

# Language Dependence in Continuation Intonation

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## ABSTRACT

This paper describes two perceptual studies in which we investigated how British English and German differ in continuation intonation. Our investigation aimed to establish: (1) differences in the preferred pitch contour to signal continuation (Experiment 1); (2) differences in the perception of continuation signalled by a rising tone in general (Experiment 2). Our findings suggest that in addition to these two aspects, languages may differ in the way they exploit the phonetic space of H% to signal different degrees of need to keep the floor in dialogue.

## 1. INTRODUCTION

It has been observed for many languages that a high pitch or a rising tone is used at a clause boundary and/or a sentence-boundary to signal speakers' intention to continue or to hold the speaking turns in dialogue. The high pitch or the rising tone here, also referred to as final rise, can be described as a high boundary tone (H%) in the autosegmental metrical tradition and is part of the intonational lexicon of a language. One account of this widespread form-function relation between H% and continuation is that it is the grammaticalisation of the universal intonational meaning deriving from Gussenhoven's Production Code. The Production Code was proposed as part of his physiologically motivated theory on paralinguistic universal intonational meaning. It is based on the fact that "the generation of energy is tied to the exhalation phase of the breathing process and hence becomes available in phases... [t]his code associates high pitch with the beginnings of utterances and low pitch with the ends" [1]. Although evidence for the commonplace grammaticalisation of the pattern 'high continuation' deriving from the Production Code mainly comes from studies of languages like Dutch, English, French, German and Spanish, this by no means implies that all studies on continuation intonation in these languages have arrived at the same conclusion for each language. More specifically, two cross-linguistic studies, [2] and [3] have put forward a view on the preferred continuation intonation in English, which is radically different from claims made in other studies on this issue.

Taking evidence for and against the grammaticalisation of 'high continuation' in English as the starting point, this paper attempts to address the question how languages, in particular intonation languages, can differ in continuation intonation, by comparing the continuation intonation of English, in particular British English (BrE) to that of German, a representative of the group of languages on

which no disagreement of the kind found for English has appeared in literature, from the perspective of speech perception.

### 1.1 'Low continuation' in English

In a corpus-based study on prosodic features of English, German, Spanish and French, [2] claimed that although finality was indicated by a falling contour in all the four languages, continuation was mainly signalled by a falling contour in English but by a rising contour in the other three languages. Assuming that Delattre's falling contour and rising contour are comparable to the falling contour described as H\* L L% and the rising contour described as L\*H H% and H\* H% respectively, his findings can be interpreted as evidence against grammaticalisation of 'high continuation' in English. This difference in continuation intonation between English on the one hand and German plus French on the other hand was confirmed by [3] in their study on the role of intonation in foreign accent. In order to find out how continuation was signalled in the native languages of their L2 learners, including English, German and French, Grover et al. measured the slope covering the word before the conjunct in each of the sentences with coordinating phrases or coordinating clauses read by native speakers of each of the three languages. The slope was obtained by dividing the maximum F0 change in the word before the conjunct by the time over which the change took place. They found that by and large the slopes were positive in German and French but negative in English. Assuming that a positive slope suggested a rising contour and a negative slope a falling contour, Grover et al. concluded that continuation was indicated by a falling contour in English and a rising contour in German and French.

### 1.2 Accounting for disparity

Regarding continuation intonation in English, previous studies have come to completely opposite conclusions on the role of final rises. Where does this disparity come from? We considered two possible reasons: (1) different studies are concerned with different types of continuation; (2) methodological inaccuracy in some studies. Regarding type of continuation, in terms of sentence structure, continuation can be signalled both at clause-boundaries - for example, *John liked watching TV, but seldom went to see a film-* and at sentence-boundaries - for example, *John liked watching TV. He found it more relaxing than reading a book.* We refer to the former as sentence-internal continuation and the latter as sentence-final continuation.

Although [2] and [3] examined sentence-internal

continuation, other studies we have reviewed are concerned with either sentence-internal continuation or sentence-final continuation and yet come to the agreement that final rises are used to signal continuation in English. We therefore reject reason (1) as a plausible account. When we took a close look at how Delattre processed information from his corpus and how Grover et al. dealt with some methodological issues, their conclusion on the English continuation pitch contour proved to be terminologically misleading in the former case and methodologically poorly supported in the latter case.

