

# **An analysis of pitch and duration in material used to test L2 processing of words.\***

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The material reported on in this paper is part of a set of experiments in which the role of Information Structure on L2 processing of words is tested. Pitch and duration of 4 sets of experimental material in German and English are measured and analyzed in this paper. The well-known finding that accent boosts duration and pitch is confirmed. Syntactic and lexical means of marking focus, however, do not give the duration and the pitch of a word an extra boost.

*Keywords: Duration, Pitch*

## **1 Introduction**

Focus marked by accent has been shown to speed up processing in a native language (see Cutler et al. (1997) for an overview). It has not yet been investigated whether such an effect is also found in processing a non-native language and whether other means of marking focus have the same effect. To this end we have conducted a number of experiments (Sennema et al., 2005). We have designed material in English and German to investigate this question. The experimental material used to investigate this question has been subjected to a measurement of pitch and duration.

This material is being used to test the hypothesis that Information Structure plays a role in L2 processing independent of focus. It is therefore necessary to know exactly what the phonetic properties of pitch and accent in our material are. This paper is a report on the phonetic properties of our material. Both pitch

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\* Shravan Vasishth's suggestions improved the graphical presentation of the statistics in this paper. Frank Kügler has provided many useful comments.

and duration are boosted by accent, as expected (Kügler et al., 2003; Kügler & Féry, prep), but the size of the boost is not influenced by structural markers of focus, such as clefts or lexical markers.

This paper is not intended as an analysis of focus and its markers in German and English: There is only one speaker per experimental set, which makes a generalization to the German or English population impossible. Moreover, the material has been controlled for prosodically, but not segmentally.

It is nevertheless important to know the phonetic properties of the material of any auditory linguistic experiment, since (sorry for stating the obvious) they are a factor in the experiment.

This paper is organized as follows: First the material is briefly described, the analysis is presented, which is summarized in the conclusions.

## **2 Material**

There are three sets of experimental material. In the first set the target word is prosodically marked for focus, by means of an accent. There is only an English version of this material (2.1).

The second set consists of material in which the target word is syntactically marked for focus. The target word is in a clefted constituent. There is an English and a German version (2.2).

The third set, finally, consists of material in which the target word is in the scope of a lexical marker for focus. There is an English and a German version (2.3).

The measurements were done with *Praat* (and its algorithms), and pitch measured in the range between 75 and 350 Hz (Boersma & Weenink, 2006). All pitch values were measured in Hz and then transformed to ERB values.

In all sets the duration, the lowest and the highest pitch of the first and the second syllable of the target word have been measured. The pitch values have

been converted from Hz to ERB.<sup>1</sup>

## 2.1 Prosodic means of marking focus

This material was read by a female native speaker of American English. The material consisted of question–answer pairs. In the answer either the target, a bird name, was accented or an adjective preceding the target. This accent was induced by the preceding question.

### (1) *Prosodic marking of focus*

- a. What noisy animal did some rude children blame the ruckus on?  
Some rude children blamed the noisy GAPPET for the ruckus.
- b. What kind of gappet did some rude children blame the ruckus on?  
Some rude children blamed the NOISY gappet for the ruckus.

There were 40 such pairs. Only the analyses of the answer sentences are presented here, since these were the sentences used in the experiment. This study was used as a pilot to test whether the phoneme monitoring paradigm was suited for our purposes and therefore we only recorded an English version. For all other experiments there are always two versions, an English version and a German version (see Sennema, prep).

## 2.2 Syntactic means of marking focus

In the next set of experiments the target word appeared either in a cleft structure or in a default declarative sentence. The target was again accented itself, or preceded by an accented adjective. The English sentences were read by a male

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<sup>1</sup> Equivalent Rectangular Bandwidth:  
 $ERB = 16.6 * \log(1 + \frac{Hz}{165.4})$  (Traunmüller, 1990)

native speaker of British English; the German sentences were read by a male native speaker of German.

(2) *Syntactic marking of focus (English)*

- a. It's the stale GANNET that is suffering from city development.
- b. It's the STALE gannet that is suffering from city development.

(3) *Syntactic marking of focus (German)*

- a. Es ist der faule KABU, der stundenlang auf einem Fuß steht.
- b. Es ist der FAULE Kabu, der stundenlang auf einem Fuß steht.

