Measurement of attitude and conversational meaning

Pragmatic functions of phrase final intonation in German wh-questions

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Abstract

Speech is a carrier of social signals and conveys attitudinal, affective and intentional information. An important acoustic cue for conversational meaning of utterances is the phrase final pitch contour. Syntactically marked questions in German can either have a rising or a falling pitch depending on speakers' attitude and social and situational context. We conducted a perception experiment to determine the pragmatic and attitudinal meanings associated with falling or rising phrase final pitch pattern: Intonation of two German wh-questions is resynthesized with a 7-step continuum of phrase final pitch contours from high rising to low falling. The perceived meaning of resulting stimuli is analyzed using the semantic differential technique. The following bipolar semantic scales were used:

polite – impolite; submissive – dominant; willing to compromise – determined; questioning – commanding; calm – irritated; interested – uninterested; emotional – objective

Data thus obtained shows wide divergence in ratings with regard to the acoustic continuum of rising and falling final pitch. High rising pitch contours are perceived as questioning, polite and submissive, whereas low falling pitch is rated as dominant and commanding.

Introduction

Phonetic and acoustic properties of utterances are correlated with conversational settings and interpersonal relationships between dialog partners. That is speech is a carrier of social signals and conveys attitudinal, affective and intentional information. Speakers are for example able to show dominant or submissive behavior to the hearer via acoustic characteristics. In German wh-questions expression of dominance or submission results preferential in either falling or rising pitch contours (cf. [1]). Thus the final pitch contour is an important acoustic cue for attitude and conversational meaning of utterances. Hence a semantic differential technique is used here to analyze the complex pragmatic connotations associated with falling or rising final pitch patterns.

Semantic differentials [2] have been introduced to phonetics and intonation research by Uldall [3] more than 50 years ago, as a tool for research on attitudinal meanings conveyed by pitch contours in English. As shown in more recent research by e.g. Dombrowski [4], Ambrazaitis [5] and Niebuhr & Dombrowski [6], this technique can contribute to a better understanding of formal and functional properties of intonational patterns. It can be used to determine the close link between pragmatic functions, attitude and their phonetic correlates.

We conducted an experiment on perception to measure attitude and conversional meaning of different phrase final pitch patterns. Therefore intonation of two German wh-questions is modeled each by a 7-step continuum of phrase final pitch contours from high rising to deep falling.

Communicative function was rated on seven bipolar scales of a semantic differential. We expect ratings on the semantic differential to be in accordance to [3] as well as Ohala's [7] *frequency code*. That is falling pitch contours have higher ratings on the harsh and strong pole of the scales (e.g. *impolite*, *determined*, *commanding*) and rising pitch on the soft and weak pole (e.g. *polite*, *willing to compromise*, *questioning*).

Method

Stimuli

Stimuli of the perception experiment are based on two German wh-questions that were spoken by a trained female speaker with slightly falling phrase final pitch.

- 'What is different here?' "Was ist hier anders?"
- 'What are we supposed to do?' "Was sollen wir machen?"

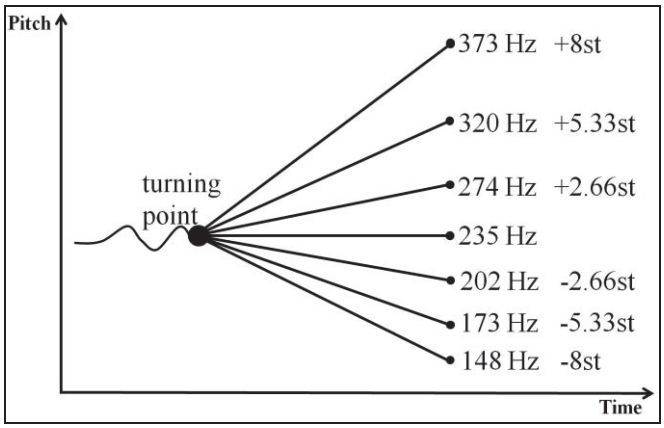

Figure 1: 7-step continuum of stylized phrase final pitch contours; range of manipulation in st; offset F0 values in Hz

F0 resynthesis was done with PSOLA [8] in Praat [9]. The phrase final stretch of the pitch contour was defined by two points: a turning point and the offset of the pitch contour (cf. figure 1). In terms of alignment the turning points of both original utterances were at the onset of the accented syllable (['ʔandɐs] resp. ['maχn]). The F0-value of the turning-points was set to 235 Hz, that of the offset was raised and lowered in 3 steps each in order to create a 7-step continuum

including a level contour. The steps were ±2.66 st, ±5.33 st, and ±8 st. The level contour was resynthesized with slightly microprosodic perturbations to sound more naturally. Resynthesizing yielded 2 x 7 = 14 stimulus utterances with following offset pitch values in [Hz]: 148, 173, 202, 235, 274, 320 and 373 (cf. figure 1). These stimuli are equidistant on the logarithmic semitone scale and correspond to equal perceptual intervals.

