

# Phonetics and Phonology of Contrast Marking in German: Issues for the Prosody–Semantics Interface

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## Abstract

Various researchers have proposed that contrastive topics in German are realised by a particular intonation contour (Wunderlich, 1991; Jacobs, 1997; Büring, 1997b). This particular intonation contour (which is shown in the lower part of figure 1) was originally discussed under the term “hat pattern” for Dutch (Cohen and t’Hart, 1967). We shall describe a production experiment here that was designed to elicit German utterances in contrastive and neutral contexts. We will argue that the difference between contrastive and neutral utterances is not based on distinctive intonation *contours* (i.e. hat pattern vs. not hat pattern) but that it manifests itself mostly in local, more subtle acoustic differences, such as the characteristics of the pitch rise, durational properties or the accent type of the second accent. Since different “types” of pitch rises (with different functions) have been proposed by some authors (Féry, 1993; Jacobs, 1997), we conducted an intersubjective prosodic annotation of some rising accents in our data. This revealed that in most cases there is no phonological difference between the rising accents in contrastive and neutral contexts, which poses problems for current proposals of a prosody–semantics interface.

## 1 Introduction

Broadly speaking, the semantic difference between a contrastive and a neutral realisation of an utterance is generally attributed to different overall intonation contours. The contour in neutral contexts often consists of one (high) accent on the focus exponent, and — in most cases — a less prominent accentual rise on the first constituent (as shown in the stylisation in the upper part of figure 1). Utterances produced in contrastive contexts (or with a contrastive

implicature), on the other hand, are often produced with two very prominent accents, a rising one and a falling one (see stylisation in the lower part of figure 1). In particular it is argued that the pitch remains high between the two accents, which has been termed *hat pattern* (Cohen and t’Hart, 1967)<sup>1</sup>. In section 2 we review the literature on hat patterns in more detail, both from a prosodic and a semantic point of view.

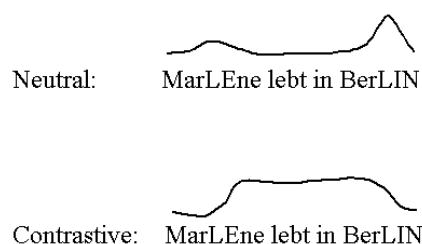


Figure 1: Stylisation of a neutral and contrastive realisation of the utterance “Marlene lebt in Berlin” (*‘Marlene is living in Berlin’*). Accent position is signalled by small capitals.

Since there are rather different views about both the actual realisation of hat patterns and their function, we performed a production study in German in which we compared the actual prosodic realisation of neutral utterances to those with a contrast in both theme and rheme (Braun and Ladd, 2003). We believe that empirical data is essential as most semantic theories so far almost solely rely on introspective accent categories (Vallduví and Engdahl, 1996; Steedman, 2000).

<sup>1</sup>Throughout this article, we shall term the first accent *thematic* and the second accent *rhematic*. The thematic part is usually said to link the utterance to the preceding context, while the rhematic part supplies new information (Steedman, 2000).

Finally, we discuss the implications of the present results for a proper definition of the prosody–semantics interface. In this context, we describe an experiment that investigated whether labellers consistently annotated the thematic accents produced in contrastive and neutral contexts with different autosegmental-metrical accent types or not.

## 2 Hat Patterns: Proposed Form and Function

The term hat pattern was initially used by Cohen and t'Hart (1967) to describe a contour that consisted of “an initial gradual fall-off, to be called declination; a steep rise, an upward shifted segment of declination line, a steep fall, and a final declination line” (p. 184). This contour was described as the basic intonation contour for Dutch. Meanwhile, there have been various notions for this particular pattern, with intonational descriptions as varied as the terms. The most commonly used terms in German articles are “Hutkontur” (*‘hat pattern’*), used e.g. by Mehlhorn (2001) and Steube (2001), “Brückenakzent” (*‘bridge accent’*), employed by Wunderlich (1991) and Büring (1997b), and “Wurzelkontour” (*‘root contour’*), originally used by Jacobs. A more functional notion found is “I-Topicalisation” (Jacobs, 1997), referring to the fact that certain constituents can only be topicalised to the preverbal field (German “Vorfeld”) if this is licensed by a particular intonational form (hence “I” for intonational).