### 2.3 Lexical means of marking focus

The target word in this set is within the scope of a lexical marker of focus (*even* or *only* in the English version). This experiment is in its preparatory stage and only the English material was available for analysis.

(4) *Lexical means of marking focus* What kind of animal did an ill lawyer move onto the sidewalk?

- a. An ill lawyer moved a RUTHLESS ganta onto the sidewalk.
- b. An ill lawyer moved only a RUTHLESS ganta onto the sidewalk.  
What ruthless animal did an ill lawyer move onto the sidewalk?
- c. An ill lawyer moved a ruthless GANTA onto the sidewalk.
- d. An ill lawyer moved only a ruthless GANTA onto the sidewalk.

## 3 Analysis of Duration and Pitch

We have measured pitch and duration of the first and the second syllable of the target word, in all conditions.

### 3.1 Prosodic marking of focus

In figure 1 (page 214) the differences of duration, lowest pitch and highest pitch between the 2 syllables of the accented and unaccented target words are shown. All differences are statistically significant, but the pitch differences in the unaccented syllables are less pronounced.

The unaccented target words were preceded by accented adjectives and were therefore in a focused constituent. This means that being in a focused constituent does not result in boosted prosody.

In figure 1 (page 214) there are three rows. In the first one the barplots of the duration measurements are presented, in the second one the measurements of the minimum pitch and in the third one the measurements of the maximum pitch are presented. In each row there are four barplots. The two leftmost barplots represent measurements of the accented syllables, a stressed one (the first) and an unstressed one (the second) and the rightmost two barplots represent measurements of unaccented syllables, again the stressed one before the unstressed one.

### 3.2 Cleft

In both data sets it will be shown that accent boosts prosody of the target words, but not cleft. The prosody of a word depends on its accentual status and not on its membership in a clefted or non-clefted constituent.

#### 3.2.1 English

Figure 2 (page 215), shows that the mean duration of the accented syllables is higher than the unaccented syllables. There is no such differences between target syllables in clefts and in non-clefts.

