

# INTERPRETING THE SCOPE OF NEGATION IN THREE VARIETIES OF GERMAN – THE EFFECT OF PROSODIC CUES

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## ABSTRACT

This paper presents two perception experiments on three German varieties investigating the effect of *pause*, *intonation contour* and *peak alignment* on (1) the scope of negation and (2) the strength of phrasal breaks. Subjects from Kiel, Vienna and Düsseldorf participated in both experiments which drew on the same set of stimuli. Results show that the interpretation of prosodic cues is task-specific, with *intonation contour* being predominantly used for scope disambiguation and *pause* being used for phrasing. This implies that the question of how German listeners resolve scope ambiguities cannot simply be attributed to the presence or absence of a phrasal break between the main and the subordinate clause. The interpretation of scope as wide vs. narrow rather depends on a more general impression of ‘cohesion’ between the clauses as indicated by prosodic means.

**Keywords:** scope of negation, disambiguation, prosody, perception, German varieties.

## 1. INTRODUCTION

This study was motivated by two considerations. Firstly, there is no research into the *perception* of scope of negation ambiguities (e.g. *William isn’t drinking because he’s unhappy* with a wide and a narrow scope reading, see [9]) in German (or any other language). So far, the prosody of negation scope has only been investigated in *production* studies in a variety of languages. Secondly, production studies have shown that German varieties differ in their tonal alignment properties. However, little is known about whether these differences have an impact on perception. More specifically, we were interested in the interpretation of negation scope by listeners from three German varieties (Kiel, Düsseldorf, Vienna).

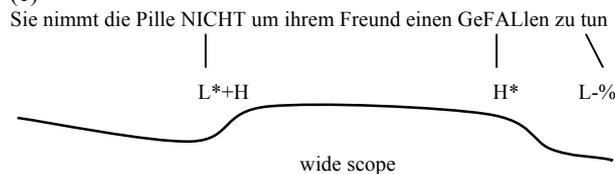
We will present two perception experiments: a semantic task, in which subjects had to judge whether a prosodically manipulated stimulus has a narrow or a wide scope reading (exp. I), and a prosodic task, in which a different group of subjects had to judge the strength of an intra-sentential phrase boundary (exp. II).

### 1.1. Prosody and the scope of negation

There has been some debate on the question of which prosodic cues contribute to the interpretation of negation scope in ambiguous sentences. Production studies

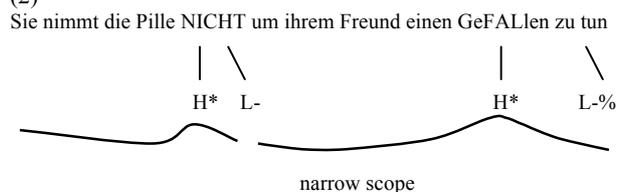
in several languages ([2, 4, 9, 10]) established the following factors: utterance-internal and utterance-final boundary tone (especially in English), pitch accent type or peak alignment (Italian, Spanish, German), global intonation contour (German), accent placement (Italian, Spanish) and pause (German). For all languages mentioned above, these prosodic cues (except for utterance-final boundary tone) have been claimed to affect intra-sentential phrasing. This suggests that phrasing is the actual cue to dissolving scope of negation ambiguities, and that the single parameters only add to the impression of a phrasal break or, respectively, lack of a break. A German example from [4] is given in (1) and (2) (accented syllables are capitalized; the original analysis has been transformed into GToBI [6] categories).

(1)



‘It is not to please her boyfriend that she takes the pill’  
(She does not want a baby, i.e. she *takes* the pill)

(2)



‘She does not take the pill, in order to please her boyfriend’  
(Her boyfriend wants a baby, i.e. she does *not* take the pill)

According to [4], the falling accent on *nicht* (‘not’) in (2) leads to the perception of a phrasal break and may be supported by temporal cues, in particular by a pause after the main clause. Additionally, different accent types are locally integrated into two global intonation contours marking either wide or narrow scope of negation: in (1), a high plateau between the accent peaks (*flat hat*, cf. [7]) marks wide scope, whereas in (2), an F0 drop between the peaks (*pointed hats* [7]) marks the narrow scope reading. In this view, both the (global) intonation contours *and* their (local) building blocks, i.e.

pitch accents, are regarded as relevant for an utterance’s semantic-pragmatic interpretation. If we consider different accent types as ‘phonologised’ differences in the *temporal alignment* of tonal targets with an accented syllable, we can thus hypothesize that peak alignment is an important cue in dissolving scope ambiguities. If this is true for German, it is essential to look at different varieties of this language as well, since German dialects are claimed to differ in the temporal alignment of accentual peaks.

