shows the mean acceptability ratings for the two contour types, broken down by sentence type. The ‘unpredictable’ sentences with ‘A’ were given a mean acceptability score of 3.11, whereas the same sentences with a ‘1&A’ contour received a score of 4.15; the ‘predictable’ sentences received a score of 3.71 with the accent-lending fall and 4.71 with a pointed hat. An ANOVA on the acceptability scores reveals a significant effect of contour — ‘1&A’ is more acceptable than ‘A’, F(1,398)= 45.8, p<.001 — and of sentence type — ‘predictable’ sentences are more acceptable than ‘unpredictable’ sentences, F(1,398)= 15.3, p<.001 — but there is no interaction, F(1,396)<1. This means that only part of the predictions were borne out:
sentences carrying new information were indeed not very acceptable when accented with 'A' and (more) acceptable with '1&A', but it is not the case that sentences carrying predictable information are unacceptable when accented with '1&A'; on the contrary: 'predictable' sentences are not particularly acceptable with contour 'A', whereas they are with '1&A'.

3.3 **Pairwise acceptability comparison**

In the second part of the experiment a pairwise comparison of both contour types was made. The same twenty subjects were presented with the two melodic versions of each sentence in immediate succession. They had to select the member of each pair with the most acceptable melody. The predictions were that the '1&A' contour would be preferred on the 'unpredictable' sentences, whereas the 'A' contour would be preferred on the 'predictable' sentences.

In Figure 2 the results are presented in terms of the percentage of preferred
contour type for the two sentence types. For the 'unpredictable' sentences there is a strong preference for contour ‘1&A’ (88%); for the 'predictable' sentences the same preference can be observed, be it less outspoken (72%). The difference in proportion is significant: there is a non-accidental association between the (relative) preference for the single fall and the predictability of the sentence ($\chi^2=8.0$, df= 1, p<.005). This means that in spite of the bias favoring contour ‘1&A’ there is still an effect in the predicted direction: ‘A’ is more acceptable on sentences containing predictable information than on sentences carrying spectacular information.

3.4 Conclusion and discussion

Question (i) — is contour ‘A’ unacceptable on sentences carrying new information? — can be answered affirmatively, whereas question (ii) — is contour ‘1&A’ unacceptable on sentences carrying predictable information? — must be answered negatively. There is a positive association between sentence type and contour type, but the effect is weak and only measurable in a pairwise comparison test. This means that the expected discrepancy between predictable information and the pointed hat is not borne out in an absolute sense; however, the results of part B bear out the basic viability of the meanings set up for ‘1&A’ and ‘A’.

Closer inspection of the data revealed that the overall preference for contour ‘1&A’ may be partly attributable to characteristics of the stimulus material. Firstly, the number of preferences for contour ‘A’ differs across the five ‘predictable’ sentences; the sentence performing most in accordance with the expectations (De butler zal het wel weer gedaan hebben), preferred with the single fall by more than 50% of the judges, expresses an expectation, a likely state of affairs. The other sentences describe actual situations (except for Mijn moeder gaat natuurlijk een appel taart bakken, but see below) and are probably more readily interpreted as carrying new information. Secondly, the only 'predictable' sentences that are judged acceptable (i.e., above scale position 4) with an ‘A’ contour are De butler zal het wel weer gedaan hebben (no. 6) and De kat heeft weer gekotst (no. 7). This effect is possibly related to the position of the accent in the stimulus sentence: the stretch of initial high declination is shortest for these two sentences, and it may be the case that longer stretches of high initial tone are less acceptable (e.g. Mijn moeder gaat natuurlijk een appel taart bakken, with high pitch up to ‘appel’).

In addition to the overall preference for contour ‘1&A’, the data reveal a clear effect of sentence type on the acceptability scores: ‘predictable’ sentences are
judged 0.6 point higher on average than ‘unpredictable’ sentences (cf. figure 1). This is not very surprising, since the ‘unpredictable’ sentences were built on the idea that they should contain rather spectacular information; however, it also means that subjects were not completely adhering to the instructions, viz. “judge the acceptability of this contour for this particular sentence”.