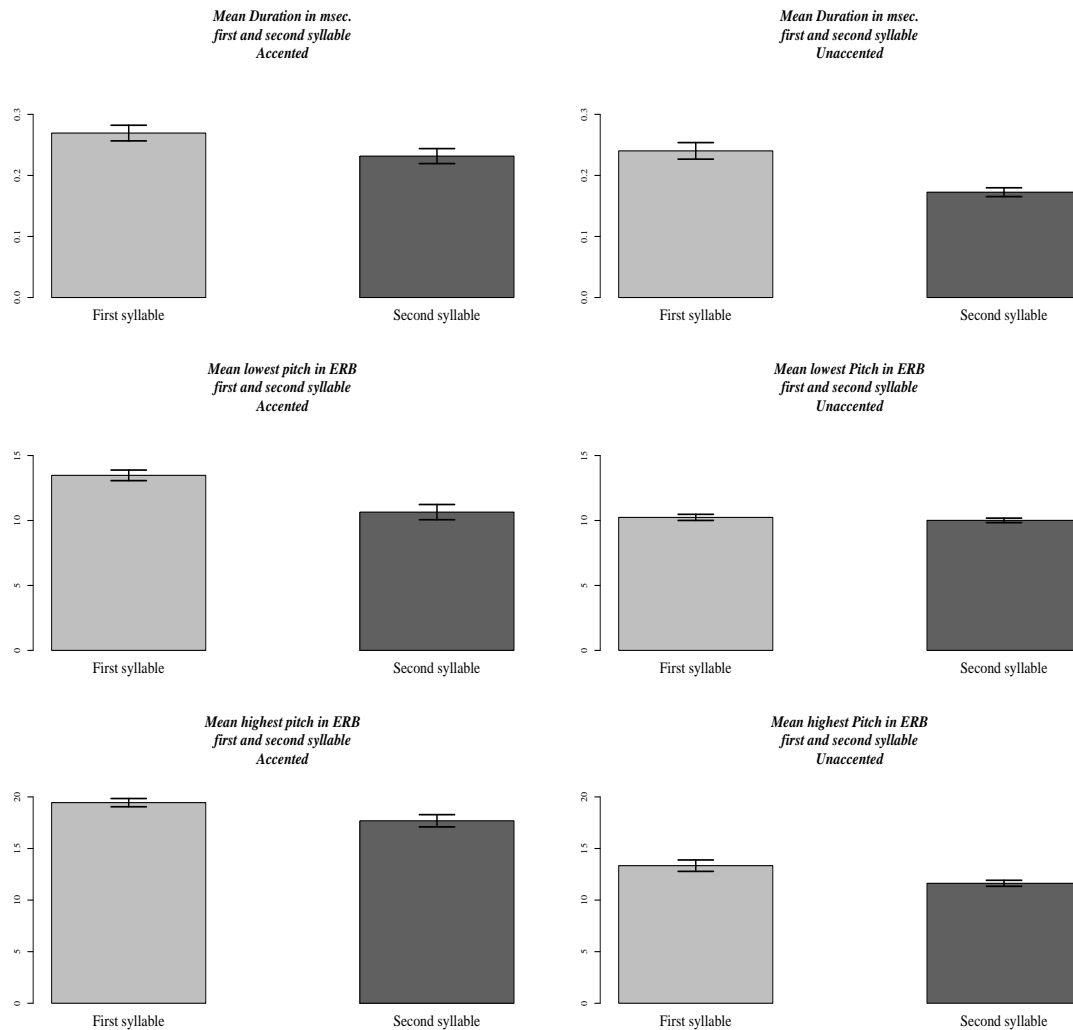


Figure 1: Prosodic marking of focus

Figure 3 (page 216) shows that pitch in accented syllables is higher than pitch in unaccented syllables. There is no consistent difference between syllables in clefts and in non-clefts.

### 3.2.2 German

The differences in duration in German are not significant. The means in figure 4 (page 217) suggest that neither accent nor cleft make a big difference. A likely explanation is final lengthening. Since the target words are always phrase final

