TEMPORAL PATTERNS IN DUTCH

S.G. NOOTEBOOM

This paper will be concerned with some exploratory experiments on the role vowel length differences play in the rhythmic programme for Dutch polysyllabic words. A convenient starting point for a discussion of this topic is formed by the 1965 Kozhevnikov and Chistovich diagram for the generation of word, as shown in Figure 1. These authors found that the time characteristics of words of the same stress

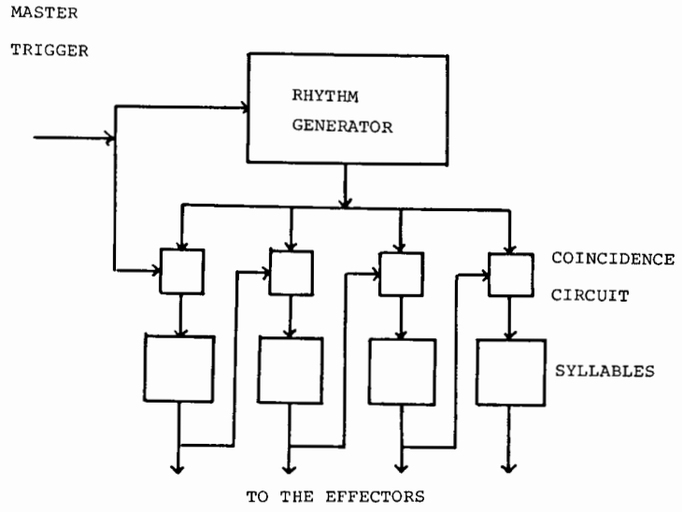

Fig. 1. Schematic diagram for the generation of a word according to Kozhevnikov and Chistovich 1965. The triggering of the second and all further syllables depends on both the preceding element and information from the rhythm generator.

pattern, if produced by humming only, were identical. In normal reading aloud however, adding a consonant to a syllable delayed all further syllable movements with a certain time. From this they concluded that words of the same stress pattern have the same rhythmic programme, in the diagram represented by the output of the rhythm generator, but that in the realization of the programme the triggering

of a syllable depends on both the rhythmic programme and the preceding syllable as shown in the diagram (i.e., Figure 1).

In the Kozhevnikov and Chistovich experiments the words were presented visually. In that way all information on the rhythmic and durational properties of the word stemmed from the subject's internalised knowledge of the language. Intuitively, it seems equally well possible to imitate the rhythmic properties of a word or phrase one has heard. An interesting question is, however, whether the rhythmic properties reproduced in such an imitation task are similar to those produced when no speech input is present. We have started a series of exploratory experiments on this question. Although these experiments are by no means conclusive, we thought it interesting to present some examples of the results obtained so far.

We tried to find out whether the difference between a long and a short vowel in the stressed syllable of a polysyllabic word affected the time characteristics of the production of a subject who was asked to produce the rhythmic pattern of this polysyllabic word by means of whistling. We chose whistling instead of humming because we found that this gave better reproducible results. We used both aurally presented stimuli and visually presented stimuli.

The aurally presented stimuli were used in two versions, one with normal intonation and one version with completely monotonous pitch, obtained with the help of a vocoder and an artificial voice source. This was done because it is known that intonation may to a large extent affect the control of duration.

In Figure 2 an example is presented of whistled responses to aurally presented stimuli. At the top one sees the schematised time characteristics of two stimulus words. These words were naturally spoken six syllable words with primary lexical stress on the second syllable. Natural intonation is preserved. The vowel in the stressed syllable of the first word was short, that of the second word long. The subject was asked to reproduce by whistling the rhythmic pattern of the word he heard as accurately as possible. He produced ten imitations of each word, each time carefully reproducing the intonation pattern without being asked explicitly to do so.

Below one sees the schematised time characteristics of the whistled imitations averaged over 10 trials. Notice that, although the subject was very confident that he accurately reproduced the rhythmic pattern, the time characteristics of the imitations differ considerably from those of the stimulus words. Among other differences, we see that the overall durations are shorter and the durational difference due to the long/short opposition is reduced from 45 to only 20 ms. If one takes the subject's judgement that he accurately reproduced the perceived rhythmic patterns seriously, one must conclude that the relation between the actual durational build-up and the rhythmic pattern is not a simple one. It seems reasonable to assume that the intonation pattern may interfere with this relation.

