The consistency and composition of functional synergies for speech movements were investigated in 7 year-old children and adults in a reiterated speech task using electromagnetic mid-saggital articulography (EMMA). Results showed higher variability in children for tongue tip and jaw, but not for lower lip movement trajectories. The contribution of lower lip to oral closures was smaller in children compared to adults, whereas in this respect no difference was found for tongue tip. The results support and extend findings of non-linearity in speech motor development and illustrate the importance of a multi-measures approach in studying speech motor development.

Abstract

The development of speech motor coordination essentially equates to the development of functional synergies of muscle activations (or coordinate structures). The degree of freedom is reduced, which makes the control task simple. Consequently, as the speech production system matures the dynamic coordination among orofacial structures becomes more consistent [1, 2].

Introduction

The stability of speech motor execution was assessed by calculating cyclic spatiotemporal index (cSTI) of movement trajectories; variability index; and the individual cycle-specific information (original, amplitude, and time normalized).

Results

Data collection

Tongue tip-jaw synergy

In summary, results showed a higher variability of jaw and tongue movement trajectories in 7 year-old children compared to adults. The children also exhibited a smaller amplitude component of lower lip in the realization of oral closures and a larger amplitude of jaw opening movements. Overall, these results corroborate earlier results, and support and extend findings of non-linearity in speech motor development [3, 4, 5, 6, 7, 8].

Lower lip-jaw synergy

Whereas in terms of stability of the lower lip-jaw synergy at the level of individual movement cycles, speech motor development approaches adult-like qualities at the age of 7-8, a close inspection of kinematic variables shows that in fact children at this age still differ from adults in the relative contribution of lower lip in bilabial closure gestures.

Tongue tip-jaw synergy

Results showed an adult-like composition of the tongue tip-jaw coordinate structure in 7 year-old children compared to adults, but with higher variability.

Discussion

At the level of individual movement cycles, speech motor development appears to follow different trajectories for different articulators. However, data on the tongue tip-jaw functional synergy earlier in development is needed to verify whether and how the developmental trajectory of the tongue tip-jaw synergy is qualitatively different from the lower lip-jaw synergy. Obtaining data on tongue tip movements in younger children constitutes a challenge for further research.

References