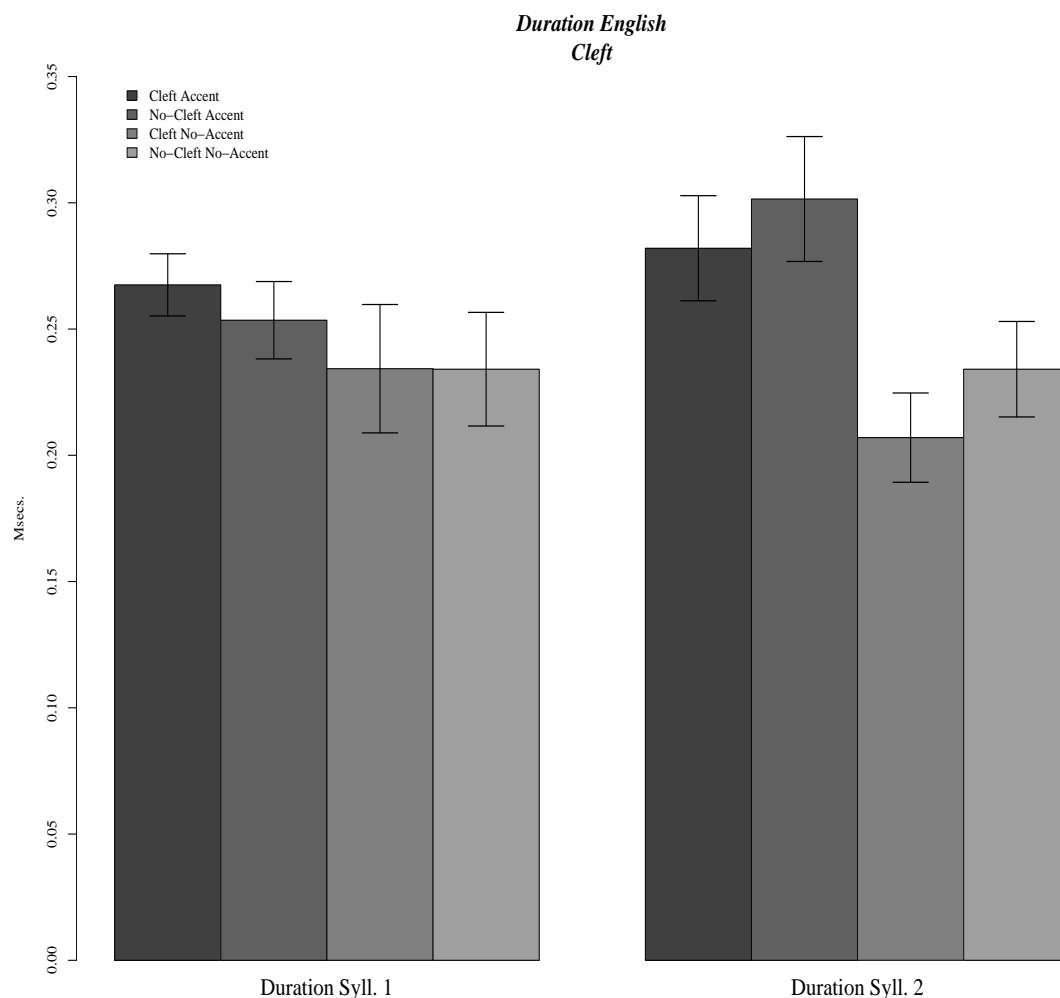


Figure 2: Duration in English clefts and non-clefts

and final syllables of phrases are always lengthened, they are likely to be lengthened. This counterbalances the lengthening due to accent. Either the lengthening due to accent is not as pronounced as in English, or final lengthening is language specific (Cambier-Langeveld, 2000).

The differences in pitch are not statistically significant among the conditions. Apart from a difference between the first (stressed) and the second syllable (unstressed), there is no difference between accented and unaccented syllables, and clefted and non-clefted syllables. This is shown in figure 5 on page 218.