In Figure 3 the same stimulus words are presented, but now the normal intonation has been replaced by a monotonous pitch. Notice that the subject now exaggerates the durational difference in the second syllable. This suggests that the effect of the

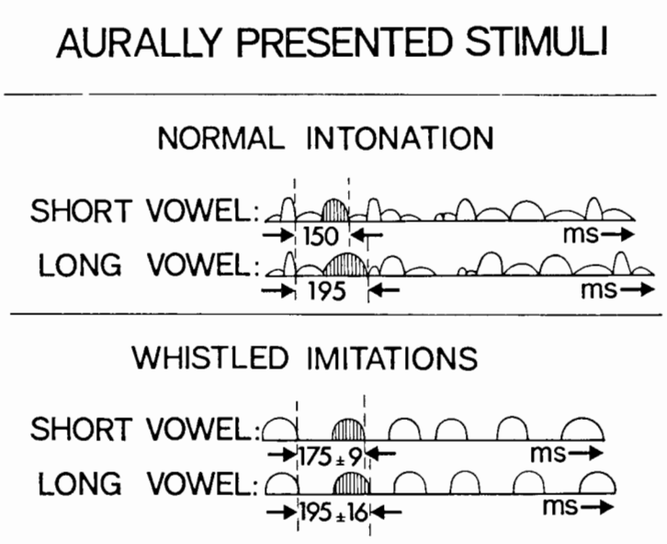

Fig. 2. At the top: The schematised time characteristics of two aurally presented stimulus words. The phonemic make-up of these words was /vəʁbɑnɪŋspʁo:sɛsə/ and /vəʁma:nɪŋspʁo:sɛsə/. They were spoken in a natural way. Normal intonation was preserved. At the bottom: The schematised time characteristics of whistled imitations of the rhythmic patterns of the above words.

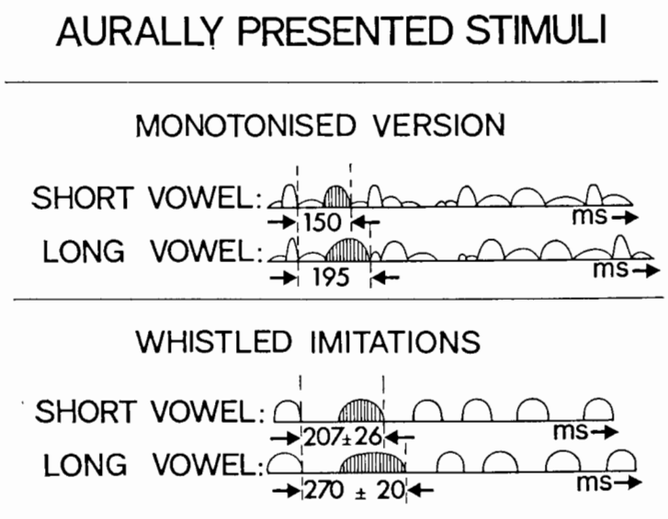

Fig. 3. At the top: The same as in Figure 2. This time, however, normal intonation was replaced by a completely monotonous pitch. At the bottom: The schematised time characteristics of whistled imitations of the rhythmic patterns of the monotonised words.

intonation pattern is substantial. We may assume that the absence of pitch movements made the subject more aware of the durational difference. It certainly becomes clear from this example that the subject is able to take the long/short difference into account in his whistled productions. This is important in interpreting the next and final example.

In Figure 4 one sees two printed four syllable words, the upper one having a short vowel the lower one having a long vowel in its stressed first syllable. These words were visually presented on cards to the subject. He was asked to whistle the rhythmic pattern of the words he read. He did so ten times for each word. In the middle of Figure 4 one sees the schematised time characteristics of his whistled productions. Notice that this time the subject did not seem to discriminate between the long and the short vowel. For comparison the schematised time characteristics of these words obtained in normal reading aloud are presented in the lower part of Figure 4. The results presented in Figure 4 suggest that in the internalised knowledge of the language the rhythmic programme for a word is independent of the long/short difference.