Results of recent acoustic and articulatory production experiments ([1, 11, 12]) confirmed the common claim that accent peaks occur later in Southern varieties than in Northern German varieties (e.g. [5]). The peak delay seems to be especially pronounced in the Vienna variety, which makes a comparison with intuitively non-delaying Northern varieties (like the ones spoken in Düsseldorf and Kiel) appear fruitful.

## 1.2. Hypotheses

We based our hypotheses on the production data presented by Féry [4], investigating the cues *pause*, *intonation contour* and *peak alignment*. In a pilot experiment with Standard German listeners, we additionally tested the effect of the parameter *utterance-final boundary tone* (rise or fall), which has been claimed to be an important cue at least for English. Since this cue proved to be a very dominant factor for German as well (rises leading to wide scope interpretations; repeated measures ANOVA:  $F=80.65$ ;  $p<0.001$ ), and because it does not influence intra-sentential phrasing, we excluded it from the main experiments.

### *Hypothesis 1: Pause*

A silent pause after the main clause (accompanied by pre-final segmental lengthening) leads to the perception of a phrasal break (e.g. [13]), which, in turn, triggers a narrow scope reading, whereas the lack of a pause leads to a wide scope reading ([4]).

### *Hypothesis 2: Intonation contour*

A sequence of two pointed hats induces the perception of a phrasal break, due to the L tone between the accentual peaks (cf. [15]). By contrast, a flat hat pattern is perceived as a single phrase. As a consequence, we expect a sequence of two pointed hats to trigger a narrow scope interpretation and the flat hat pattern to trigger wide scope (cf. [4]).

### *Hypothesis 3: Peak alignment*

Early peak accents in the main clause (i.e. on the negation particle) trigger the perception of a break between the two clauses (due to the impression of finality of early peaks as opposed to medial and late peaks (e.g. [14]). In contrast, late peak accents in the main clause are not expected to evoke a phrasal break since they often occur in prenuclear position ([1, 16]). Consequently, we expect that early peaks lead to narrow scope interpretations, while late peaks trigger wide scope interpretations.

## *Hypothesis 4: Dialectal influence*

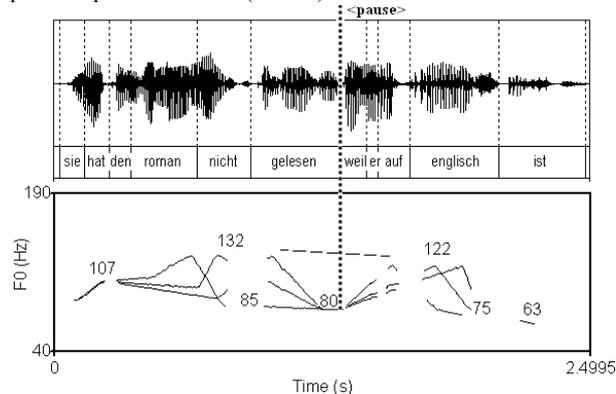
The three parameters *pause*, *intonation contour* and *peak alignment* are used as perceptual cues for phrasing and for resolving scope ambiguities in all three varieties investigated. However, we expect systematic variation in the interpretation of peak alignment differences, given the fact that accent peaks in the Vienna variety usually occur later than in the varieties spoken in Düsseldorf or Kiel [11]. Thus, Viennese listeners should generally perceive accent peaks as earlier than listeners from Kiel and Düsseldorf, which, in turn, may result in an increase in narrow scope interpretations for Viennese subjects. That is, we expect an interaction between the factors *alignment* and *variety*.

## 2. METHOD

### 2.1. Stimuli

The experiments were based on the test sentence *Sie hat den Roman NICHT gelesen, weil er auf ENGLisch ist* (‘She did not read the novel because it is in English’). The sentence had two accents (as indicated by the capitals) and was ambiguous as to the scope of its negation: a ‘yes’ reading (‘She read the novel, but for another reason’; wide scope) contrasts with a ‘no’ reading (‘She did not read the novel, the reason being that it is in English’; narrow scope). The utterances (as well as filler sentences) were spoken by a trained male speaker of Standard German (Northern variety). The realisations of pointed hats served as the basis for stimuli resynthesis. According to our hypotheses, three parameters of the base sentence were manipulated using Praat [3]. An overview of the stimuli design is given in Fig. 1.