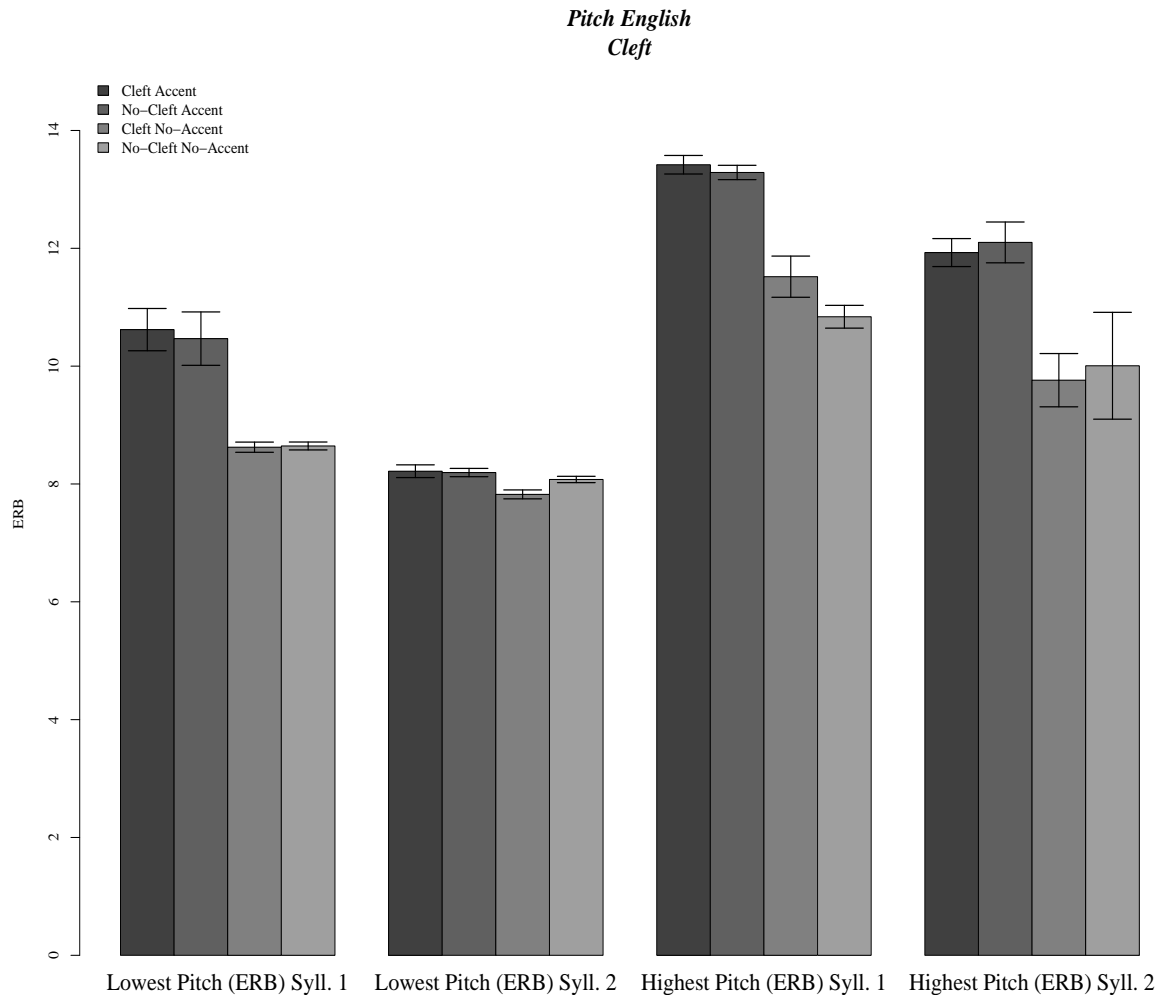


Figure 3: Pitch in English clefts and non-clefts

### 3.3 Particles

There are no differences between the conditions (see figure 6 on page 219). Apart from a difference between the first (stressed) syllable and the second (unstressed) syllable, there is no difference between accented or unaccented syllables or between syllables that are in the scope of a lexical focus marker and those that are not.