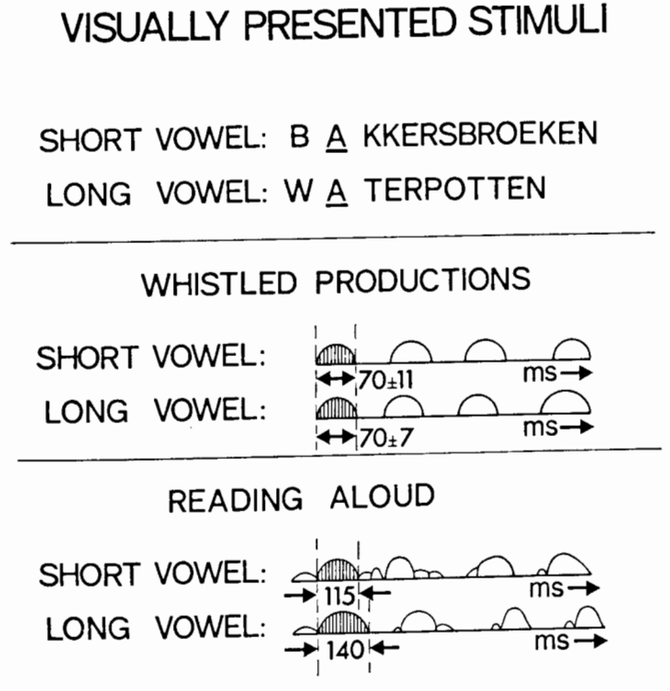

Fig. 4. At the top: Two printed four syllable words used as visually presented stimuli, one containing a short vowel in the stressed first syllable, the other containing a long vowel in the stressed first syllable. In the middle: The schematised time characteristics of whistled productions of the rhythmic patterns of the above words. At the bottom: The schematised time characteristics of the same words in normal reading aloud.

The examples presented above of some exploratory experiments on vowel length and the time characteristics of whistled rhythmic versions of polysyllabic words, which were either aurally or visually presented, do not allow any definite conclusions. They seem to suggest, however, that the rhythmic properties reproduced in imitating aurally presented words are different from those produced in responses to visually presented stimuli. Where in the case of visually presented stimuli the phonemic long/short difference is overlooked in the realization of a rhythmic programme, in the case of aurally presented stimuli the long/short difference does show up in the rhythmic programme. This suggests that the effect of the long/short difference found in the whistled imitations, must be ascribed to the perceived difference in syllable duration rather than to the phonemic difference in vowel length. We may, then, tentatively assume that intonation affects the perceived syllable duration.

The most interesting indication, we think, is that found in the last example, *viz.* that at some level of the complex production processes there exists a rhythmic programme which is independent of vowel length and thus abstract from important and functional properties of the word form.

Although the provisional conclusions from these experiments are close to mere speculation, we feel that the method of having a subject produce the rhythmic patterns of words or phrases in a non-speech way is useful for exploring the complex relations between rhythmic programme, phonemic make-up and intonation. We intend to pursue this line of research in the near future.

Institute for Perception Research (IPO)
Eindhoven, The Netherlands

REFERENCE

Kozhevnikov, V.A. and L.A. Chistovich
1965 *Speech Articulation and Perception* (= *JPRS* 30) (Washington, D.C., Moscow-Leningrad) [J.P.R.S. translation.]

DISCUSSION

ALLEN (Chapel Hill, N.C.)
Many theories of speech production include explicit reference to speech perception. Therefore, the rhythmic ability of a SPEAKER should be more complicated to discover than those of the LISTENER, simply because the perceptual situation is in some sense 'purer'. I would therefore suggest that speech rhythm production is 'confused' (or 'confusing'?) rather than complex.

NOOTEBOOM
I agree with the viewpoint that in some way speech perception is involved in speech production. It is, however, not clear why this should mean that speech rhythm in perception is less complicated than speech rhythm in production. In the examples given, I do not know what speech rhythm actually is, but the subject seemed to respond in a more complex way when the stimuli were presented aurally than when presented visually. Supposedly some acoustic durational factors entered in his conception of rhythmic pattern in the case of aural presentation, which did not in the case of visual presentation.