**Figure 1:** Prosodic manipulations of the test sentence: Hz values are given for each relevant point of the trajectory (early, medial, late peaks in relation to the accented syllables *nicht* and *Eng-*); solid lines show pointed hats, the dashed line indicates a flat hat contour; the dotted vertical line points at the place of pause insertion (300ms).



These manipulations led to 20 test stimuli (2 pause conditions x 2 intonation contours x 5 peak alignment combinations, i.e. early/early, early/late, late/early, late/late and medial/medial). We included the medial-medial combination as a control condition. 20 filler sentences

were added. They consisted of prosodically manipulated versions of a sentence that was syntactically similar to the test sentence.

## 2.2. Subjects and procedure

**Experiment I** 17 subjects from Kiel (11m, 6f) as well as from Düsseldorf (7m, 10f) and 18 subjects from Vienna (14m, 4f) participated in the first experiment. All of them were between 17 and 33 years old (mean: 24.3 years). The subjects were paid for participation. The test stimuli were presented over loudspeakers in a sound treated room and to small groups of subjects simultaneously. The 40 stimuli were repeated three times, randomised and interspersed by pauses of three seconds in which the subjects had to make their decisions. The resulting twelve blocks of ten stimuli each were preceded by a training block and followed by a finishing block, which were not evaluated. The subjects' task was to decide in a forced-choice test whether a stimulus could be interpreted either as a narrow or wide scope reading. Participants had to mark their choices on a questionnaire.

**Experiment II** 15 subjects per variety (Kiel: 6m, 9f; Düsseldorf: 5m, 10f; Vienna: 5m, 10f), aged between 18 and 57 (mean: 29.8 years), were tested in the second experiment. Subjects were asked how strong they felt the two clauses in the test sentence to be 'disconnected'. They had to mark their answers on a nine-point scale for each utterance. Position 0 on the scale was labelled "not disconnected at all" and position 8 "very strongly disconnected".

In an additional task, the subjects were instructed to *silently read* a list of utterances with different semantic and syntactic structures that also contained the test sentence. Subjects had to mark on a sheet of paper which of two given interpretations was the most suitable description of the sentence's meaning. This task was added in order to find out whether there was a bias towards one of the two possible scope interpretations and whether there are differences between the varieties tested.

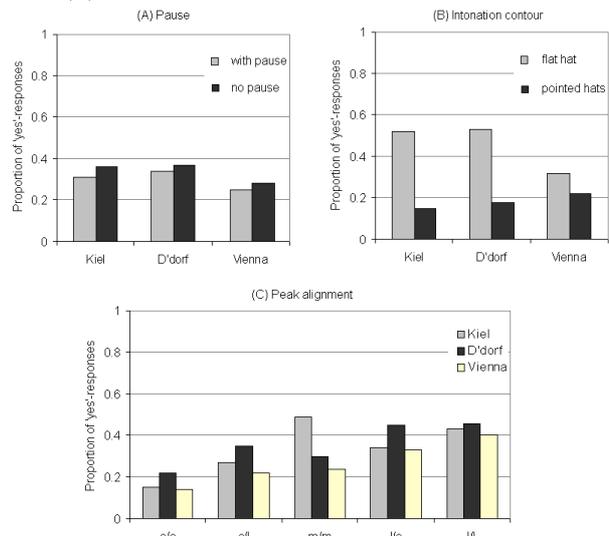
## 3. RESULTS AND DISCUSSION

For experiment I, a repeated measures ANOVA revealed that, across all subjects, the factors *intonation contour* ( $p < 0.001$ ) and *peak alignment* ( $p < 0.05$ ) had a significant main effect on scope interpretation, whereas *pause* did not (Fig. 2). Furthermore, there was a significant interaction between *peak alignment* and *intonation contour* ( $p < 0.05$ ) showing that the presence of a flat hat pattern in combination with late peaks induced the largest number of 'yes'-responses (i.e. wide scope) whereas pointed hats accompanied by early alignment of F0 peaks were judged least often as marking wide scope.

