

Bavarian -a- Vowels: Experimental Investigations on the Comparability of the First Two Formants and of Phonetic Transcriptions

Klaus G. Schweisthal, Stephan Forstner, Kurt Kotten
Munich, FRG

1. Object

In contrast to the current Standard pronunciation of German it is a noticeable characteristic of several Southern Bavarian dialects that there are no central -a- sounds in monophthongs.

On the other hand one can postulate a front phoneme /a/ with at least two variants [a], [æ], and a back phoneme /ɔ/ lacking in Standard German which has about four allophones [ɒ], [ɔ], [o], [u]. This situation led us to hypothesize that the back variants in stressed syllable position occur only in words which have been in the language since the time of Old German or Middle High German, while the front variants in stressed syllable position occur only in later words e.g. loan words and foreign words in a way similar to the relatively late occurrence of the i-Umlaut in Bavarian dialects.

2. Method

2.1. Word List Used in the Tests

Three groups of twelve nouns all containing the letter -a- in stressed syllable position and also occurring in Standard German were selected, mainly from the 'Bayerisches Wörterbuch' (Schmeller² 1872-1877, 1973). In the first group the twelve nouns were first recorded in the Old High German period, in the second in the Middle High German period, and in the third from Middle High German onwards. Each group had six examples of long -a- and six examples of short -a- (in the standard pronunciation). A further requirement on the list was that the individual words could be combined to form 18 compounds existing in Standard German. Furthermore it was necessary to distribute expected front variants (short and long) systematically over the first and the second position in the compounds, for example 'Nagellack' and 'Taxifahrer', 'Garagenwagen' and 'Lampenkabel'.

2.2. Recording of the Speech Data

In order to reduce the influence of Standard spoken and written language as far as possible we used picture puzzles as an elicitation technique. The

compound had to be guessed and spontaneously uttered from the pictures of the individual parts (e.g. the picture for 'Nagel' - nail, then the picture for 'Lack' - varnish, and then the compound 'Nagellack' - nail varnish). The compounds had to be uttered in the standardized context ('Das ist ein ... glaub' ich' - this is a I guess) in order to avoid list effects and to keep the accentuation reasonably constant.

Requirements for the Native Speakers: Born in the village where the recording was made; had spoken the dialect since childhood; no lengthy absences from the region; no higher education; dialect spoken as a matter of course at home; more than 30 years old.

Eight male speakers from Upper Bavaria; four speakers from the south and four from the north.

2.3. Digital Data Processing

The recordings were digitalized (sample rate 20 KHz) and segmented using a segmentation routine available on the Institute's PDP 11/50. Five consecutive pitch periods were segmented individually from the central portion of the -a-vowel in the individual words and in the compounds. An analysis program then calculated the fundamental frequency, the first three formants with their bandwidths and the length in milliseconds. For the production of the test material a waveform manipulation program was used to double every period because we imagined that a sequence only five periods long would be too short for a transcription to be possible.

2.4. Transcription

Each new sequence of ten periods was presented five times to the subjects over loudspeakers. The subjects (all trained listeners) were instructed to note tongue-height and tongue-position (front - back) on two scales with seven steps each (Fig. 1).

2.5. Combined scales

A system of coordinates was tried out. On the ordinate the seven steps of the transcription used for the evaluation of tongue-position and at the same time the measured values of F_2 are entered.

The abscissa shows the seven steps of the transcription of tongue-height and at the same time the measured values of F_1 (Fig. 2). For the definition of the formant scale we followed suggestions of Ungeheuer (1962) and Ladefoged (1971). We restricted ourselves to the vowel system forming the subject of our investigation. For each speaker the average of five F_1/F_2 measurements was entered on the system of coordinates, together with the average transcription results of ten trained listeners. The areas enclosed by the dashed lines were assigned the corresponding transcription symbols. In this way we also obtained a readily understandable aid for courses in experimental phonetics.

