

## 7 Conclusion

A comprehensive assessment of this study is best attained by re-examining its results with respect to the initial four major objectives as presented in the introductory section.

These aims can also be interpreted as questions asking whether the stated assumptions about the behavior of prosody in general and intonation in particular are correct as far as the subject of foreign accent is concerned. All the experiments and analyses performed in this study are motivated by these basic assumptions. Since the results of all the respective investigations are regarded as conclusive, it can be claimed that this study has achieved its objective of describing the contribution of intonation to foreign accent.

The major assumptions and goals of this study that collaborate in the description of the relationship between intonation and foreign accent can be summarized as follows:

- speech technology can be used effectively to confirm the relevance of detected intonational deviations to the perception of foreign accent
- particularities in the behavior and representation of intonation have to be taken into account, especially pertaining to the fact that the results of the analysis of foreign accent may have different manifestations depending on the used method of intonation description
- identification of concrete phonetic and phonological causes of intonational foreign accent in the English productions of native speakers of German and vice versa in the German productions of native speakers of American English.
- investigation of the contribution of prosody and intonation to foreign accent in terms of its general relevance as well as in comparison to segmental foreign accent

The study's results with respect to these main areas of investigation are summarized in more detail in the following subsections.

## 7.1 The use of speech technology in foreign accent identification

The relevance of the detected intonational deviations, i.e. instances of intonational foreign accent was confirmed by means of the analysis-by-synthesis method (see section 4.4.2).

Strictly speaking, the crucial application of speech technology is however the use of rule-based  $F_0$  generation to produce alternative intonation contours to facilitate a subsequent comparison of two versions of the same utterance by means of PSOLA-based resynthesis.

Furthermore, the rule-based generation has the important advantage of equating a system of intonation description and the generation mechanism proper, which enables the user to deliberately alter the intonation contour and, with the help of the resynthesis, immediately evaluate these changes auditorily.

This procedure also has potential for future use in foreign language teaching. Learners could compare their own voices producing an inappropriate (original) intonation pattern and a rule-generated alternative that is acceptable in the second language (see also Jilka and Möhler, 1998). The generation is controlled by easily interpretable ToBI tone labels and could therefore serve as the basis of pedagogical applications of this kind (in restricted contexts the assignment of pitch accents and phrasal tones could be effected automatically).

Another use of speech technology in this study that is worth mentioning is the application of synthesis (based on diphones from the MBR OLA project) to generate stimuli without audible changes to the intonation contour and/or without segmental foreign accent.

Also, carrying out the perception tests via the internet improved the accessibility of the tests and greatly facilitated statistical analysis.

## 7.2 Particular aspects in the analysis of intonation with respect to foreign accent

In order to perform an analysis of intonational foreign accent that would yield meaningful, reasonable results, it was indispensable to anticipate several factors in connection with the general character of intonation as well as intonation representation.

Most important is the insight that the perceived form of intonation units relevant to the impression of foreign accent is strongly influenced by the used method of intonation description and analysis. This was made clear in a comparison of tone sequence-style and superpositional models' views of the intonation contour and its relevant units (see section 3.3).

Even within the category-oriented approach on the basis of the Tone Sequence Model, which was chosen eventually, it is possible that the phonetic parameters relevant to the realization of the phonological tone category are interpreted completely differently. This is shown in a comparison of the basic phonetic parameters of the realization rules in the rule-based approach and those employed in the PaIntE approach (see chapter 5).

Accordingly, the PaIntE approach yielded an alternative, more accurate description of deviating realizations on the phonetic level, i.e., phonetic intonational foreign accent. In the examination of the rising pitch accent in German as produced by native speakers of German and American English it was shown that steepness and amplitude of the American speakers' rises were significantly greater than in the German speakers' productions.

While the concentration on a category-centered view of the intonation contour seems justified due to the more intuitive and practical character of the Tone Sequence Model and ToBI system of intonation description, it must be emphasized again that this does not

exclude the identification or perception of completely different forms of intonational foreign accent from being just as correct.