Hat patterns in German have attracted the interest of both syntacticians and semanticists (Steube, 2001; Jacobs, 1982; Wunderlich, 1991; Krifka, 1993; Büring, 1997a; Büring, 1997b). Syntactically, the hat pattern licences otherwise ungrammatical word orders, including preverbal modal adverbials, resultive predicatives, directive adverbials, depictive predicates, predicatives, and infinitive verbal complements (Steube, 2001). Semanticists claim that scope relations may be inverted when an utterance is produced with a hat pattern, compared to a neutral realisation (Jacobs, 1982; Büring, 1997a; Krifka, 2001; Jacobs, 1997). This, however, only applies to utterances with two quantifiers or one quantifier and a negation particle; for further restrictions see Büring (1997a). Ex-

ample 1(a) shows the semantic interpretation of a neutral utterance (accented word in small capitals), example 1(b) shows the semantics of the same utterance produced with a hat pattern (bold face signals the thematic accent, i.e. the rise, small capitals signal the rhematic accent, i.e. the fall).

- (1) a) Alle **P**OLITIKER sind nicht korrupt.  
 $\forall x[\text{Politiker}(x) \rightarrow \neg \text{korrupt}(x)]$   
*‘All politicians are uncorrupt.’*
- b) **Alle** Politiker sind NICHT korrupt.  
 $\neg \forall x[\text{Politiker}(x) \rightarrow \text{korrupt}(x)] \equiv$   
 $\exists x[\text{Politiker}(x) \wedge \neg \text{korrupt}(x)]$   
*‘Not all politicians are corrupt.’*

In recent linguistic publications there have been proposals that the thematic (rising) accent has to fulfil certain prosodic constraints in order to license a contrastive topic accent. Jacobs (1997), e.g. discusses that it is not the pitch rise *per se* that signals a contrastive topic but rather the fact that the rise is preceded by a noticeable trough (which is why he prefers the notion *root contour*).

Féry (1993) distinguishes between two different kinds of hat patterns. *Hat pattern 1* (which she describes as instable) is signalled by a sequence of H\* and H\*L. The genuine hat pattern seems to be represented by what she calls *hat pattern 2* with a L\*H H\*L contour (p. 149ff). She discusses the problem that the difference between these two contours “is not always phonologically clear-cut.” (p. 151), which is probably the reason that she does not describe semantic differences between these contours.

Wunderlich (1988) describes the *bridge accents* in terms of the following tone sequence: H\* H L\*. The H tone without diacritics signals a floating tone, which is associated with all unspecified intervening syllables that are not associated otherwise. According to Wunderlich, the bridge accents can be used in a large variety of cases, such as broad focus, proverbs, alternative questions, lists, to signal different syntactic bracketing, syntactic extractions and gapping (see Wunderlich, p. 242f). He argues that all these cases exhibit some sort of contrast (in a particularly broad usage of the term) and further proposes a layer of contrast that constitutes the interface between a hierarchically organised

syntactic structure and a linearly organised intonational structure.

Prosodically, Kohler (1991a) acknowledges different forms of the hat pattern. They are described as combinations between “medial” and “late” peaks for the thematic accent and “early” and “medial” peaks for the rhematic one (these accents are roughly comparable to ToBI accents: early peak to (!)H+L\*, medial peak to H\*, and late peak to L+H\* and H\*, cf Grice et al. (in press)). Functionally, Kohler argues that “[t]he semantics of the most common ‘hat pattern’, viz ‘medial’ + ‘early’, referring to the picking up of a theme as the basis of a conversation of the obvious, makes this intonation contour ideally suited for matter-of-fact reading in German” (p. 328). Other phonetic realisations of the hat pattern mainly add a paralinguistic component (e.g. a “grain of opposition”).

