

Dept. for Speech, Music and Hearing  
**Quarterly Progress and  
Status Report**

**Velopharyngeal function in  
connected speech**

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### III. SPEECH PRODUCTION

#### A. VELOPHARYNGEAL FUNCTION IN CONNECTED SPEECH

Earlier reported studies of the physiology of the velum and its function as a valve between the oral and nasal cavity systems in normal subjects and in cleft palate patients have resulted in two MD thesis publications. <sup>(1)(2)</sup>

The former of these two provides data on typical dimensions of the velum and a quantitative relation between the width of the velopharyngeal passage as observed from a sagittal X-ray projection and the cross-sectional area of this passage. This relation is approximately linear for velopharyngeal distances greater than 2 mm and of the order of 30 mm<sup>2</sup> area increase per 1 mm sagittal distance increase. The thesis by Björk <sup>(1)</sup> also includes diagrams of velopharyngeal opening movements and synchronous records of speech spectrograms of connected speech from several subjects. The following observations have been made:

1. In normal speech the mean duration of velum movements from closed to open state are of the order of 130 msec and the opposite transition, i.e., closure, occupies 160 msec on the average.
2. The speed of velum movements does not change proportionally to the overall speaking rate but tends to be less variable. In low, normal and high speaking rates corresponding to overall durations of 100 - 200 - 300 respectively, on a relative scale the velum movements were found to vary in proportions 100 - 130 - 160.
3. The assimilated nasality on both sides of a nasal consonant in connected speech affects a larger part of the speech before the nasal consonant than after the nasal consonant. Even unvoiced stops and fricatives may be affected to some extent without serious effects on speech quality as judged by trained listeners.
4. The effect of a slight nasalization as in normal speech in segments close to nasal consonants is primarily the reduction of the first formant level versus other formants. Typical velopharyngeal coupling area is of the order of 60 mm<sup>2</sup>.

5. The effect of an extremely large degree of nasalization in which the velum may approach the back of the tongue and the velopharyngeal coupling area is of the order of  $250 \text{ mm}^2$ , is a shift down in the frequency of the first formant (nasal resonance) and a relative decrease of the levels of the second and the third formants. An additional closing of the nostrils causes an increase in the level of the first formant (low frequency resonance).
6. The typical feature of spectrograms from cleft palate patients is the reduction of second and third formant intensity in voiced sounds and the reduction of the intensity of unvoiced fricatives and stops.
7. Operated subjects whose speech was rated as barely acceptable displayed irregular and insufficient velum movements.

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- (1) Björk, L.: "Velopharyngeal Function in Connected Speech. Studies Using Tomography and Cineradiography Synchronized with Speech Spectrography", Thesis work. Acta Radiologica, Suppl. 202, Stockholm 1961, 94 pp. (From the Dept. of Diagnostic Radiology of the University Hospital, Uppsala, Sweden, and the Speech Transmission Laboratory of the Royal Institute of Technology, Stockholm, Sweden).<sup>x)</sup>
- (2) Nylén, B.: "Cleft Palate and Speech. A Surgical Study Including Observations on Velopharyngeal Closure During Connected Speech, Using Synchronized Cine-radiography and Sound Spectrography", Thesis work. Acta Radiologica, Suppl. 203, Stockholm 1961, 124 pp. (From the Dept. of Plastic Surgery of the University Hospital, Uppsala, Sweden).
- (3) Moll, K.L.: "Cinefluorographic Techniques in Speech Research", J. of Speech & Hearing Research 3, 227-241 (1960).

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