There are clear differences between the mean pitch of accented syllables, but



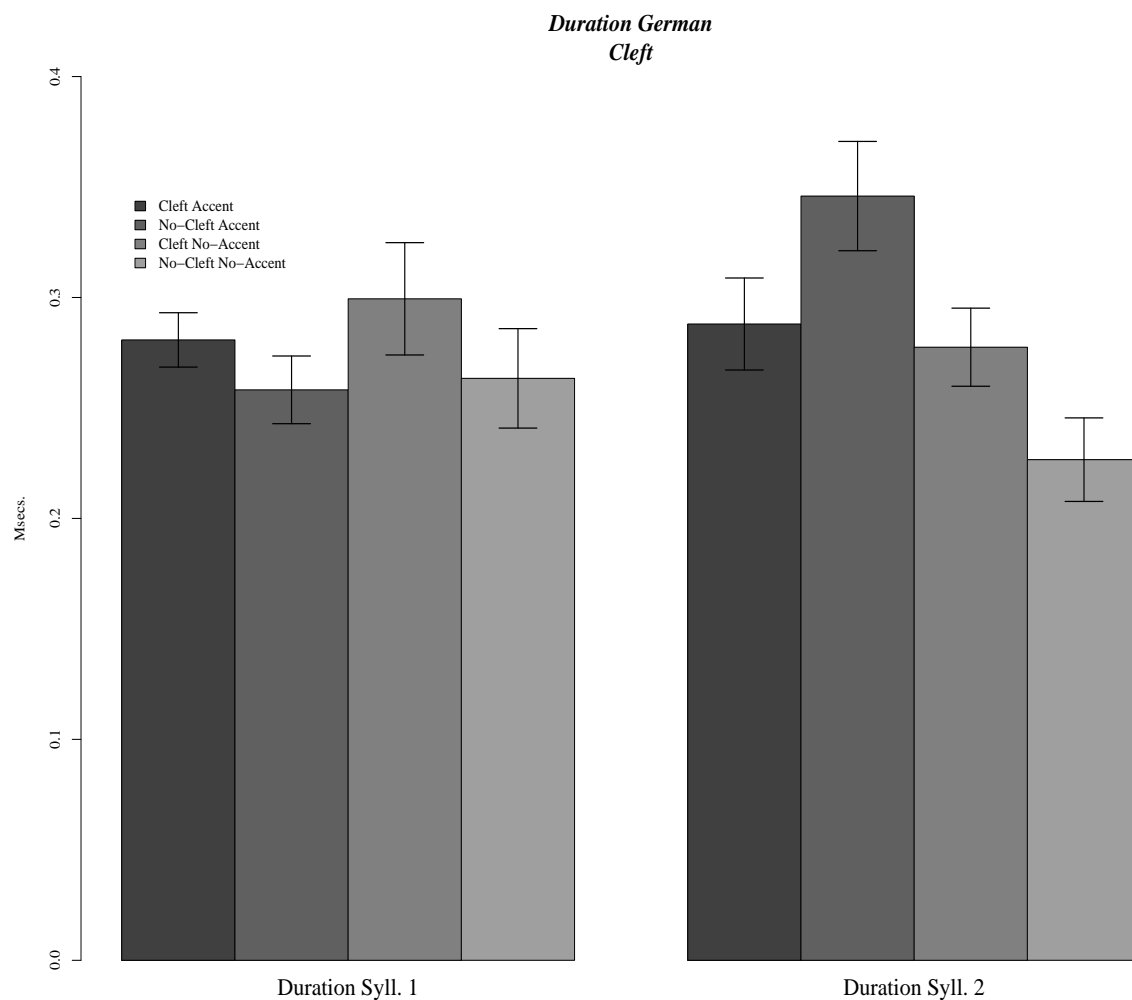


Figure 4: Duration in German clefts and non-clefts

there are no consistent differences between syllables that are within the scope of a lexical marker of focus and those that are not (see figure 7 on page 220).

#### 4 Conclusion

In this paper, we reported on measurements of duration and pitch of target words of three sets of our experimental material. We wanted to investigate whether non-prosodic ways of marking focus (syntactic and lexical) had an effect on the