We hope that this brief overview made clear that there is neither consensus about prosodic nor functional aspects of the hat pattern. There is some indication that the actual realisation of the thematic accent is important for interpretation (Jacobs, 1997; Féry, 1993) but there is hardly any detailed acoustic description concerning the differences between a rise in a hat pattern and a “normal” rise (some data is found in the study by Mehlhorn (2001), but her interest lay more in investigating the production and perception of hat patterns, so there is not much “neutral” data). Functionally, for one group of researchers the hat pattern signals contrastiveness, for another group of researchers it is a commonly used intonation pattern with a variety of functions.

Before we proceed to present the results of a production experiment in which we compared the actual prosodic realisation of identical utterances produced in contrastive and neutral contexts (section 4), we first want to make clear what concept we have in mind when we speak about *contrast*.

### 3 A Note on Contrast

Different researchers have rather different concepts associated with the term *contrast*: Semanticists usually interpret all accents as conveying contrastive information because one element is selected from (a possibly infinite number of) alternatives. This is reminiscent of the statement

of Bolinger (1961) that “in a broad sense, every semantic peak is contrastive” (p. 87). This view, however, confuses focus and contrast and e.g. fails to explain the pragmatic difference between utterances 2 and 3. The former presupposes<sup>2</sup> that Marcel proved something (which might additionally be interpreted as exclusive reference, i.e. that he proved nothing else), while such a presupposition is not directly available the utterance in 3. Since the object is focused in both utterances, the notion of contrast (that is different from focus) is necessary to distinguish the pragmatic difference between these utterances.

- (2) It was COMPLETENESS that Marcel proved.  
>> Marcel proved something
- (3) Marcel proved COMPLETENESS  
>>?? Marcel proved something

Phonologists, on the other hand, tend to use corrections to elicit contrast. There is evidence from certain languages, however, that corrections — with their meta-linguistic function — have the power to change the syntactic structure. The Catalan examples in 4 and 5 (taken from Vallduví and Engdahl (1996), p. 504) show that a syntactic structure that is possible in the correction in 4 is impossible in the question-answer context in 5<sup>3</sup>:

- (4) *Posarem* “EXTENSIÓ” *en aquesta*  
1p-fut-put extension in this  
*oració* (no “INTENSIÓ”)  
sentence (not intension)  
‘We’ll use “EXtension” in this sentence (not ‘INtension’).’
- (5) Q: Which term will we use in this sentence?  
A: \**Posarem* EXTENSIÓ *en aquesta oració*.

Because we cannot foresee what effects corrections have in English or German, we propose to investigate utterances with a double contrast instead (like ‘Anna loves the seaside but Marlene likes to go to the mountains’). Obviously, the two clauses need not be combined in one sentence but can be separated by intervening sentences/information. Similar criteria have been put forward by e.g. Prevost (1995) and Theune (1999).

<sup>2</sup>Following Levinson (1983), we use >> to signal presuppositions.

<sup>3</sup>A similar case is reported for Italian deaccentuation by Ladd (1996).

## 4 Production Data

Eleven subjects were recorded reading 52 short paragraphs (containing five to six utterances each). Some of the paragraphs contained “minimal pair” utterances, i.e. identical utterances in pragmatically distinct contexts (contrastive vs. neutral). The actual target utterances (and the respective contexts) were designed in such a way that the accents would be realised on the same words in both contexts. Contrastive contexts contained a proposition about an alternative item in the precontext while such an alternative item was absent in neutral contexts (for further details about the production experiment see Braun and Ladd (2003)).

We analysed 86 utterance pairs and compared the realisation of thematic and rhematic material in contrastive and neutral contexts. Thematic accents (which were entirely rising accents) were analysed in detail on an acoustic basis, including pitch values of the rise (minimum, maximum,  $f_0$ -excursion), duration of the rise as well as segmental duration. Rhematic accents, for which categorically distinct accent types have been established (Kohler, 1991b), were analysed on a phonological basis only.

