

PERCEPTUAL PARAMETERS OF VOWEL DURATION AND QUALITY IN GERMAN

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In the normal production of vowels in German there exists a systematic opposition of vowel duration and quality in accented syllables. The opposition is such that the long vowels are normally also more close and tense and the short vowels more open and lax.

Although there is little dispute over the fact that vowel length and quality are very closely related and seem to form an inseparable entity in the normal production of German vowels, it is not clear, however, whether native Germans depend more upon duration or more upon quality in their perception of vowels.

This question served as the basis for an experiment conducted last year by the speaker at the University of Colorado Sound Laboratories under the direction of Professor H.H. Wängler. The purpose of the experiment was to devise a perception test containing enough variations in vowel quality and quantity (with the normal relationship no longer intact), so that parameters could be drawn with some degree of accuracy.

It was decided that the items used for the perception test be entirely the unaltered product of human articulation, even though this would allow less control over the acoustic features themselves than would, for instance, synthesized speech. In order to reduce the variables as much as possible, only one person was used to utter all the variants. All items produced were in the ['b—tən] environment. Substitution of various vowels in this environment yields 15 meaningfully distinct types of utterances, each illustrating a distinct phonetic and phonemic vowel variant as the basis of the systematic opposition between short-open and long-close. In addition, discrimination choices could be based upon the orthography since the 15 phonemic distinctions can be indicated orthographically by the subjects.

By applying a rather complex procedure, a great number of vowel variations in the ['b—tən] environment were produced by an experienced phonetician, Professor H.H. Wängler. Qualitative and durational variants were produced by a combination of aural screening, oral reduplication and acoustic analysis. A voice-triggered oscilloscope was used to monitor the production of duration. As a result of numerous recording sessions and subsequent formant analysis of the items produced, 287

items, the vowels of which exhibited a good distribution of quality and duration, were picked to constitute the corpus of the listening test. The 287 items reflected 65 qualitative steps of four to five durational variants each. The items were randomized by a computer and the test was subsequently given to 20 native Germans who were asked to classify each item they heard as the orthographic item it most resembled. The orthographic selections were then translated into phonetic symbols and the number sequence derandomized so that the change in the perceptual pattern of the original systematic sequence could be studied.

After the results were calculated and plotted out, it was evident that the quality-duration relationship was a very complex relationship, indeed. Individual parameters were influenced particularly by dialect background. Some evidence of a correlation between individual production and perception was also found although this evidence was not conclusive.

The individual subjects themselves differed in their method of classification; some seemed to rely more heavily upon the qualitative distinctions (i.e., normally short-open vowels when lengthened were still classified as short-open vowels), others more upon the quantitative aspects (i.e., if sufficiently long, it was classified as a long-close vowel regardless of the vowel's quality). It was found that the northern Germans tended to classify generally more on the basis of quality and the southern Germans more on the basis of duration.

In general, the more the principle of long-close/short-open was violated, the more disagreement in the responses; for example, a lengthened normally short-open vowel variant close to [i] was classified as five different vowels: [e:] 55%, [i] 20%, [ε:] 15%, [ε] 5%, [ø:] 5%; a shorter variant of a normally long-close vowel close to [e] was classified as four different vowels: [e:] 40%, [i] 30%, [ε] 20%, [ε:] 10%.

A means of depicting the modals, or most frequent responses to each item, was attempted on Figure 1. Here the qualitative steps are indicated along the perimeter of the circle. The steps in duration of the modals are shown as the distance of the points along the radii. The time scale is given in the blank space between [u] and [ε]. The more peripheral the vowels, the longer is the duration. A black line separates the perception of the short vowels from the long vowels.

We see that shorter variants were accepted as long vowels when they came closest to the intended quality of the long-close vowels ([i], [u], etc.). We also see that longer variants were still classified as short vowels when they came closest to the intended short vowel quality ([i], [u], [ɔ], etc.). We note also that the distinction between [ε] and [ε:] and the low vowels [a] and [a:] were made strictly on the basis of length. For these vowels duration is almost always the distinguishing feature.