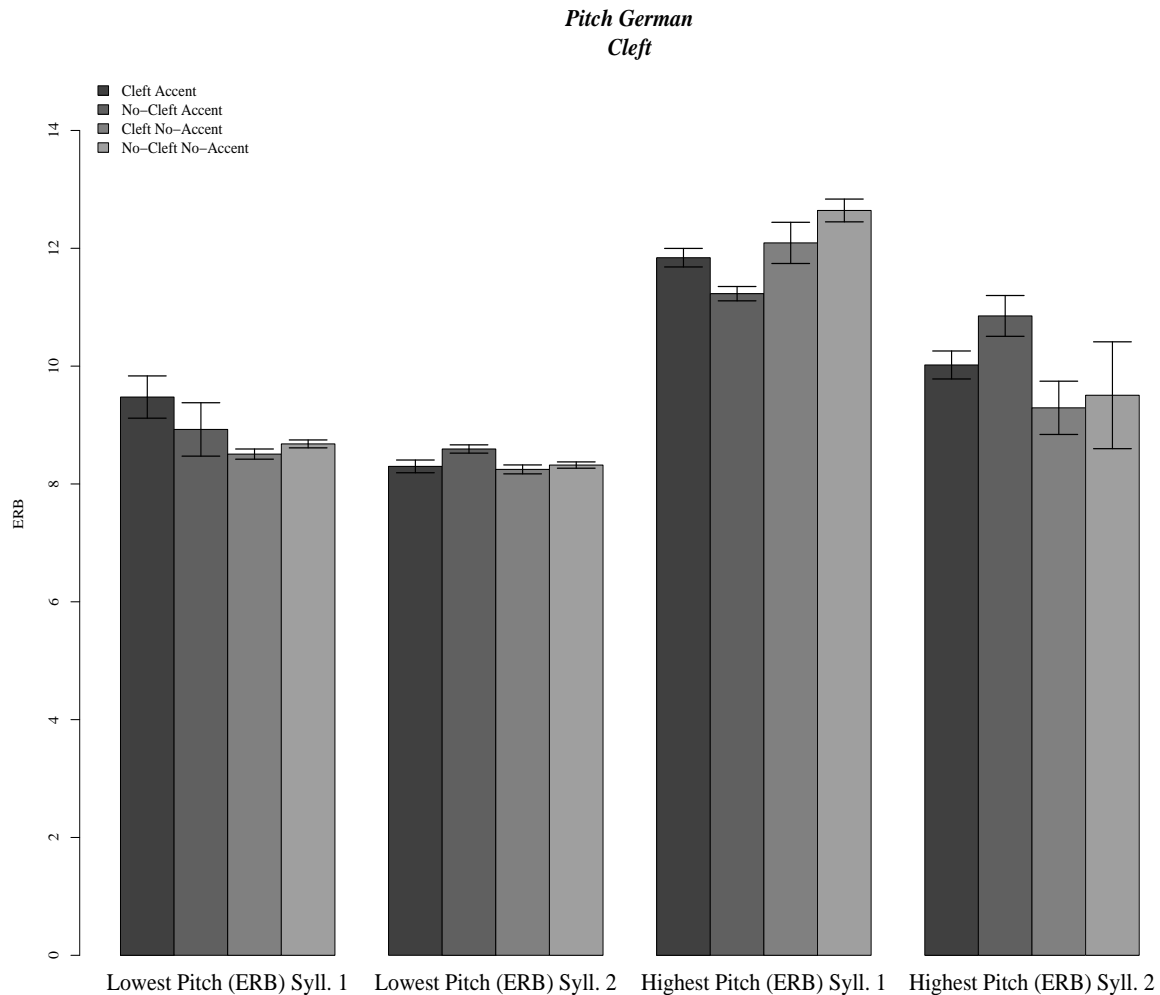


Figure 5: Pitch in German clefts and non-clefts

prosody of our target words. It turned out that it did not. Even though we do not wish to interpret these results beyond the material of our experiments, we have seen that accent boosts both duration and pitch, but neither cleft, as a way of syntactically marking focus, nor lexical focus markers had an additional effect. This is certainly important for the interpretation of our results.