The compatibility of this representation of tonal units with established models of second language acquisition also speaks in favor of the categorical approach (see also section 7.3).

The influence of a different view of the pitch movements in an utterance can be illustrated by a comparison of the characteristic parameters of intonational foreign accent identified in this study with the intonational deviations in the English productions of Dutch speakers described in Willems (1983). Willems' study, while anchored within the framework of the British English school of intonation, is strictly phonetically oriented and therefore does not rely too much on higher levels of linguistic representation. Many of its characterizations are purely descriptive and can be compared with the TSM/ToBI-influenced terminology and point of view of this study.

Many of Willems' observations of Dutch speakers' intonational deviations in their English productions are obviously equivalent to the results of this study. For example, what Willems describes as a difference in the direction of the pitch movement (e.g. a rise instead of a fall) apparently corresponds to the choice of different type of pitch accent. Similarly, a "displaced" accent equals the wrong placement of a pitch accent as discussed in section 4.4.3.1.

Furthermore, Willems' observations of a greater magnitude of the excursion of pitch movement in the British English speakers' productions is mirrored by the insight described in section 5.3. of this study that speakers of American English make more use of their potential pitch range than their German counterparts.

Willems also describes the transfer of a Dutch realization of a specific discourse situation (e.g. a rise at the end of a *wh*-question) in an English utterance. This is equivalent to the transfer of a more complex continuation rise observed in the German productions of native speakers of American English.

Willems also registers that native speakers of British English begin an utterance (“outset”) in the middle of their pitch range, while Dutch speakers start in the lower half of their pitch range. Again, this corresponds to the descriptions of the so-called default beginning in American English and German given in section 4.4.3.3.

Finally, Willems suspects that there are no relevant differences concerning the position of the beginning of a tonal movement in an accented syllable, an assumption that in this study is confirmed for German and American English in the analysis of the relevance of the timing of a pitch accent as described in section 5.3.

Apart from aspects concerning the consequences of different views of the intonation contour additional assumptions about the general behavior of intonation were also helpful, if not necessary in the analysis of intonational deviations that are indicative of foreign accent (see section 3.5). It is hypothesized that

- intonational deviations can only be associated with foreign accent, if the context allows no other interpretation that would make the complete utterance still acceptable in the L2
- context-dependent variation in intonational realizations is much more frequent than in segments
- foreign accent may be present not in a particular type of intonational variation, but only in the degree and/or frequency of the variation (as native speakers also deviate from the prototypical realization of a tonal category)

This latter aspect led to the conclusion that slight intonational deviations, that alone or in small numbers (in short utterances) would not be perceived at all, can accumulate in longer stretches of speech and trigger an effect of foreign accent. This accumulation effect was observed both on the phonetic level of tonal realizations of a category and the distribution of actual tonal categories (see example in Figure 3.4).

### 7.3 Identification of concrete instances of intonational foreign accent

In the analysis part of this study the German productions of ten native speakers of American English as well as the (American) English productions of ten native speakers of German were examined (see section 4.4.1 for more details).

The speakers read news reports and short stories, repeated short utterances that were played to them and also produced spontaneous speech in conversation with the author.

The analysis was performed on the basis of the ToBI intonation description. Thus, the intonation contour was interpreted as a sequence of discrete tonal categories.

The categorical view of intonation is especially compatible with the established theories of second language acquisition, which were originally developed to account for segmental foreign accent.

While there are several different approaches (see section 2.2.4), they all share the assumption of a representation of underlying phonological categories with varying phonetic realizations. New L2 stimuli may be perceived as belonging to an existing L1 category, leading to a transfer of phonetic category realizations from the L1 in subsequent speech production.

Four major causes of intonational foreign accent were identified and described in section 4.4.3. They involved a general incorrect choice and/or placement of tonal categories, the transfer of tonal categories from the speaker's L1 in corresponding discourse situations, transfer in the phonetic realization of tonal categories and overall characteristics such as relatively more tonal movement in the productions of the American speakers.