A sample utterance pair is shown in figure 2 (neutral context on the left-hand side, contrastive context on the right-hand side). Themes in contrastive contexts were realised with a higher and later peak, and an increased duration of the prenuclear rise<sup>4</sup>. Contrary to expectation, there was no prosodic difference in the trough before the actual rise, which might be partly due to the difficulty of finding trustworthy pitch values in utterance-initial position. Furthermore, themes in contrastive contexts were realised significantly longer than those in neutral contexts. Interestingly, the duration of the whole utterance did not differ in the two context condition, which resulted in a shorter duration for rhematic contrast.

For the rhematic part, there was a difference in the distribution of accent types: In contrastive contexts, there were more low accents (H+L\*) than high ones (H\*). The overwhelming use of low accents (especially in contrastive contexts) might point to some weakened form of hat pattern, with a strong dip between thematic and rhematic accent. In non-contrastive

<sup>4</sup>Only significant differences are reported.

contexts, high and low accents were equally distributed.

There was thus a difference in encoding the textual contrast, depending on the information-structural category: Thematic contrast was realised more emphatically phonetically, which resulted in a more pronounced rise and an increased segmental duration. Rhematic contrast, however, was mainly encoded with a categorically distinct accent type (significantly more low than high accents), which probably made additional durational marking superfluous. Note, however, that low accents are generally interpreted to be less prominent than high accents (Kohler and Gartenberg, 1991). Since it is fairly counter-intuitive that rhematic contrast is realised in a less prominent way than neutral rhematic accents, we assume either that rhematic contrast is sufficiently signalled by a very prominent theme (hence stating that contrastive themes necessarily co-occur with contrastive rhemes, a view that is e.g. rejected by Steedman (2000) for English) or that rhematic contrast marking is achieved by a *combination* of a sufficiently prominent theme accent together with a low rheme accent.

Except for one speaker, the hat pattern was not rather frequent in our data. Our data therefore does not confirm the view that contrast is signalled by this particular intonation pattern. We rather found that the influence of the precontext on the actual realisations is more subtle. In the next section we describe an experiment to explore whether the differences in theme marking (i.e. the rising accent) is strong enough to be encoded using categorically distinct accent types or whether the rising accents in our data are instead continuously variable. This question is important because — at the current stage of prosody–semantics interfaces — a categorical difference is necessary.

## 5 Implications for the Prosody–Semantics Interface

In an exploratory experiment we asked linguists who regularly use GToBI<sup>5</sup> for prosodic analysis to annotate the prenuclear (thematic) accent of a subset of our data. Since GToBI accent types are categorically distinct *per definitionem*, this

<sup>5</sup>German Tone and Break Indices, see Grice et al. (in press).

