

BURST INTENSITY AS A MEANS OF ASSESSING
SPEECH MOTOR PERFORMANCE IN UNINTELLIGIBLE CHILDREN

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ABSTRACT

As part of a larger study of children with a diagnosis of specific developmental speech and/or language disorder, the burst intensity in repetitive productions of the syllable /ta/ was examined in 24 children between 4;6 and 8;0 years of age with unintelligible speech. Twenty-four children without speech/language deficits matched for age served as controls. The intraindividual variability was significantly greater in the children with unintelligible speech than in the controls. This is interpreted as an indication of a deficit in speech motor coordination. The patterns of variability in the unintelligible children differed, however, indicating an inhomogeneous group with different types of underlying motor deficits.

INTRODUCTION

Normal children can be understood by strangers at the age of 4 years. There is a group of children, however, with normal intelligence, normal hearing and otherwise normal development who are unintelligible much longer, sometimes till age 7 or 8. Recently, the phonological aspect of this disorder has been emphasized, following a trend in studies on speech and language disorders to stress cognitive and linguistic aspects and deemphasize or disregard motor functioning. In our previous studies we found that motor coordination problems contribute as much to unintelligibility in children with specific speech and language disorders as do dysgrammatism, paraphasia, and other linguistic abnormalities [1,2].

Since speech requires constant permutations and combinations of gestures in tightly defined temporal sequences, speech motor coordination can

be assessed only during the act of speaking and with methods that do not interfere with this activity. We used acoustic analysis of repetitions of a simple syllable [4] to compare speech motor coordination in unintelligible children and normally developing children of the same age.

Speech can be considered as a skilled act, practiced increasingly during childhood. Two important aspects of skilled acts are speed and low variability in repetitions of the same movement. Besides other parameters, we measured the mean intensity of the release burst of the /t/ in slow and fast repetitions of the syllable /ta/. The intensity of the release burst is dependent on the intraoral pressure build-up during the stop closure and the speed of the release of the stop. Therefore, the subglottal pressure, the opening of the glottis, the closure of the velum and the seal of the stop closure all have to be controlled and related to each other to result in an overall invariant burst intensity [5,6,8]. Measurements of intraoral pressure [3] or peak airflow [7] have shown that adults have very little variation in syllable repetitions.

METHOD

Subjects

The subjects were 24 children between 4;6 and 8;0 years of age from several special schools for speech and language handicapped children. They had been selected for our study because of their unintelligible spontaneous speech. None of the children had a subnormal IQ or any hearing deficit. A detailed language assessment revealed that the children had speech and language deficits of varying types and severity, including language comprehension problems, dysgrammatism and word finding problems. The control subjects were 24 children without speech or language problems matched for age.

Procedure

The children were tested individually in a quiet room at their school. They were asked to repeat the syllable /ta/ first slowly and then as fast as possible about 20 times each. The speech was tape-recorded with a Sennheiser microphone MKE 803 and a Nagra 4.2 tape recorder. The microphone was placed in front of the child about 50 cm from the mouth. For each child the recording level was adjusted at the beginning of the recording. The tape-recorded speech was digitized at 20 kHz. The intensity level was again adjusted at the beginning of the digitization. The syllables were segmented at the release of the stop under visual and auditory control using a segmentation program developed by M. Dames on an LSI II/73.

The mean intensity of the 12.5 ms from the beginning of the stop release was calculated in dB in relation to the overall amplitude of the analog-digital converter. This procedure allows comparisons of relative mean burst intensity in individual children but not of absolute intensity between children. The difference between the burst intensity of two consecutive syllables was calculated in % of the intensity of the preceding syllable.

Statistical analysis

Since not all children produced 20 syllables, difference scores for up to 15 syllables per child were used. These

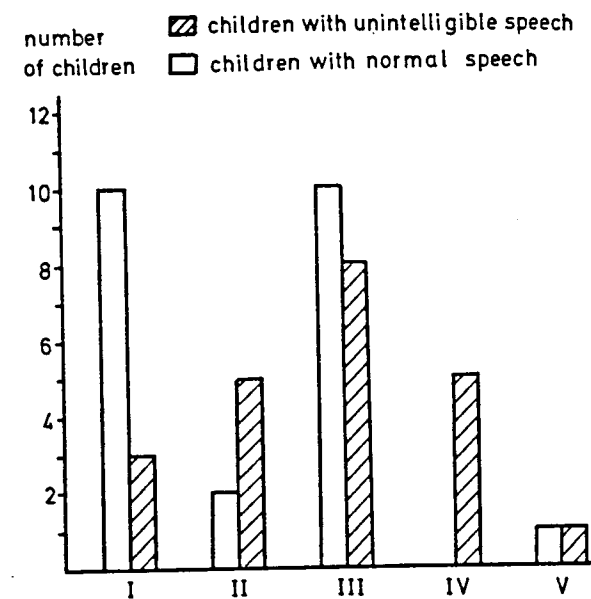


Figure 1
Classification of children into 5 clusters according to the variability of the mean intensity of the 12.5 ms after the stop release of /ta/.

scores were then grouped into 5 clusters using Ward's [9] cluster analysis. Group I included those children with less than 10% variability, Group II 10-13%, Group III 14-19%, Group IV 20-29% and Group V 30-45% variability. The Wilcoxon matched pairs test was used to test for the difference in ranks between the two groups.

RESULTS

Figure 1 shows the distribution of the children with unintelligible speech and the matched controls over the 5 clusters. In cluster I (indicating the least variability) there are 10 children from the control group and 3 children with unintelligible speech, whereas in cluster IV there are only children with speech disorders. The difference between the distributions is significant ($p < 0.01$). There is no significant correlation with the variability of the mean intensity of the total syllables or the speed of fast syllable repetitions.

DISCUSSION

Zue [10] has measured the average RMS-amplitude 10-15 ms following stop release in adults. He does not give data on the variability, however. No studies on the variability of the burst intensity in children were found in the literature. If conclusions can be drawn from the low variability of intraoral air pressure [3] or peak airflow [7] for syllable repetitions, one would expect to find little variation in burst intensity in normal adults. The higher variability of the mean intensity of the first 12.5 msec of burst release in slow and fast repetition of the syllable /ta/ in children with unintelligible speech as compared to age-matched control children can be interpreted in terms of the problems these children have with motor coordination. It is most likely that they are having difficulty with the necessary and normally highly automatized constant adjustment and coordination of subglottal pressure and glottal opening, and with the nasal and oral closure. In a few of the children the high variability in the speed of the stop release might also play a role.

The group of children with unintelligible speech was not homogeneous. Some of the children were in fact able to establish control as well as the children with normal speech and language development. The high variability of the burst intensity had different explanations in different children. Some subjects were able to control the intensity for the first few syllables but seemed to lose this control later on. A few produced several syllables with very

similar burst intensity and then there was a sudden change. These were children who showed involuntary choreiform movements.

These results are compatible with our findings on phonatory abnormalities in children with unintelligible speech [1]. It seems to be the continuous adjustment and fine coordination of the different interacting systems that is the problem. Both cerebellar deficits and extrapyramidal abnormalities may be responsible for the variability in the motor output of children with unintelligible speech.

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