Semantic differential

We used a semantic differential, developed by Osgood et al. [2], as tool for measuring attitude and conversational meaning. A complete differential consists of several bipolar semantic scales and as [2] proclaimed 'the crux of the method, of course, lies in selecting the sample of descriptive polar terms'. Our scales are selected based on [1] as well as on [10]. Additionally, we applied concepts of Kohler [11] and Dombrowski & Niebuhr [12] to develop semantic scales. Thus the list of semantic scales is chosen based on hypotheses instead of running factor analyses to determine proper scales. Furthermore our set of semantic scales is designed to contribute a priori all three basic dimensions of semantic differentials: *Evaluation*, *potency* and *activity* are interpreted as fundamental and universal dimensions of affective and attitudinal meaning.

Poles of the semantic scales (cf. table 1) were given by two antonyms, e.g. *polite – impolite*. The scales had 7 steps, which included a neutral midpoint. No numbers or verbalized descriptions below the 7 steps were given:

polite O O O O O O O impolite

The stimuli were embedded in the utterance 'The speaker seems to be...' "Die Sprecherin wirkt…".

Table 1: Scales and dimensions of the semantic differential; German terms and English translations

Evaluation Dimension	höflich – unhöflich	polite - impolite
Potency Dimension	sich unterordnend – dominant	submissive – dominant
	verhandlungsbereit – entschlossen	willing to compromise – determined
	fragend – befehlend	questioning – commanding
Activity Dimension	gelassen – genervt	calm – irritated
	interessiert – desinteressiert	interested – uninterested
Additional Scale	emotional – sachlich	emotional – objective

The scale *emotional – objective* has been added, since it is for example possible to sound *determined* in a quite emotional, but also more objective way. Note that *uninterested* is the opposite of *interested*, but a term like *not dominant* would be somewhere around a neutral midpoint of a scale better described by the antonyms *submissive – dominant*.

Semantic differentials are a highly sensitive technique in terms of statistics. In our data a difference of only 0.65 steps on a scale yields to significant differences (α = 5 %) if a Wilcoxon rank sum test with continuity correction is performed for comparison of distributions. For example the difference between M = 1.7 vs. M = 2.35 on the submissive to dominant dimension results in a significant difference (W = 111.5, p-value = 0.0106). We argue that this difference is statistically significant but is not essential for the interpretation of attitude and conversational meaning, since both mean values are a trend towards the right pole of the scale, but it is no striking difference. As we observe much more extreme divergence in ratings with regard to the acoustic continuum, we represent the results of the perception task solely in plots.

Subjects and procedure

20 listeners, (10 female and 10 male; age between 19 and 28 years) participated in the experiment. All subjects were students at Kiel University and speakers of Northern Standard German. The stimuli were presented to the listeners via loudspeaker in three sessions with 5–9 participants. Subjects responded by ticking boxes on prepared response sheets.

The perception task included 14 x 7 = 98 stimuli, because each acoustic stimulus was paired with each bipolar semantic scale. The 14 stimuli as well as the 7 semantic scales were randomized and each stimulus presented to the listeners was rated on a single scale at a time. The stimuli were preceded by a short attention beep and followed by a 4-seconds response interval. Overall the experiment took about 25 minutes, including instructions and a short break.

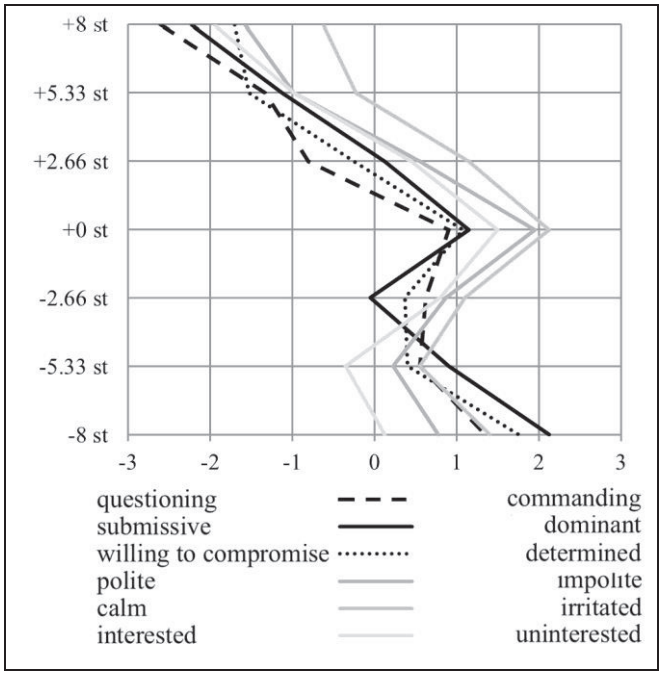

Figure 2: Mean judgments for stimulus continuum on semantic differential. Scales of potency dimension highlighted in black.