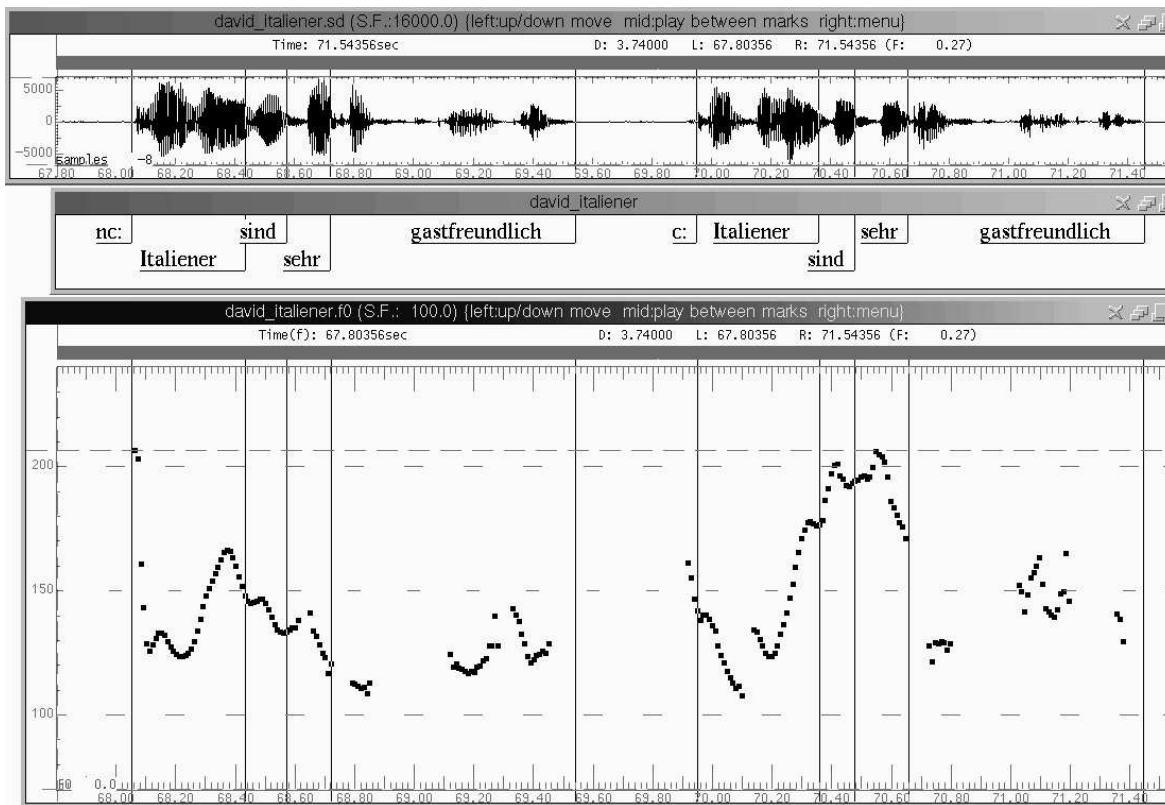


Figure 2: Sample utterance “Italiener sind sehr gastfreundlich” (“*Italians are very hospitable*”) produced in a neutral context (left-hand side) and in a contrastive context (right-hand side).

experiment should answer the question whether we can reasonably define a prosody–semantics interface on the basis of our data: If experts were able to label a major part of the data consistently, we could be confident in using information about pitch accent types for semantic theories. If, on the other hand, labelling turned out to be rather inconsistent, we should rethink the validity of the prosody–semantics interface, as currently defined.

From the 86 utterance pairs analysed, we selected ten whose realisations — and especially the realisations of the prenuclear accent — were audibly distinct. Although it is commonly believed that the rheme accent of a given utterance should not influence the labelling of the prenuclear accent, we only chose pairs with the same rheme accent in contrastive and neutral realisation. We decided on this preselection of material because we wanted to keep the test small and concise to attract as many labellers as possible. The annotators were individually contacted via email and asked to participate in an anonymous,

web-based labelling experiment. After starting the experiment, the prenuclear accents of the 20 stimuli had to be labelled in random order. Annotators were not explicitly pointed to the presence of utterance *pairs* but they nevertheless might have detected them. We decided against a pairwise presentation because subjects could have been inclined to mark the differences they perceived even if these differences would not exceed the threshold of categories, if presented in isolation.

Annotators were told that the experiment was meant to collect intersubjective labels of 20 prenuclear accents. They could listen to the whole utterance or to the preverbal constituent in isolation, with the option to play the parts as often as they wanted. They were given the choice between the three most probable accent types ( $H^*$ ,  $L+H^*$  and  $L^*+H$ ) as well as the category “other accent type” that they could specify in a special text field nearby. They were further asked to briefly justify their choice.