In [2], a difference was made between major continuation and minor continuation. Major continuation occurred at boundaries of major sentence constituents, minor continuation at boundaries of sentence constituents within a major sentence constituent. In German (Spanish and French), major continuation is said to "rise more frequently" and have "a higher, steeper rise" than minor continuation. In English, major continuation is said to have "a more pronounced fall" followed by "a larger proportion of rising...at the end". This implies that when generalising continuation intonation in English, Delattre seems to have left the rising part of the contour out of consideration. In fact, his falling contour can be more accurately described as a fall-rise contour (H\*L H%). Hence, contrary to what his conclusion may have led to us to believe at first sight, in all three languages H% is most frequently used to signal continuation. The difference between English on the one hand and German, French and Spanish on the other hand in Delattre's data can therefore be better interpreted as a difference in the pre-boundary tonal specification, i.e. the pre-boundary pitch accent.

In [3], the slope was used to decide whether a contour was a falling contour or a rising contour. The slope value was obtained by dividing the maximum F0 change by the time the F0 change took. A problem with this measurement is that it may ignore the rise at the end of a fall-rise contour as the minimum F0 occurred right before the final rise. Furthermore, even if the F0 value of the final rise was taken as the minimum F0, the contour could still be counted as a fall because of the assumption that a positive slope indicated a rising contour and a negative slope a falling contour. These drawbacks in the measurement and the assumption make us question how reliable Grover et al.'s conclusion is that English has a falling continuation intonation contour.

As will have become clear now, there is no sound evidence about the absence of the grammaticalisation of 'high continuation' in English. The difference between English and other intonation languages, such as German and French, seem to be located in the pre-boundary tonal specification. In utterances with one pitch accent, the difference is then in the pitch accent. We therefore hypothesise that BrE and German both employ H% to indicate continuation but differ in the pre-boundary pitch accent. More specifically, the preferred continuation pitch contour is expected to be H\*L H% in English but L\*H H% or H\* H% in German. We refer to this as **Hypothesis 1**. This hypothesis is fed by [4] for BrE and indirectly by [5] for German.

### 1.3 Perception of continuation signalled by rising tones

If there is a difference in the preferred continuation pitch

contour between English and German, the question arises as to what effects this difference may have on the perception of continuation as signalled by a rising tone in general. As the H% in H\*L H% is a rising tone initiating from the preceding low tone, a strong preference for H\*L H% may lead to a bias towards lower pitch values for H%. By contrast, the H% in the H\* H% and L\*H H% is a continuation or an extension of the preceding high tone, a strong preference for H\* H% or L\*H H% may therefore lead to a bias towards higher pitch values for H%. As a result of these biases, when asked to judge how likely an utterance is to be followed by at least another utterance in an unknown language, for a given rising tone English listeners would assign a higher degree of likelihood of continuation than German listeners.

Preliminary production studies suggest that BrE has a much wider standard pitch range than German (Ineke Mennen, pc). If the difference in the standard pitch range were in effect, we would expect that for a given rising tone, German speakers assigned a higher degree of likelihood of continuation than BrE listeners. However, previous studies (e.g. [6]) have shown that when both the standard pitch range and another linguistically motivated factor may affect the perception of intonational meaning, the effects of standard pitch range appear to be suppressed.

We therefore hypothesise that in the perception of continuation as signalled by a rising tone, at identical offset pitch heights of the rising tone BrE listeners will perceive a higher degree of likelihood of continuation than German listeners. Furthermore, BrE listeners will distinguish a bigger difference in the degree of likelihood between the lowest pitch height and the highest pitch height than German listeners. We refer to these as **Hypothesis 2**.

Section 2 and section 3 describe the two perceptual studies testing Hypothesis 1 and Hypothesis 2 respectively. Methodology will be dealt with only briefly and selected findings will be discussed; for detail see <http://www.let.kun.nl/english/chen.php>.

## 2. Experiment 1: testing Hypothesis 1

### 2.1 Stimuli

Since type of continuation and position where pitch accent is realised may affect the choice of pitch contour, we designed four complex sentences with coordinating structures and four sequences of two simple sentences, exemplifying the two types of continuation: sentence-internal continuation and sentence-final continuation. These accommodated the two positions for pitch accent: final vs. non-final. Natural productions of these eight utterances in each language served as the source utterances for the stimuli. They were read by a male speaker speaking native-sounding BrE and German. Speech manipulation was performed with the help of Praat [<http://fonsg3.let.uva.nl/praat/>].

The first unit of each utterance was assigned each of three pitch contours, H\*H%, H\*L H% and L\*H H%, as illustrated in Figure 1.