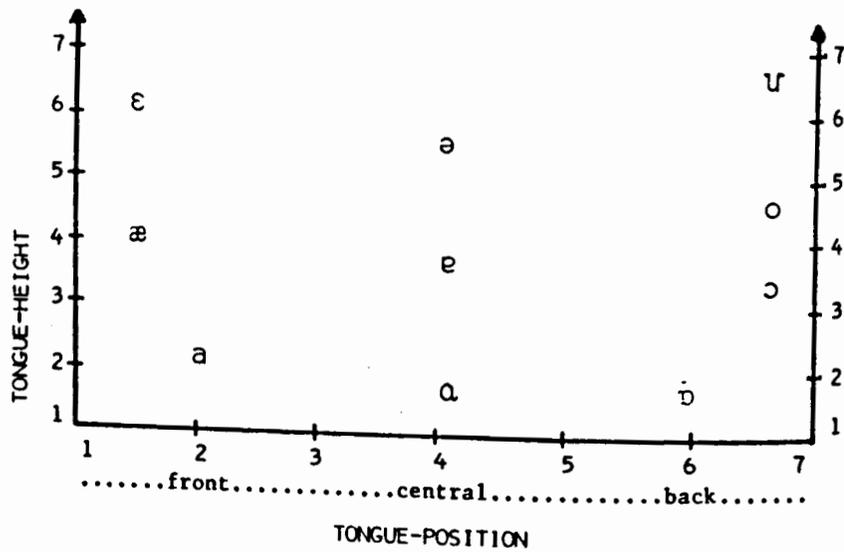
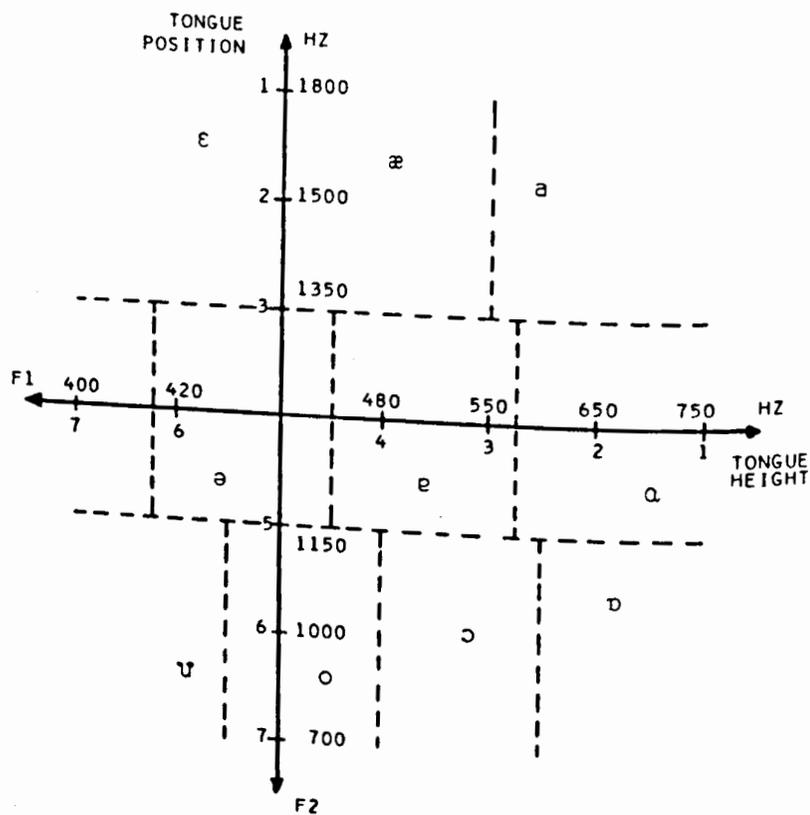


Fig. 1. Steps of transcription.

Fig. 2. Combined scales for F_1/F_2 -measurements and steps of transcription.

3. Results and Discussion

3.0. To date a representative sample of 16 words from the total 36 (and thus eight of the 18 compounds) from five of the eight male speakers have been analysed. The speakers all had average fundamental frequencies between 100 and 120 Hz.

This gave a total of 160 -a-productions. The percentages given below relate to this total.

3.1. The following average formant frequencies were assigned to the transcription symbols on the basis of the combined scale:

F_1	F_2	F_1	F_2	F_1	F_2
[æ]	550/1650;	[a]	680/1500;	[ɑ]	640/1250;
[a]	530/1250;	[ɔ]	650/1000;	[ɔ̄]	550/ 900;
[o]	450/ 850;	[u]	410/ 800.		

Comparison with Delattre's (1965) formant charts shows that the Bavarian F_2 values for front -a- realisations are much higher than the Standard German values, while the F_1 values of the back -a- productions are generally somewhat higher. The relatively low F_2 values for [u] can be explained by the influence of nasalization.

3.2. Complete agreement between measured and heard results was found in 78.2% of the cases. A difference of one step along the tongue-height scale was found in 18.3% and a one step difference in tongue-position in 3.2%. If one combines [a] and [æ] (Delattre 1965) the number of complete agreement rises to 88.5%. The rate of agreement could probably be improved still further by calibrating each speaker's formant scale on the basis of the formant values for his individual neutral vowel [ə].

3.3. In only 2.5% of the cases [ɑ] was measured and was transcribed in 4.3%. Most of the occurrences of [ɑ] were in the test word 'Harfe' - harp (three speakers) which is attested as early as the Old High German period. Centralized [ɐ] was measured and heard in 2.5% of the cases especially in the second position of the compounds (secondary stress).

A total of 95% of the test words were categorized on the basis of the measurements and transcription as either front or back.

Running counter to the hypothesis -a- in 'Kaffee' received a back realisation in all cases ($18 \times [ɔ]$ and $2 \times [ɔ̄]$). The hypothesis would predict an [a]-realisation since "Kaffee" has entered the language relatively late. The reason for the discrepancy is probably that it has been psychologically domesticated by daily use.

References

- Delattre, P. (1965). *Comparing the Phonetic Features of English, German, Spanish and French*. Heidelberg.
- Ladefoged, P. (1971). *Preliminaries to Linguistic Phonetics*. Chicago and London.
- Schmeller, J. (1973). *Bayerisches Wörterbuch*. 3. Neudruck der von G. Karl Fromman bearbeiteten 2. Ausgabe, München 1872-1877. Aalen.
- Ungeheuer, G. (1962). *Elemente einer akustischen Theorie der Vokal-artikulation*. Berlin, Göttingen, Heidelberg.