On average, in 58.6% of the cases both ver-

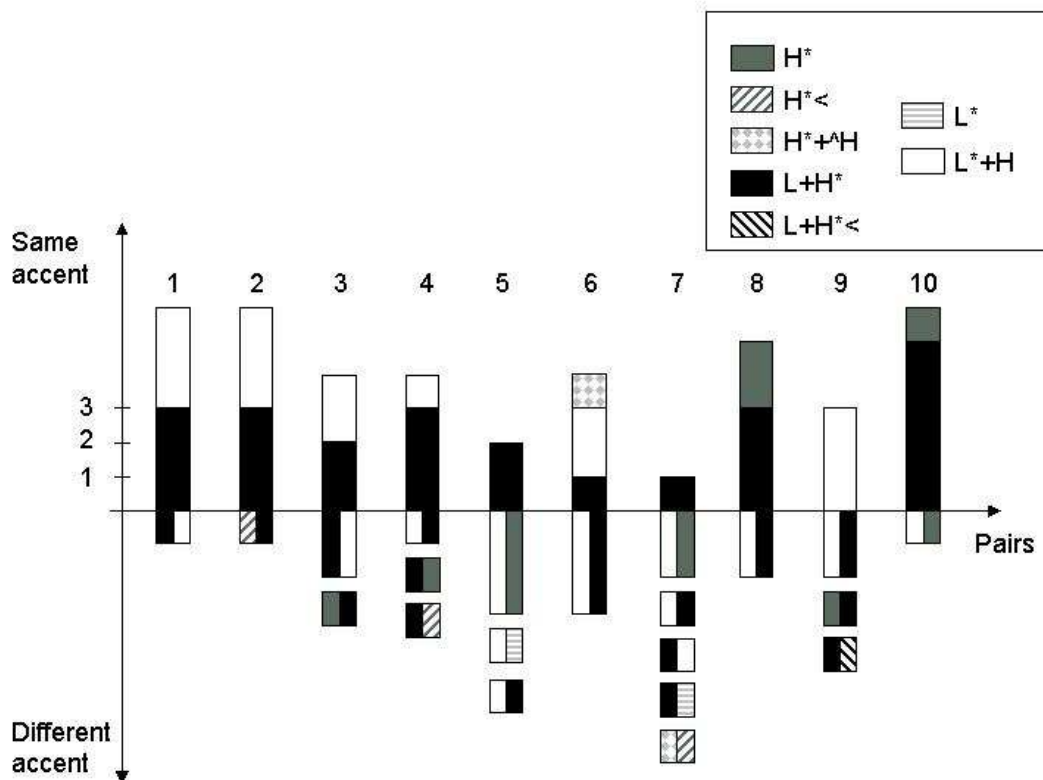


Figure 3: Graphical display of the results of the labelling experiment. The ten utterance pairs (identical utterances produced in contrastive and neutral contexts) are plotted on the x-axis. The height of the bars in the upper part of the chart corresponds to the number of experts that labelled both versions of the pair with the same accent type. The height of the bars in the lower part of the figure represent how often the two versions of the pair were annotated with *different* labels (left bar represents the realisation in non-contrastive context, right bar the realisation in contrastive context). Different “label-pairs” are separated vertically by small spaces.

sions of the pairs were annotated using the same accent type, whereas in the remaining cases, the two versions the pairs were labelled with different accent types. In figure 3, the size of the bars in the *upper part* of the figure corresponds to the number of experts that labelled the two versions of an utterance pair with the *same* accent type. Figure 3 shows that “same accent” does not necessarily mean intersubjectively identical. Rather, different experts used different intonational categories to express their percept. Even in the cases in which six out of seven subjects labelled both versions of an utterance pair with the same accent type (pairs 1, 2, and 10), there were two different opinions on the type of accent to assign, with a pronounced preference for L+H\* (23 ×) as opposed to L\*+H (14 ×), H\* (3 ×), and H\*+^H (1 ×).

The range of different accent types used in-

dicates that these accent categories (if they indeed constitute different categories) are not sufficiently well defined. It seems that labellers each have their own internal “representation” of the ToBI-categories used. These might still be categorically distinct from other accent types in their particular system but do definitely not fully coincide with the representation of other labellers. Among the criteria that labellers reported we found information about the slope of the rise (“Es besteht kein steiler Anstieg” as criterion for H\*),  $f_0$ -excursion (“Die Stimme überschlägt sich fast, so hoch geht der Sprung” for L+H\*). Furthermore, labellers used pre-suppositions about prenuclear accents (“Der F0-Gipfel wird zwar erst auf der Silbe ”no” [=post-stressed syllable] erreicht, aber das ist in pränukelearer Position normal” for H\*, “Ein tiefer Akzentton am Satzanfang scheint mir

ungewöhnlich” for  $H^* + \hat{H}$ ).