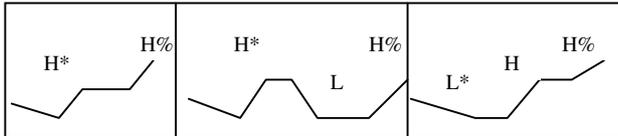


Figure 1. Stylised contours for H\* H%, H\* L H% and L\* H H%

These contours were realised with a fixed set of pitch values and pitch alignments. Some natural variation in the realisation of H% of the first unit were created by including two end pitch values for the H% of each of the three pitch contours. As boundary depth is not necessarily marked by a pause, the pause between the first unit and the second unit for each source utterance was normalised to 120ms. The second unit of each utterance was assigned the contour %L H\*L H%. Declination was taken into account by assigning the %L a lower pitch value than that of the first unit and the H\* a lower value than that of the first unit.

We then paired the six variations of each source utterance with each other in both AB and BA orders. A 1000ms pause was inserted between the two utterances in each pair. This gave us 120 pairs of utterances, representing six contour pairs in AB order and another 120 pairs representing the six contour pairs in BA order. In the six contour pairs in both AB and BA orders, three pairs involved comparisons of identical contours differing only in the pitch height of the boundary tone.

## 2.2 Procedure

Thirty-two native speakers of BrE and eighteen native speakers of German took part in the experiment. Subjects listened to the stimuli in their native language through loudspeakers in a quiet room and were asked to judge for each utterance pair which utterance of the two sounded better in terms of how the connection between the two units of each utterance was made intonationally and how much better it sounded on a 7-point scale (-3, -2, -1, 0, 1, 2, 3). Point 0 means no preference. Points -1, -2, and -3 represented increasing degrees of preference for utterance 1 and points 1, 2, and 3 increasing degrees of preference for utterance 2. Subjects were told in advance that the experiment was about what was the most appropriate intonation to signal continuation.

## 2.3. Statistical analysis and results

A data set was obtained from the raw data by excluding data of subjects using a 'second utterance is better' strategy throughout the test as well as data of utterance pairs representing a comparison between the two variations of the same contour. This data set was then encoded such that each negative score was counted as one preference judgement for the first utterance in each pair and each positive score one preference judgement for the second utterance in each pair. This gave us a new data set with the frequencies of preference judgements for each contour pooled over all comparing contexts made by an equal number of subjects in these two languages. Subsequently, an ANOVA was performed on this data set with frequencies of preference judgements as the dependent variable. It comprised two within-subject factors, Pitch Contour (3 levels) and Continuation type (2 levels) and one between-subject factor Language (2 levels).

The three-way interaction Language  $\times$  Continuation type  $\times$  Pitch Contour ( $F_{2,156}=4.74$ ,  $p<0.01$ ) was found to be significant. It shows that for sentence-internal

continuation, BrE prefers H\* L H% (H\*L H%-68, H\* H%-32, L\*H H%-25, per cent), while German prefers L\* H H%, though not as much as we expected (L\*H H%-43, H\* H%-41, H\*L H%-40 per cent). Interestingly enough, for sentence-final continuation, both BrE and German prefer H\*L H%, as shown in Figure 2. Hence, our hypothesis on the preferred continuation pitch contour in BrE is borne out, but our hypothesis that the L\*H H% and/or the H\* H% would be the preferred continuation pitch contour(s) in German is moderately supported regarding the sentence-internal continuation only.

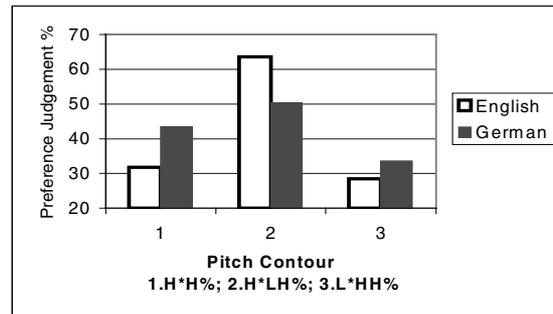


Figure 2. Preference judgements for contours signalling sentence-final continuation

## 3. Experiment 2: testing Hypothesis 2

### 3.1 Stimuli

Eight utterances were selected from the CVCVCV utterances with a sonorant for the second V designed for [7]. Natural productions of these eight utterances served as the source utterances of the stimuli. There were read by the same speaker as in Experiment 1. Speech manipulation was performed by means of Praat. For each utterance, a rising tone with tonal quality comparable to Tone 2 in Mandarin Chinese was assigned to each of the three syllables. The rising tone started at the CV boundary and continued till the end of the vowel. The onset pitch value of the rising tone was 80 Hz and the offset pitch value was 100 Hz. The offset pitch value of the utterance final rising tone was varied from 100 Hz to 180Hz in 20 Hz steps. This gave us 40 experimental stimuli. Another 40 utterances were generated and served as the fillers.