Results

Measuring attitude and conversational meaning in German wh-questions yields highly diverse results: phrase final pitch contours signal both speaker's attitude and determine pragmatic functions.

Figure 2 shows mean judgments for the stimulus continuum for the scales of the evaluation, potency and activity

dimension. Because the additional scale *emotional – objective* it is not part of the basic dimensions it is excluded from the results. Stimuli of the continuum are plotted against the vertical-axis. Horizontally the 7-step scale with mean judgments for each bipolar semantic dimension is shown. Left antonyms of scales (e.g. *questioning*) are represented by -3 value and right antonyms (e.g. *commanding*) by +3 value.

We found no gender-related differences in rating the stimuli, hence in all further results no differentiation between male and female is made.

At first sight, all dimensions behave similar: Highly distinct judgments are observed with regard to the acoustic continuum of rising and falling final pitch. Furthermore all six scales build a cluster. This shows a clear pragmatic link between all dimensions of the semantic differential: falling pitch contours have higher ratings on the harsh and strong pole of the scales (positive values) and rising pitch on the soft and weak pole (negative values).

For a more precise interpretation, Figure 2 is analyzed separately in two parts:

- the rising section of the continuum (from +2.66st to +8st)
- the level/falling section of the continuum (from 0st to -8st)

In the rising section the plotted scales run approximately linear. The higher the rise of the phrase final pitch is, the more the ratings are shifted towards left pole of the bipolar scales. In the level/falling section scales behave differently. In particular the level contour is a special case, since mean judgments for all scales are clearly shifted towards the right pole of the antonyms. The level contour even shows highest overall amplitude for scales of the activity and evaluation dimension. So it is perceived as *impolite, irritated* and *uninterested*. In contrast for the potency dimension (highlighted in black) highest amplitude is determined for the -8st-contour. Furthermore scales of the potency dimension clearly cluster together.

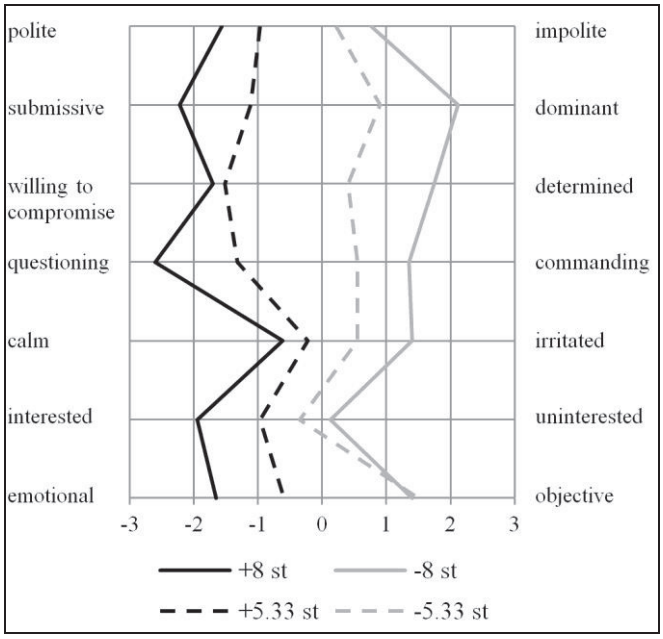

Figure 3: Semantic profiles of ±8 st and ±5.33 st contours.

As shown in Figure 3 the high rising +8st-contour has highest ratings on the soft/weak pole on the semantic differential. The contour is e.g. perceived as *submissive, willing to compromise, questioning* and *interested*. Low falling -8st-contours are complete opposites pragmatically. They get highest ratings on the harsh/strong pole of the dimensions. That is they are perceived as e.g. *dominant, determined* and *commanding.*

It should be noted that the high rising as well as the low falling contour is rated with quite extreme mean judgments by subjects. For example on *submissive – dominant* scale the +8st-contour has a mean value of M = -2.2 in contrast to a mean of M = 2.1 for the -8st-contour. Plots of the ±5.33st-contours run in between plots of the ±8-st-contours. The +5.33st-contour as well as the -5.33st-contour show same trend as stronger rising or falling patterns, but tendency to center is stronger. We assume a functional continuum of attitude and conversational meaning conveyed by different manifestations of rising and falling pitch patterns.