In the cases in which the two versions of a pair were assigned *different* accent types, there was one very common distinction that occurred 16 times:  $L+H^*$  vs.  $L^*+H$ . Furthermore, we found four other distinctions that were less preferred:  $6 \times L^*+H$  vs.  $H^*$ ,  $3 \times L+H^*$  vs.  $H^*$ ,  $2 \times L^*$  vs.  $L^*+H$  (by the same labeller) and  $3 \times$  various other distinctions involving diacritics, all from one labeller). This is visualised in the *lower part* of figure 3 where two neighbouring bars indicate the two accent categories assigned to each version of the utterance pair. The bars to the left represent the accents assigned to the neutral realisations, the bars to the right the accents for the contrastive ones. As before, the height of the bars corresponds the number of experts that labelled this distinction with the same distinct accent types. For better discriminability, the different “accent-pairings” are separated vertically by spaces.

Note that there are two utterance pairs, for which the majority of annotators assigned different accent types to the contrastive and neutral realisation (pairs 5 and 7). For these utterance pairs, the agreement in accent types used was particularly low. This indicates that the current definition of these autosegmental-metrical labels is inappropriate to capture human perception adequately. To find out to which acoustic differences labellers were most sensitive to, we correlated the number of labellers who annotated the two versions of an utterance pair with a different accent type with the some prosodic variables that describe the acoustic difference between the realisation in contrastive and neutral contexts (such as difference in peak alignment between contrastive and neutral realisation, peak height ratio between contrastive and neutral realisation and slope-ratio of the rise). Surprisingly, the only significant correlation found was between number of “same” labels and  $f_0$ -excursion-ratio ( $r=0.8$ ,  $p=0.005$ ,  $N=10$  using the conservative Spearman’s Rho). Labellers obviously were most sensitive to extreme  $f_0$ -excursions in the pitch rise, a fact that cannot be annotated with the standard GToBI system.

In sum, for the majority of data labelled, there was no categorical difference between the contrastive and neutral realisation. To factor

out that the realisations are not categorically different because of a poor reading performance, it will be necessary in the future to analyse more spontaneous data rather than read speech. There is some indication that for certain utterance pairs labelled there might exist a categorical distinction. The acoustic basis of this difference lies in the pitch excursion of the prenuclear rise, however. More research is important to decide whether  $f_0$ -excursion in prenuclear accents should be incorporated in a model of German intonation.

## 6 Discussion

The presence of a hat pattern was not a sufficient condition to signal contrast in our data. However, there is a higher proportion of low rheme accents in contrastive contexts, which indicates some kind of weak hat pattern. Further, we found that themes in contrastive contexts exhibit a longer duration with respect to the overall utterance duration, i.e. contrastive rhemes get shortened. In addition, contrastive themes have a higher  $f_0$ -excursion and a later peak, compared to neutral theme accents. But as the labelling experiment showed, most of these differences cannot be captured by current autosegmental-metrical accent types. Especially the  $f_0$ -excursion of the prenuclear rise and the peak height appear to be very important cues for listeners (see also perception experiments with naïve listeners, reported in Braun (2004)). It is still an open question, however, whether the vertical scaling of accents may convey linguistic information (Ladd, 1994) or whether it is merely gradually variable.

Further research is needed to find out whether there actually exists a categorical distinction between prenuclear accents in contrastive and neutral contexts which simply cannot be captured by present-day annotation schemes or whether we are rather dealing with a genuinely gradual variation. For solving the former problem we will have to explore further whether there is sufficient empirical basis for enriching the current model of German intonation to take pitch-excursion differences in prenuclear position into account. If the variation in thematic accent marking indeed proves to be gradual in the future, new proposals for the prosody–semantics interface will become necessary.