It becomes quite evident that the relationship of quality and quantity is an inverse relationship: i.e., the better the quality, the more deviation of length is allowable and the less critical the duration factor. The more distorted the quality, the more critical the duration factor. Note that with the exception of the [ɔ] variants, all vowels irrespective of the quality are classified as long-close vowels if sufficiently lengthened.

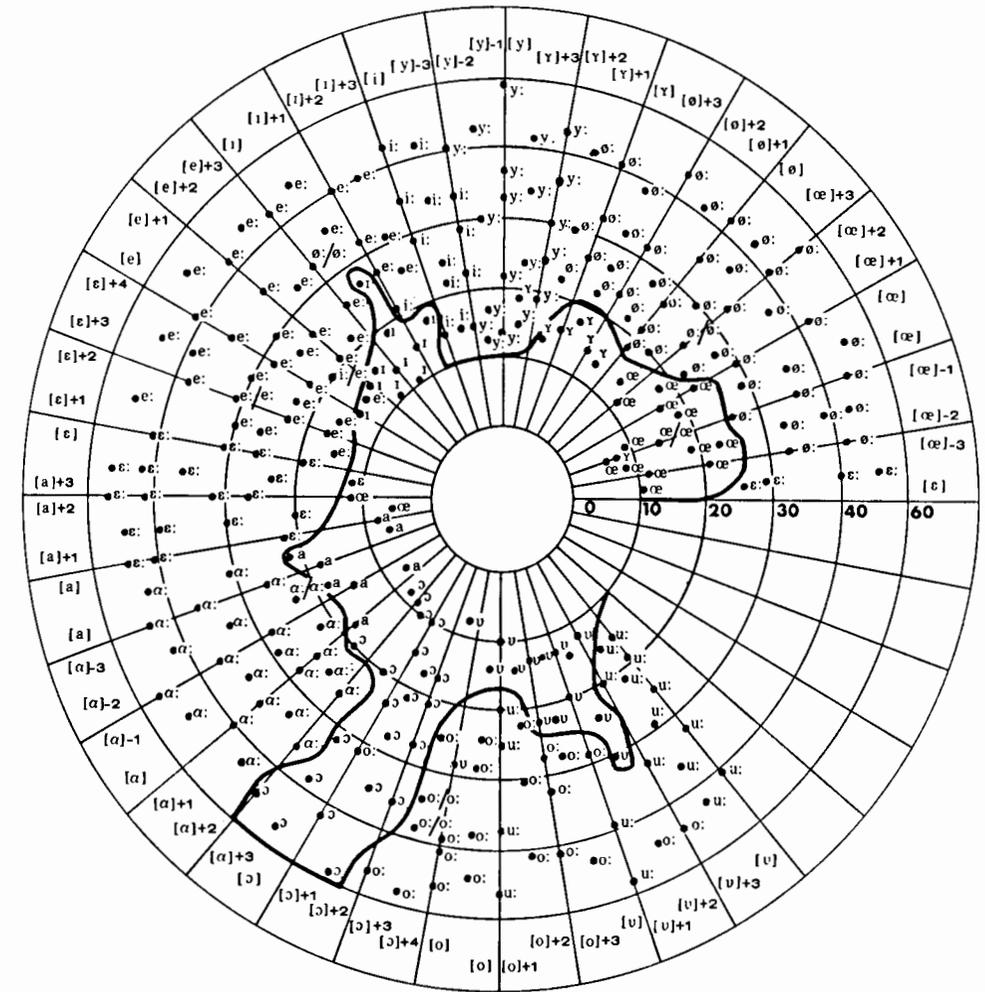


Fig. 1.

However, the reverse is not the case. The shortest variants of all the normally long-close vowels were not always classified as short-open vowels. This is particularly true of the high-close vowels [i], [y] and [u]. When a short mid-close vowel was classified as a short vowel, it was often classified as a high-short vowel (not mid-short vowel). Thus short [ε] > [i], short [o] > [u], short [ø:] > [y].

In conclusion, we find that the problem of weighing quantity versus quality with respect to the perception of German vowels is a very complex one. This experiment has demonstrated a different approach to the problem and has shown that it is impossible to generally assert that quality is a more important perceptual cue than duration

in German, or vice versa. The relative importance of one over the other depends upon the speaker, the dialect and the individual vowels themselves.

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