The foregoing indicates that a new experiment with revised materials and instructions might lead to cleaner results.

4. Experiment 2

4.1 Materials

The experiment was repeated with a revised set of stimulus sentences, with the pitch accent located on the second word:

‘unpredictable’ sentences
(1) Mijn AUto staat in brand.  
   my CAR is on fire  
   ‘My car is on fire.’
(2) De PAUS is net vermoord.  
   the POPE is just murdered  
   ‘The pope has just been murdered.’
(3) De BLIKsem is ingeslagen.  
   the LIGHTning is struck  
   ‘Lightning has struck.’
(4) De STROOM is uitgevallen.  
   the POwer is failed  
   ‘There is a power breakdown.’
(5) Mijn HUIS is ingestort.  
   my HOUSE is collapsed  
   ‘My house has collapsed.’
(6) Het SNEEUWT in Portugal.  
   it SNOWS in portugal  
   ‘It’s snowing in Portugal.’

‘predictable’ sentences
(7) De BUTler zal het wel weer gedaan hebben.  
   the BUTler shall it well again done have  
   ‘The butler must have done it.’
(8) De KAT heeft zeker weer gekotst.
the CAT has surely again thrown up
‘The cat has surely thrown up again.’

(9) Mijn AUTO zal wel weer niet starten.
my CAR shall well again not start
‘My car will probably not start.’

(10) Het Eten zal wel weer op zijn.
the FOOD shall well again finished be
‘The food will surely be finished again.’

(11) Het RENGent zeker weer.
it RAINS surely again
‘It’s raining, surely.’

(12) Tot MORgen allemaal.
until toMORrow all
‘See you all tomorrow.’

The ‘predictable’ sentences now all are hypotheticals, except for no. 12 (a farewell). The instructions were rewritten, in an attempt to clarify more adequately what should be evaluated by the subjects (judge the extent to which the intonation contour suits the verbal content of the utterance, rather than the suitability of the sentence as such). Apart from the instructions, the procedure was identical to the one used in experiment 1. This time 29 (unpaid) subjects participated.

4.2 Results

The results of the second acceptability rating test are presented in figure 3. The ‘unpredictable’ sentences with ‘A’ were now given a mean acceptability score of 2.72, whereas the same sentences with a ‘1&A’ contour received a score of 4.47; the ‘predictable’ sentences received a 4.36 with the accent-lending fall and 4.61 with a pointed hat. There is a significant effect of contour, $F(1, 693) = 67.7$, $p < .001$, of sentence type, $F(1, 693) = 86.5$, $p < .001$, and a significant interaction between both factors, $F(1, 691) = 48.4$, $p < .001$. For the ‘predictable’ sentences, figure 3 shows virtually no difference in acceptability between the sentences with a pointed hat contour and with fall ‘A’, whereas the ‘unpredictable’ sentences with ‘A’ are clearly unacceptable. A Newman-Keuls post-hoc analysis confirms that the ‘unpredictable’ sentences with a fall differ significantly from the other three groups of stimuli. This means that the overall effect of sentence type as found in experiment 1 (‘predictable’ sentences were judged as more acceptable than ‘unpredictable’ sentences) has vanished, presumably as a result of changing
the instructions. Furthermore, the overall preference for '1&A' has been reduced, probably as a consequence of the changes in the stimulus sentences.

The results of the pairwise comparison test can be found in Figure 4. The preference for the pointed hat contour on the 'unpredictable' sentences has risen to 98%, whereas the percentage of preferred 'A' contours for the 'predictable' sentences has risen to 33% ($\chi^2 = 57.2$, df= 1, $p<.001$). Inspection of the data reveals no conspicuous differences among the individual sentences within both

Figure 3. Acceptability scores per contour type, broken down by sentence type.

Figure 4. Percent preference for contour type, broken down by sentence type.
groups. The overall results closely resemble those of the first pairwise comparison test, except that the preference for the accent-lending fall ‘A’ has increased.