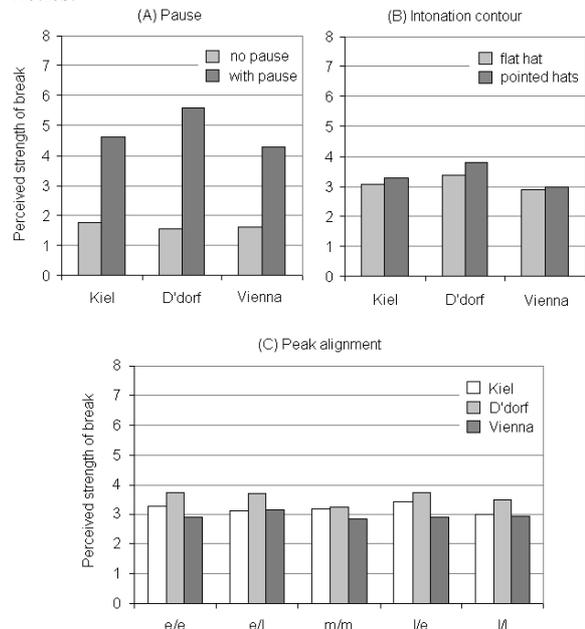
The bars in Fig. 2 indicate that there was a general bias towards the narrow scope reading, since the average numbers for 'yes' responses fall short of the arithmetic mean in all three varieties. This bias was clearly

confirmed by the additional silent reading experiment mentioned above: 93% of the Viennese subjects and even all subjects from Kiel and Düsseldorf interpreted the test sentence as having narrow scope. Apparently, the syntactic structure displaying a main clause and a subordinate clause which are separated by a comma, is more likely to trigger an interpretation of two separate pieces of information (see also [8]).

**Figure 2:** Proportion of 'yes' responses per condition within the factors *pause* (A), *intonation contour* (B) and *peak alignment* (C) across three German varieties.



**Figure 3:** Perceived strength of phrasal break (mean numbers) per condition within the factors *pause* (A), *intonation contour* (B) and *peak alignment* (C) across three German varieties.



Across all subjects, the factor *pause* was significant in the second experiment (repeated measures ANOVA;  $p < 0.001$ ) and was involved in all significant interactions

between the variables (with *variety* and *contour*). *Intonation contour* also affected the perception of a phrasal break ( $p < 0.01$ ). In contrast, no effect of *peak alignment* (neither as a main effect nor in an interaction) could be observed (Fig. 3).

Let us consider the specific hypotheses. Only the first part of *hypothesis 1* could be confirmed: A silent pause after the main clause in the test sentence proved to be the strongest indicator for a phrasal break (exp. II). In contrast, presence or absence of a pause had no significant influence on the resolution of scope of negation ambiguities (exp. I). In particular, and somewhat surprisingly, it could not be shown that a phrasal break as indicated by pausing triggers a narrow scope interpretation in the three varieties of German.

*Hypothesis 2* was largely confirmed. The shape of the intonation contour turned out to be the most salient cue for resolving scope ambiguities in German (exp. I): A sequence of two pointed hats triggered the interpretation of a narrow scope whereas a flat hat pattern rather induced a wide scope reading (at least in relation to a baseline which is biased towards narrow scope). In experiment II, the factor *intonation contour* reached significance as well but appeared to be a much weaker cue for the perception of a phrasal break, only adding to the strong effect of pausing in interactions. Generally speaking, flat hats seem to enhance the *cohesion* between two information units whereas pointed hats are more likely to mark them as separate.

The first part of *hypothesis 3* could not be confirmed, since variation in peak alignment did not have an influence on the perception of a phrasal break (exp. II). However, our results were in accordance with the second part of the hypothesis: alignment differences proved to have a significant influence on scope interpretations (exp. I). As assumed, early peak accents led to more narrow scope readings whereas late peak accents induced more wide scope interpretations. Medial peak accents generally took a position between early and late peak accents. This result was true both for the accent on the negation in the main clause and for the accent on the complement in the subordinate clause.

In neither of the two experiments we found a significant main effect of the factor *variety* (*hypothesis 4*). This finding is in line with the first part of our hypothesis saying that all three dialects generally make use of the same set of prosodic parameters for the perception of phrasing on the one hand and for resolving scope ambiguities on the other. Thus, the results can be interpreted as being valid for German in general. Nevertheless, we found a significant interaction between *variety* and *peak alignment* (as hypothesised) and *intonation contour* in experiment I. As can be seen in Fig. 2, there was a tendency for fewer wide scope readings by Viennese subjects. We take this difference as an indication that they interpreted (late) peaks as earlier than listeners

from Kiel and Düsseldorf, since Viennese displays later peaks than Northern German does.

To sum up, resolving scope ambiguities proved to be predominantly tune-based in German, since the shape of the intonation contour (flat hat versus a succession of pointed hats) turned out to be the most important factor (in interaction with local peak alignment). Interestingly, however, the prosodic cues were interpreted differently depending on the task: pause, e.g., was relevant for the prosodic task but not for the semantic task. This result suggests that it is not necessarily prosodic phrasing which governs the interpretation of negation scope in German but a more general notion of *cohesion* between a main clause and a subordinate clause.

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