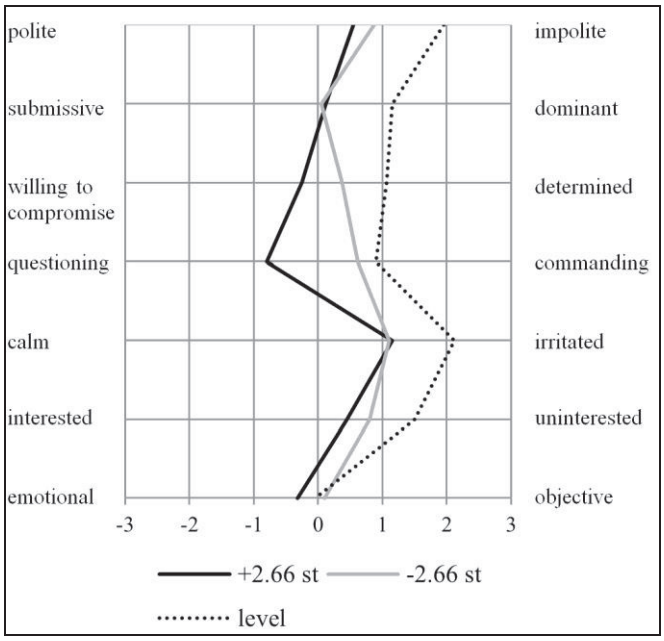

Figure 4: Semantic profiles of ±2.66 st contours and level contour.

A comparison of the slightly rising +2.66st-contour and the slightly falling -2.66st-contour results in a less clear picture (cf. Figure 4). The ±2.66-contours appear not to be part of the functional continuum mentioned above. Plotted lines are nearly congruent on most dimensions of the semantic differential. Only for the *questioning – commanding* scale a relevant divergence occurs. Subjects tend to rate the +2.66st-contour as slightly *questioning* (M = -0.8) and the falling -2.66st-contour as slightly *commanding* (M = 0.62). This shows, despite syntactical marking as question slightly falling intonation already leads to a perception of commanding attitude.

Figure 4 also supports the assumption that the level contour has to be considered as a special case. It does not run between the ±2.66st-contours, but is shifted approximately one scale point towards the harsh/strong pole of the 7-step scale.

Discussion and conclusion

Pragmatic function

Our experiment on perception explores the close connection between phonetic form and pragmatic function. The phrase final pitch contour cannot be seen only as an acoustic cue to determine the sentence mode of an utterance, but is also an important carrier of social signals and pragmatic functions. It acts for example as an indicator of submission or dominance and other signals of social hierarchy. The findings for rising and falling pitch contours are in accordance with Ohala's frequency code [7]. In matters of communicative function and conveyed attitude the level contour seems to represent a functional category of its own. Speakers using a level contour are perceived as impolite and irritated. Additional research should also take topics like boredom or routine into account.

Semantic differential and conversational meaning

The semantic differential technique is appropriate for measurement of conversational meaning. With this technique we verified that different rising or falling pitch contours results in highly distinct perception of attitude and conversational meaning.

Although subjects generally do not tend to give extreme ratings in perception tasks for example (central tendency bias) we observe quite extreme answers on most scales of the semantic differential. This is also remarkable, since we only modified direction and range of phrase final pitch patterns. Other prosodic parameters potentially relevant for conversational meaning like voice quality, tonal alignment, global pitch level, shape of the pitch contour (convex vs. concave) [12], and segmental durations were not taken into account.

Notes on questions

Our experiment on perception shows that pragmatics of what we call *questions* are widespread. A 'Question' in communication has no uniform interactional function. Phonetic structures determine how an interrogative utterance is perceived. On the one hand we find typical questions where the speaker politely requests for an answer. But on the other hand the results of the semantic differential show the same question with different intonation is perceived rather as impolite and dominant. Thus we have to assume that there is a concept 'commanding question'. For instance in a situation where a parent is impatiently waiting for its child and calls out 'Are you coming?'. Such a generic commanding question is generally expected to have a falling or level intonation. Furthermore, the parent does not expect an answer but a physical action. This type of utterances located at the strong poles of the potency dimension (dominant, determined, commanding) is associated with falling intonation. The semantic profile shows that already the slightly falling contours have a commanding connotation that becomes stronger the deeper the final pitch contour falls.

Our results as well as the above example accentuate the need for further research on formal and functional properties of phonetic structures: In order to develop a phonologically orientated system of prosodic functions in conversational interaction phonetic cues like pitch have to be linked with attitudinal and interactional criteria.

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