### 3.2 Procedure

The stimuli were presented to both groups of listeners as taken from Miao, a language spoken on an island of the Chinese coast, which method was earlier used in [7]. A learning session was given prior to the experiment to give subjects the idea that continuation was signalled by a final rise in Miao. In the experimental session, subjects judged how likely each stimulus was spoken as the first utterance of a sequence of two and recorded their judgements for each stimulus on a 100mm scale.

### 3.3 Statistical analysis and results

In order to make inferences about the findings of Experiment 2 from those of Experiment 1, only data obtained from the listeners whose data were included into the analysis of Experiment 1 were included into the analysis here. An ANOVA was performed on the data with the likelihood score as the dependent variable. The analysis comprised one within-subject factor, Pitch Height of the utterance-final rising tone (5 levels) and one between-subject factor Language Background (2 levels).

The two-way interaction of Pitch Height  $\times$  Language Background ( $F_{4,1322}=23.68$ ,  $p<0.001$ ) was found to be significant. It shows that although in both BrE and German, by and large, the higher the end pitch, the higher the degree of likelihood for the utterance to be spoken as the first one of a sequence of two utterances, BrE data differ from German data in two ways. First, BrE listeners distinguished a much larger meaning difference between the lowest and the highest pitch heights than German listeners. Second, towards the higher end of the pitch height continuum, at identical pitch heights, a higher degree of likelihood was perceived in BrE than in German, as shown in Figure 3.

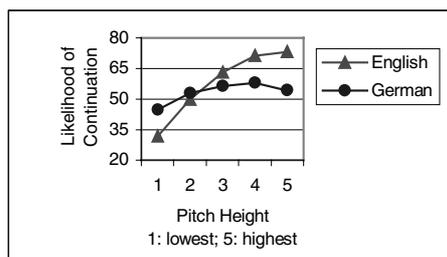


Figure 3. The interaction of Pitch Height  $\times$  Language Background

#### 4. DISCUSSION

Although the findings of Experiment 2 conform to Hypothesis 2, they cannot be accounted for along the line of the reasoning underlying it. We predicted the differences between BrE and German of the kind as found here because we expected a bias towards lower end pitch values in BrE listeners and a bias towards higher end pitch values in German listeners as a result of their preferred continuation pitch contour. Experiment 1 does not lend strong support to the prediction that German prefers L\*H H% and H\* H% to H\*L H%. Pooling the results over Continuation Type, we have found that H\*L H% appears to be the preferred contour in both German and BrE. Hence, the predicted biases might not apply utterance-finally. Instead, we suggest that the differences between German and BrE listeners found in Experiment 2 may be because German listeners are not very keen on exploiting the phonetic space of H% to signal different degrees of continuation in German. By contrast, BrE listeners do exploit the phonetic space of H% to signal different degrees of continuation, just as much as they exploit the phonetic space of L% to signal different degrees of finality [8]. The exploitation of the phonetic space of the high boundary tone to signal different degrees of continuation may serve as a very useful strategy in dialogue, where one can use a higher H% to indicate a stronger need of keeping the speaking turn. Possibly German speakers do not employ this strategy to such an extent as BrE speakers do.

#### 5. CONCLUSIONS

By examining continuation intonation in BrE and German, we have demonstrated how languages, in particular intonation languages, can differ in continuation intonation. Two aspects have been identified in which languages can differ: (1) the preferred continuation pitch contour(s); (2)

the perception of continuation as signalled by a rising tone. Regarding (1), while the grammaticalisation of 'high continuation' may be present in both languages, the two languages can differ in the pitch accent of the preferred continuation contour. In the case of BrE and German, German prefers L\*H H% for sentence-internal continuation but H\*L H% for sentence-final continuation, while BrE prefers H\*L H% for both types of continuation. Regarding (2), languages can differ in 'strengths' of the perceived 'high continuation'. This is manifested in differences in the perceived likelihood for continuation between the lowest and the highest end pitch values as well as at identical end pitch values. The language-dependence in (2), in the case of BrE and German, cannot be accounted for by the difference in the preferred continuation contour, as we initially believed. We have therefore suggested another explanation for these differences. That is, German speakers may be less inclined to exploit the phonetic space of the high boundary tone to indicate different degrees of continuation than BrE speakers. Future research on to what extent speakers of German and speakers of BrE increase the height of the high boundary tone to signal a stronger need to keep the floor in dialogue will contribute to a thorough understanding on the findings in Experiment 2. This itself can be a third aspect in which languages can differ.

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