Most of these manifestations of intonational foreign accent are present in the American speaker's version of the utterance "... denn man hatte dort am Abend vorher auf einem Schild schon lesen können, daß frische Butter eingetroffen sei" (... because one had been able to read on a sign there already the evening before that fresh butter had arrived), which is depicted in the top contour of Figure 7.1. The middle contour shows

the corresponding version of a native speaker of German, while in the bottom contour the rule-generated, improved, version of the American speaker's original can be seen.

As for all other examples in this study, the three versions of the example utterance are also available for auditory evaluation by the reader at <http://www.ims.uni-stuttgart.de/phonetik/matthias/sound4diss.html>

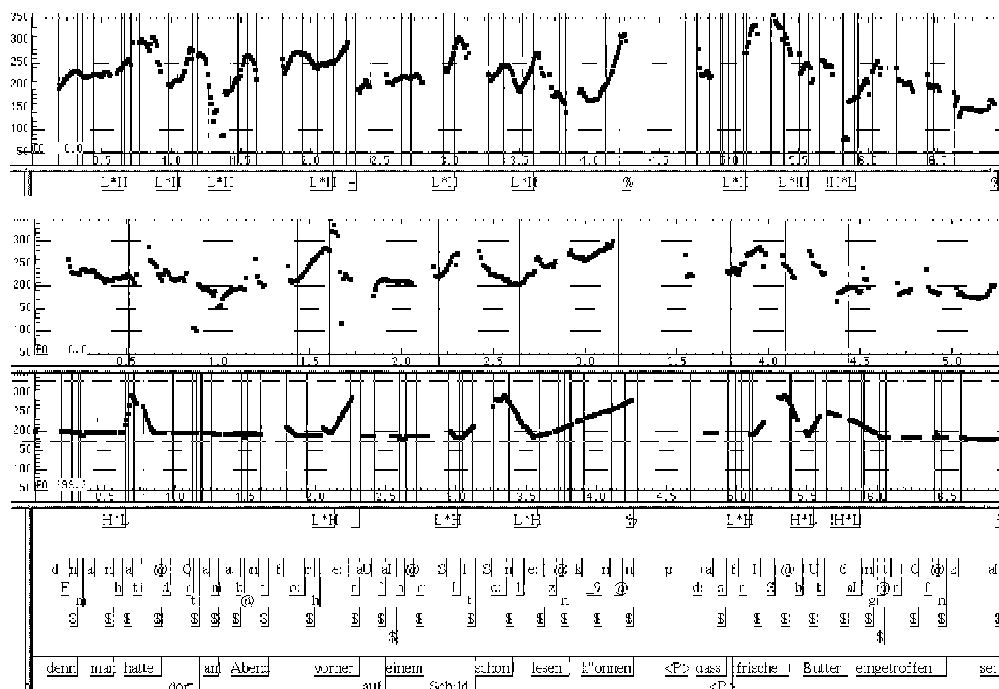


Figure 7.1. F<sub>0</sub> contour of the utterance “... denn man hatte dort am Abend vorher auf einem Schild schon lesen können, daß frische Butter eingetroffen sei” (... because one had been able to read on a sign there already the evening before that fresh butter had arrived). Top contour: American speaker's version; Middle contour: German speaker's version; Bottom contour: generated version of American speaker's original following the label description of the German speaker's version.

The example utterance includes another transfer of an American English continuation rise on “lesen können” which involves a rise-fall-rise movement (using the American ToBI tone description this pattern would be described as L+H\* L-H%; it cannot be transcribed precisely with the German ToBI tone inventory), whereas the German version

only contains a simple rise on “lesen” which spreads to the phrase boundary (see also Figure 4.7).

The example also illustrates differences in the placement and choice of tonal categories (e.g. a rising pitch accent on “Butter” (L+!H\*) in the American version opposed to a fall (H\*L) in the German version). This phenomenon extends to an overall impression of more tonal movement in the American speaker’s version with additional L\*H pitch accents on “dort” and “Abend”.