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## References

- Dwight L. Bolinger. 1961. Contrastive accent and contrastive stress. *Language*, 37:83–96.
- Bettina Braun and D. Robert Ladd. 2003. Prosodic correlates of contrastive and non-contrastive themes in German. In *Proc. of the 8th European Conf. on Speech Communication and Technology*, Geneva, Switzerland.
- Bettina Braun. 2004. Answers to the perception of thematic contrast and questions concerning the perception of thematic "non-contrast". In *Proc. of the 2nd International Conference on Speech Prosody*, pages 685–688, Nara, Japan.
- Daniel Büring. 1997a. The great scope inversion conspiracy. *Linguistics and Philosophy*, 20:175–194.
- Daniel Büring. 1997b. *The Meaning of Topic and Focus – the 5<sup>9</sup>th Street Bridge Accent*. Routledge, London.
- Antonie Cohen and Johan t'Hart. 1967. On the anatomy of intonation. *Lingua*, 19:177–192.
- Caroline Féry. 1993. *German Intonational Patterns*, volume 285 of *Linguistische Arbeiten*. Niemeyer, Tübingen.
- Martine Grice, Stefan Baumann, and Ralf Benz Müller. in press. German intonation in autosegmental-metrical phonology. In Sun-Ah Jun, editor, *Prosodic Typology*. Oxford University Press, Oxford.
- Joachim Jacobs. 1982. Neutraler und nicht-neutraler Satzakzent im Deutschen. In Theo Vennemann, editor, *Silben, Segmente, Akzente*, pages 141–169. Niemeyer, Tübingen.
- Joachim Jacobs. 1997. I-Topikalisierung. *Linguistische Berichte*, 108:91–133.
- Klaus J. Kohler and Robert Gartenberg. 1991. The perception of accents: F<sub>0</sub> peak height versus F<sub>0</sub> peak position. *Arbeitsberichte des Instituts für Phonetik der Universität Kiel (AIPUK)*, 25:219–242.
- Klaus J. Kohler. 1991a. A model of German intonation. *Arbeitsberichte des Instituts für Phonetik der Universität Kiel (AIPUK)*, 25:295–360.
- Klaus J. Kohler. 1991b. Terminal intonation patterns in single-accent utterances of German: Phonetics, phonology and semantics. *Arbeitsberichte des Instituts für Phonetik der Universität Kiel (AIPUK)*, 25:115–185.
- Manfred Krifka. 1993. Focus and presupposition in dynamic interpretation. *Journal of Semantics*, 10(4):269–300.
- Manfred Krifka. 2001. Scope inversion under the rise-fall contour in German. *Linguistic Inquiry*, 29(1):75–112.
- D. Robert Ladd. 1994. Constraints on the gradient variability of pitch range, or, Pitch level 4 lives! In Patricia A. Keating, editor, *Papers in Laboratory Phonology III. Phonological Structure and Phonetic form*, pages 43–63. Cambridge University Press, Cambridge.
- D. Robert Ladd. 1996. *Intonational Phonology*. Cambridge University Press, Cambridge.
- Stephen C. Levinson. 1983. *Pragmatics*. Cambridge University Press, Cambridge.
- Grit Mehlhorn. 2001. Produktion und Perzeption von Hutkonturen im Deutschen. *Linguistische Arbeitsberichte*, 77:31–57.
- Scott Prevost. 1995. *A Semantics of Contrast and Information Structure for Specifying Intonation in Spoken Language Generation*. Ph.D. thesis, University of Pennsylvania.
- Mark Steedman. 2000. Information structure and the syntax-phonology interface. *Linguistic Inquiry*, 31(4):649–689.
- Anita Steube. 2001. Grammatik und Pragmatik von Hutkonturen. *Linguistische Arbeitsberichte*, 77:7–29.
- Mariët Theune. 1999. Parallelism, coherence, and contrastive accent. In *Proc. of the 6th European Conference on Speech Communication and Technology*, volume 1, pages 555–558, Budapest, Hungary.
- Enric Vallduví and Elisabeth Engdahl. 1996. The linguistic realisation of information packaging. *Linguistics*, 34:459–519.
- Dieter Wunderlich. 1988. Der Ton macht die Melodie – Zur Phonologie der Intonation des Deutschen. In Hans Altmann, editor, *Intonationsforschungen*, Linguistische Arbeiten 200, pages 1–40. Niemeyer, Tübingen.
- Dieter Wunderlich. 1991. Intonation and contrast. *Journal of Semantics*, 8:239–251.