5. Conclusion and discussion

In the second experiment the predicted association between sentence type and contour is clearly stronger than in the first experiment, and measurable not only in a pairwise comparison test but also in an absolute rating test. We interpret these results as indicating that the ‘A’ contour is unacceptable on a sentence explicitly expressing new information; this provides support for Keijsper’s analysis. But again no incompatibility was found between the pointed hat contour and the sentences expressing predictable information: the pointed hat contour seems just as acceptable with both types of sentence.

According to Keijsper, ‘l&A’ carries the meaning of accent, and only in final position (i.e., when it is the last pitch accent in the utterance) is the semantic nuance new added to that basic meaning. Our results suggest that this is not always true and that a final pointed hat — in the ‘predictable’ sentences — may just mean accent. However, it may also be the case that the ‘predictable’ sentences can be interpreted as carrying new information, which indeed seems possible (e.g. you enter the front door and establish the fact that the cat has been sick, again).

In the more abstract treatment of (Dutch) intonation by Gussenhoven (1984, 1988, 1991) both contours consist of the basic H*L tone morpheme, with the abstract meaning of ‘addition’: “I add this information to the background”, which is close to Keijsper’s meaning for ‘l&A’. In Gussenhoven’s autosegmental terms, ‘l&A’ is a simple H*L tone with a (default) low onset. ‘A’, however, differs in two respects from ‘l&A’: the morpheme “downstep” has been added to the H*L tone, and it is preceded by a high onset. Grabe, Gussenhoven, Haan, Marsi and Post (1997, 1998) found that high onsets followed by H* accents and low onsets followed by L* accents were judged less favorable (less friendly, less polite, more aloof, and more irritated) than when high onsets were followed by low accents or low onsets by high accents. Furthermore, downstepped ‘A’ probably sounds more final (and less involved) than ‘l&A’ (cf. Swerts, Bouwhuis and Collier 1994, Rietveld and Gussenhoven 1995, Ladd 1996). This means that within the autosegmental approach to Dutch intonation, ‘l&A’ and ‘A’ share the same basic meaning of adding (new) information to the background, but ‘A’ may sound more final and less friendly than ‘l&A’. Assuming that it is not unusual for sentences containing predictable information to be
uttered on an irritated 'tone', this analysis would provide an alternative explanation for the finding that the 'A' contour is acceptable only on the 'predictable' sentences.

Summarizing, our experimental results indicate that the pointed hat contour is suitable for focussing unpredictable as well as predictable information, whereas the accent-lending fall is suitable only on sentences containing predictable information. The theoretical analyses of both Keijsper and Gussenhoven associate '1&A' with new information, which seems to contradict our findings. However, since even the 'predictable' sentences can be interpreted as carrying new information, both approaches can be reconciled with the acceptability of '1&A' on both types of sentence. Both analyses also provide an explanation for the more limited distribution of 'A', but the one offered by Keijsper seems simpler and intuitively more attractive. An experiment set up to evaluate the relative suitability of Keijsper's and Gussenhoven's solutions more formally is currently underway.

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Notes

1. Both 'addition' and 'selection' are terms borrowed from Gussenhoven (1984); however, there the meaning 'selection' — adopted by Gussenhoven from Brazil (1975) — is attached to the H* LH pitch accents (cf. '1&A2').
2. We owe this sentence type to Tina Cambier-Langeveld.
3. In addition to the difference in onset, the two melodic shapes differ with respect to the timing of the fall in the prominent syllable; in Gussenhoven's model the early fall 'A' is called "downstepped" (cf. Rietveld and Gussenhoven 1995). The use of the term 'downstepped' seems odd as a characterization of a pitch phenomenon that is essentially a matter of timing. Also, the downstepped H* L seems the normal, default choice for the fall of the very frequent 'flat hat' configuration (cf. Collier 1991). These considerations make Gussenhoven's transcription of the GDI 'A' less than obvious.
References