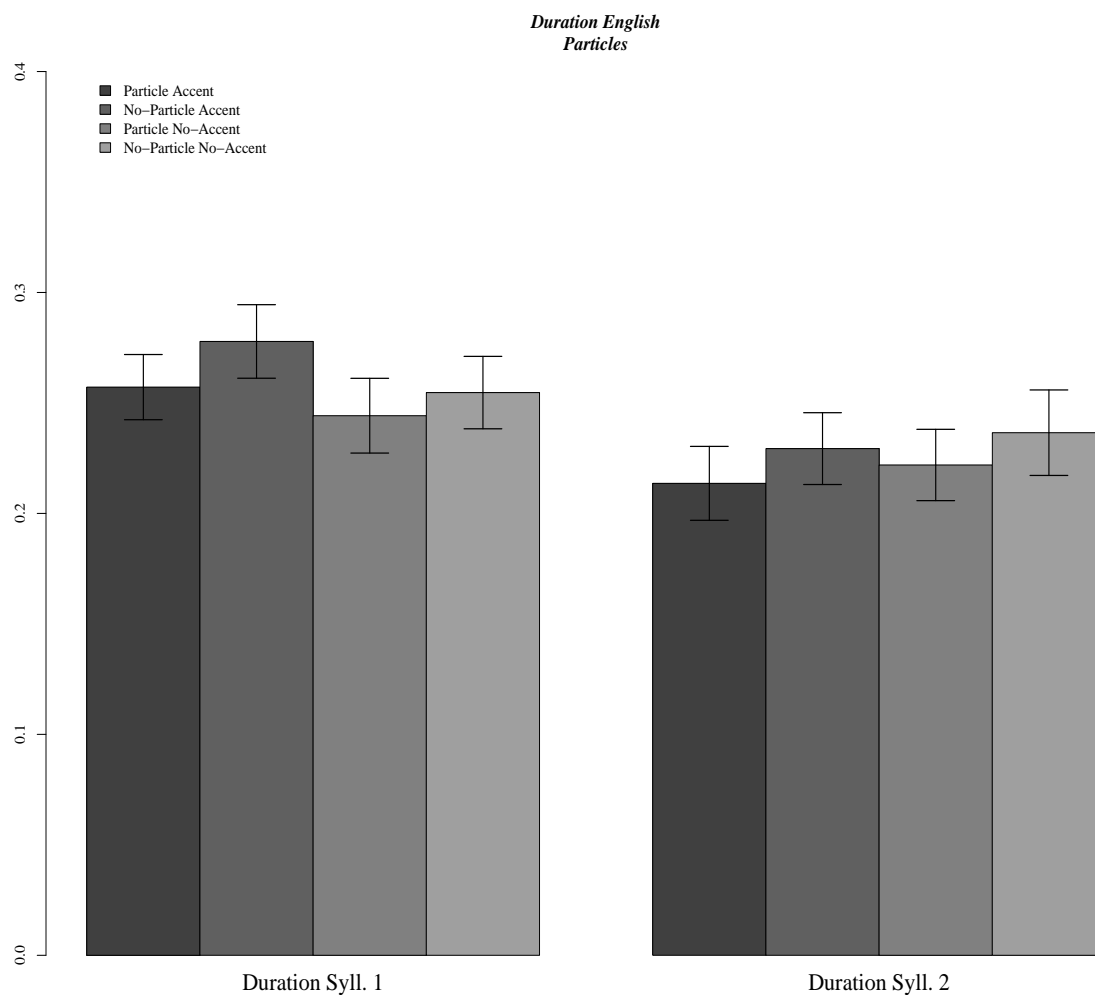


Figure 6: Duration of words in and out of scope of lexical markers

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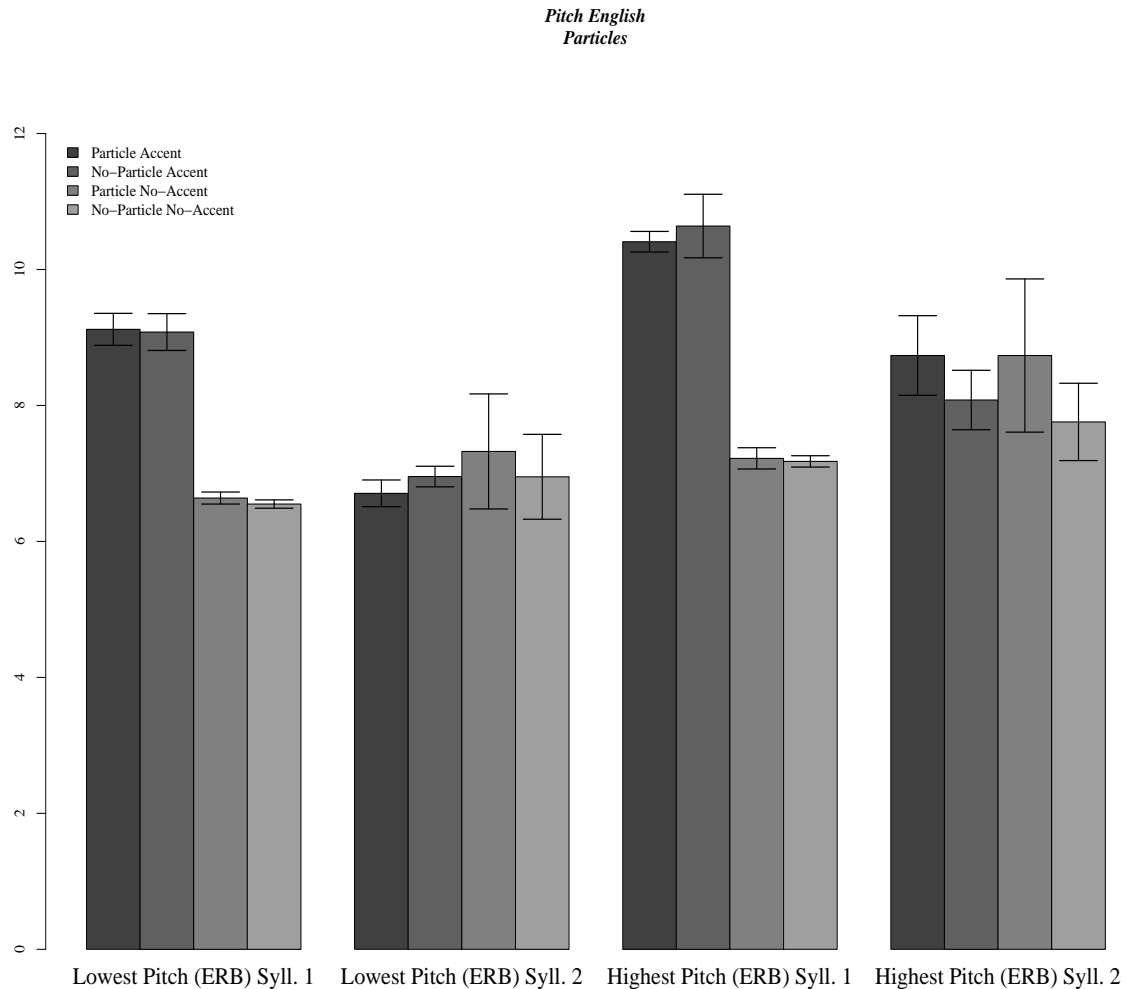


Figure 7: Pitch of words in and out of scope of lexical markers

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