Differences in the phonetic realization of a category, e.g. in the steepness of the rises, are more subtle and can at best be hinted at in this representation of the F<sub>0</sub> contour.

In summary, it can be stated that the analysis of instances of intonational foreign accent performed in this study gives a comprehensive overview of the most important cases and types of intonational foreign accent in the German productions by native speakers of American English as well as the (American) English productions of native speakers of German.

#### 7.4 The contribution of prosody and intonation to foreign accent

While the thorough analysis of individual cases of intonational foreign accent implies that intonational deviations do indeed contribute to the perception of overall foreign accent, this study also had more ambitious aims. Firstly, to show that prosody and intonation have influence on listeners’ impressions of foreign accent, and secondly to examine how big the contribution of intonation is in relation to that of both prosody in general and segmental aspects.

In order to achieve this aim a substantial number of listeners was asked to take part in several perception experiments (see chapter 6) dedicated to the overall objective of examining all aspects of the contribution of intonation to foreign accent.



The scope of the investigation also included the experimental confirmation of the preceding identification of individual instances of intonational foreign accent.

In the experiments using low-pass filtered stimuli the relevance of prosody in language identification is demonstrated. Especially in the tasks involving native speaker identification and direct comparison of different versions of the same utterance spoken by native speakers of German and American English, respectively, it can be shown that there is a sufficient number of prosodic differences between American English and German (see section 6.3.1).

As it can be assumed that the prosodic characteristics of the L1 are reflected in the L2 (provided an L2 speaker does indeed exhibit foreign accent), this is taken as evidence for the relevance of prosody in the recognition of foreign accent.

Using low-pass filtered stimuli with monotonous intonation the results for the same tasks are significantly worse (see section 6.3.2), clearly implying that intonation is by far the most important prosodic factor contributing to foreign accent in relation to other prosodic factors such as rhythm or speaking rate.

Apart from confirming the preceding analysis of detected intonational deviations the foreign accent rating task and the direct comparison, both employing original and rule-generated/ resynthesized versions of an utterance, also indicate the relevance of exclusively intonational characteristics of foreign accent.

Changes concerning only the intonation contour are shown to significantly improve foreign accent ratings and influence judgments in pair comparisons (see section 6.3.3).

However, a comparison with synthesized stimuli, that exhibit no segmental foreign accent, demonstrates that the latter form of foreign accent clearly makes the largest contribution to the perception of foreign accent, intonational aspects being of lesser importance (see also the summary of the perception test results in section 6.3.4 for a more detailed discussion of this subject).

## *Conclusion*

The dominance of segmental foreign accent is even more underlined by the fact that all the tested stimuli were of course selected because they did contain instances of intonational foreign accent. As previously discussed, it cannot be assumed that intonational foreign accent occurs in all samples of L2 speech, taking into account, for example, the similar realization of declarative utterances in American English and German.

For this reason it is very likely that the influence of segmental foreign accent is even greater in everyday speech production despite possible effects of accumulating tonal deviations that become evident over longer stretches of speech.

In summary, this investigation has attempted to give a first coherent account of the manifestations and the general occurrence of intonational foreign accent.

Future work in the field of this study could deal with more detailed descriptions and classifications of intonational foreign accent, especially concerning the somewhat vaguely defined overall accumulatory effect of foreign accent.

Other possible objectives could involve more elaborate uses of  $F_0$  generation in language teaching and of course the application of the presented methodology to the investigation of foreign accent in the comparison of other languages.

A final important extension of this work might be to find a more exact method of quantifying the contributions of intonational, generally prosodic, and segmental deviations to overall foreign accent.

In conclusion, it can be claimed that the present study has reached its goal of examining and describing the relevant aspects of the contribution of intonation to the perception of foreign accent. The groundwork for other, more elaborate investigations in the area has been laid.